Deutsche Stiftung für internationale Entwicklung
German Foundation for International Development

Nabil Chaherli, Peter Hazell, Tidiane Ngaido,
Thomas Nordblom, and Peter Oram (eds.)

Agricultural Growth, Sustainable Resource Management, and Poverty Alleviation in the Low Rainfall Areas of West Asia and North Africa

Proceedings of the International Conference
held from 2 — 6 September 1997 in Amman, Jordan

Prepared in collaboration with the National Agricultural Systems of Iraq, Jordan, Lebanon, Syria, Algeria, Libya, Morocco, and Tunisia

IFPRI

International Food Policy Research Institute (IFPRI)

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

Jordanian National Center for Agricultural Research
and Technology Transfer (NCARTT)

Zentralstelle für Ernährung und Landwirtschaft (ZEL) - Feldafing/Zschortau
Food and Agriculture Development Centre

DSE. The Deutsche Stiftung für Internationale Entwicklung (German Foundation for International Development) provides a forum for development policy dialogue and offers initial and advanced training of specialists and executive personnel from developing and transitional countries. In addition, it supports experts of German technical and cultural cooperation, and their families, in their preparation for assignments in developing countries, and maintains the largest documentation and information centre on development cooperation issues in Germany.

The DSE works in the areas "Education, Science and Documentation", "Economic and Social Development", "Public Administration", "Industrial Occupations Promotion", "Food and Agriculture", "Health", and "Journalism".

Conferences, meetings, seminars and training courses support projects which serve economic, social, and ecologically compatible development, thus contributing to an effective, sustainable and wide-ranging development.

The DSE cooperates with partners at home and abroad. A considerable number of the programmes take place in developing and transitional countries, and the rest in Germany. Since 1960 the DSE has given advanced professional training to more than 150,000 decision-makers, specialists and executive personnel from over 150 countries. Every year approximately 10,000 participants take part in the DSE's dialogue and training programmes.

The DSE contributes to development cooperation on the basis of the guidelines of the German Federal Government's development policy. The German Foundation is funded by the Federal Ministry for Economic Cooperation and Development (BMZ). Some of its programmes, however, are financed by other donors (e.g. other Federal ministries, the Federal States, the European Union).

Additionally, the Federal States of Baden-Württemberg, Bavaria, Berlin, North Rhine-Westphalia, Saxony and Saxony-Anhalt provide conference and training centres and buildings. Since its foundation in 1959 the DSE has been jointly financed by the Federal Government and the Federal States. This corresponds to the German Foundation's decentralized structure with specialized departments (Centres) and conference centres in a number of Federal States.

Agricultural Growth, Sustainable Resource Management, and Poverty Alleviation in the Low Rainfall Areas of West Asia and North Africa

Food and Agriculture Development (ZEL) of
Deutsche Stiftung für internationale Entwickung (DSE)

International Food Policy Research Institute (IFPRI)

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

Jordanian National Center for Agricultural Research and Technology Transfer (NCARTT)

AGRICULTURAL GROWTH, SUSTAINABLE RESOURCE MANAGEMENT, AND POVERTY ALLEVIATION IN THE LOW RAINFALL AREAS OF WEST ASIA AND NORTH AFRICA

Proceedings of the International Conference
held from 2-6 September 1997 in Amman, Jordan

Edited by
Nabil Chaherli, Peter Hazell, Tidiane Ngaido,
Thomas Nordblom, and Peter Oram

Prepared in collaboration with
the National Agricultural Systems of Iraq, Jordan, Lebanon,
Syria, Algeria, Libya, Morocco, and Tunisia

Supported by:
International Fund for Agricultural Development (IFAD)
Arab Fund for Economic and Social Development (AFESD)

Zentralstelle für Ernährung und Landwirtschaft (ZEL)
Food and Agriculture Development Centre of
Deutsche Stiftung für internationale Entwickung (DSE)
German Foundation for International Development

Published by:
Deutsche Stiftung für internationale Entwicklung (DSE)
Zentralstelle für Ernährung und Landwirtschaft
Phone (*49) 8157 – 9380, Fax (*49) 8157 – 938777
Wielinger Str. 52
D-82340 Feldafing
Germany

Editors:
Dr. Nabil Chaherli, Dr. Tidiane Ngaido, Dr. Tom Nordblom
IFPRI/ICARDA
P.O. Box 5466
Aleppo, Syria

Dr. Peter Hazell, Mr. Peter Oram
IFPRI
1200 Seventeenth Street, N.W.
Washington, DC 20036-3006 USA

DOK 1821 a
IT 711-319-97

ISBN 3-931227-49-9

Print:
Proff Offsetdruck, D-82547 Eurasburg
September 1999

Gedruckt auf holzfreiem, säurefreiem, chlorfrei gebleichtem und alterungsbeständigem Papier.

CONTENTS

PART III. POSTER SESSION PAPERS

A. Modeling

B. Property Rights

ACKNOWLEDGMENTS

This publication serves two purposes: it is both the proceedings of an international conference to discuss key issues of agricultural policy for the achievement of equitable growth, poverty alleviation, and sustainable resource management in the low rainfall areas of West Asia and North Africa, and a means of displaying the results and policy implications of dedicated field work by researchers from the eight Mashreq and Maghreb countries in a collaborative project with staff from two international agricultural research centers ICARDA and IFPRI.

We gratefully acknowledge the inputs that this field work made to the substance of the conference; the financial support of the donors to the project (IFAD and AFESD); and to the Conference (DSE/ZEL); and the insightful participation of distinguished policy makers and scientists in the discussion and recommendations.

An international conference of this nature requires considerable planning and organization, and the Amman meeting was no exception. It was a true team effort closely involving staff from DSE/ZEL, IFPRI and ICARDA (both from Aleppo and the Amman Regional Office), and from the National Center for Agricultural Research and Technology Transfer (NCARTT) in Amman.

We are greatly indebted to Jurgen Richter and his efficient staff from the DSE Food and Agricultural Development Center in Feldafing: for Jurgen's wise counsel and experience during the months preceding the conference, and for his enthusiastic participation in the discussions; as well as for the invaluable logistical assistance of his team in the organization of working groups, field visits, and poster sessions.

We are also grateful to our colleagues in Jordan; Nasri Haddad and his staff at the ICARDA Regional Office; and Awhi Taimeh, Director-General of NCARTT and his staff. All of these colleagues went beyond the call of duty to make the conference a success.

The choice of conference chair can be critical to its success; we were fortunate that Nasrat Faddah, previously Director-General of ICARDA, was available to guide the discussions. His experience, patience, wisdom, and good humor was invaluable.

Invited papers and poster sessions provided critical insights to the problems facing policy makers and scientists in the region and provoked a lively discussion. We acknowledge the important contribution the authors of these papers made to the meeting and to the formulation of its

recommendations, as did the work of the rapporteurs who volunteered for these discussions.

The editing and preparation of the Conference Proceedings was largely the responsibility of Peter Oram at IFPRI. Particular thanks are due to Beryl Hackett for her patient and helpful support to the editor in the long process of document preparation, despite many other duties; and to Beverly Abreu for the efficient final processing of the report.

PART I. INTRODUCTION

EXECUTIVE SUMMARY

Nabil Chaherli, Peter Hazell, Tidiane Ngaido, Thomas Nordblom, and Peter Oram[1]

An international conference was held in Amman, Jordan in September 1997 to examine mounting problems of poverty and environmental degradation in the low rainfall areas (LRAs) of the eight Mashreq and Maghreb countries of West Asia and North Africa[2] and to seek solutions which reconcile economic growth with equity and environmental conservation — the 3 E's of sustainable development.

The conference, held under the distinguished patronage of His Royal Highness, Crown Prince Hassan of Jordan, was co-sponsored by the German Foundation for International Development (DSE), the Jordanian National Center for Agricultural Research and Technology Transfer (NCARTT), the International Center for Agricultural Research in the Dry Areas (ICARDA), and the International Food Policy Research Institute (IFPRI). It was attended by policy-makers, scientists, and farmers from countries of the region, international development agencies, and international researchers.

The conference was also presented with the findings of a three-year collaborative research project dealing with these issues and including scientists from the eight Mashreq and Maghreb countries and two international agricultural research centers. This project was co-financed by the Arab Fund for Economic and Social Development (AFESD) and the International Fund for Agricultural Development (IFAD).

---

[1]The authors wish to express their gratitude to the following colleagues who worked with them to plan and organize the meeting, and who contributed greatly to its success: Nasrat Fadda, Chairman of the Conference; Nasri Haddad, ICARDA Regional Coordinator and his staff, (West Asia); Jurgen Richter, German Foundation for International development (DSE), and his staff; Awni Taimeh, Director-General, the Jordanian National Center for Agricultural Research and Technology Transfer, and his staff, which hosted the meeting.

We also gratefully acknowledge the financial support provided by DSE; the Arab Fund for Economic and Social Development (AFESD) and the International Fund for Agricultural Development (IFAD).

[2]Iraq, Jordan, Lebanon and Syria from the Mashreq region, and Algeria, Libya, Morocco and Tunisia from the Maghreb.

I. KEY PROBLEMS IDENTIFIED BY COMMISSIONED PAPERS AND WORKING GROUPS

A. Seven commissioned papers were prepared for the meeting as a basis for problem analysis and subsequent discussion by working groups and plenary sessions. These papers and the debate that followed show that the countries of the Mashreq and Maghreb regions face extremely challenging and interlinked environmental, economic, and social problems if they are to achieve the goals of the conference. Those problems include:

- *Climatic aridity and frequent droughts* The eight countries have an extraordinarily high proportion of their total agricultural area in ecozones with less than 400 mm rainfall, and their irrigation potential is nearing exhaustion. This restricts farmers' choice of enterprises and places a ceiling on crop yields. Drought compounds aridity, inhibits adoption of new crops and farming techniques, causes extreme inter-annual variability of production and loss of animals, and in severe cases can seriously damage the national economy.

- *Rapid population and income growth are putting severe pressures on the fragile environment of the LRAs* Concern over environmental degradation in these regions is not new: the 1959 report of the FAO Mediterranean Development Project sounded a strong warning on those issues. Since then, however, human population has more than doubled to 112 million, numbers of small ruminant animals have risen by 65 percent (an addition of 25 million head), tractor numbers have increased five-fold to about 345,000 and encroachment on the fragile rangeland system have increased also.

- *Attempts by governments to achieve food self-sufficiency have created perverse incentives to agricultural mismanagement, resulting in resource depletion* Producer and consumer subsidies on red meat and cereals and on fuel and agricultural machinery, have encouraged mechanized cereal cultivation of marginal lands, while subsidized animal feed has raised animal numbers in the same areas,

generating conflicts, degrading the environment and increasing vulnerability to drought. These measures also create dependencies, with social repercussions if they are withdrawn — as has happened under structural adjustment. As they are generally untargeted, they favor larger farmers.

- *Insecure property rights have prevented farmers and communities investing in productive land improvements and adopting sustainable cropping and grazing practices.* Archaic legislation, state appropriation of traditional common pasture in Mashreq, and incapacity of local institutions to address adequately the new resource demands of a growing populations are major contributory factors. This has opened the way to land grabbing, degradation of common property resources, and exacerbated conflicts over rangeland resources.

- *Government and private investment has been concentrated primarily on high rainfall and irrigated areas.* Research, extension, market development, and social infrastructure of the LRAs has been neglected. Consequently there is a dearth of improved agricultural technology to generate productive growth of crops and livestock and increase farm incomes, as well as of alternative employment opportunities. Hence these are the most impoverished regions of their countries, with increasing spontaneous out-migration. Contrary to conventional wisdom, however, participants did not consider that the poor were the main agents of environmental degradation, with the possible exception of damage due to fuelwood gathering.

B. In-depth discussion by working groups of the issues raised in the commissioned papers focused on four assigned topics: Public and Private Investment; Crop-livestock Integration; Technology Adoption; and Range Rehabilitation.

Their analysis both confirms the main conclusions of the commissioned papers and highlights the difficulties of attempting to treat the major problems of the LRAs in isolation, whether from each other or from decisions made at the national level, because of their linkages and interactions.

Four main categories of problems are evident from their discussions, cutting across their assigned topics These are: policy and economic constraints, resource endowment and management problems, technology related issues, and institutional, social, and property rights problems. Nested within each of these categories there are numerous sub-problems, like a Chinese box. For example, nine such problems were identified under policy and economic constraints.

This approach proved useful in locating the main obstacles to progress in achieving sustainable development of the LRAs, identifying the actions needed to find solutions, and indicating where the main responsibilities for initiating action should lie. It is noteworthy that while all working groups allocated high priority to solving policy and economic problems, each of them weighted priorities for solutions to the other three problem categories somewhat differently in relation to the nature of their assigned topic.

II. PROBLEM-SOLVING: INSTRUMENTS FOR ACHIEVING THE '3 E's'

In the second main phase of the conference four different working groups were convened to examine the instruments which might be applied to solution of the problems discussed above. Those four instruments were: Market-liberalization; Property Rights reform; Drought management; and Appropriate Technologies. Each working group was assigned an instrument and asked: i) to identify its impact on the 3 E's, and ii) how it could be better designed to achieve positive and minimize negative effects in solving problems of the LRAs.

Their findings were then reviewed in plenary discussion to reduce overlapping, and applied to the four key topics identified under problem analysis so as to develop recommendations for presentation to an invited audience of policy-makers, donors, and farmers on the final day of the conference. Field visits by the working groups to four diverse communities in Jordan, and discussions with farmers, extension staff, and local people provided further insights to problems and possible solutions. Their particular concerns relate to the future of the rangelands in the absence of more secure property rights and a suitable technological package; to the lack of opportunities for income diversification in or outside agriculture; and to difficulties of obtaining credit without better collateral. The ever-present threat of drought is highlighted by the

unfortunate conjunction of the elimination of feed subsidies in Jordan with one of the worst drought years on record, resulting in the premature slaughter of 30 percent of the national flock and emphasizing the need for development of a comprehensive national drought management strategy.

A lesson which emerges from these exchanges on the ground, is the inter-relation of the 3 E's; and the risks inherent in policy changes which unduly favor one component of the critical triangle, without careful assessment of their potential impact on the other two sides of the triangle. A more effective mechanism for providing policy makers with reliable information from the grassroots on local conditions and the impact of their decisions, is considered indispensable.

In a final summation by participants, five key issues were discussed. These were:

1. *Which of the 3 E's should have priority?* Participants stressed the need to study and capitalize on the positive interactions among the 3 E's in attempting to achieve this delicate balance. However if 'equity' implies more even access to resources, it was felt that this should be a first choice. Currently too much emphasis is placed on 'efficiency' and not enough on social security. Moreover, efficiency and growth are not necessarily synonymous, if the growth pattern is environmentally or socially destructive or distorts the economy.

2. *How to reform markets and eliminate policy distortions without increasing poverty.* Abrupt withdrawal of long standing price and subsidy supports under structural adjustment could increase poverty in the LRAs, which have generally been neglected by other government investments and services, and which have limited scope for economic diversification. They should be phased out cautiously, with safety-net measures to protect the poor, over a transitional period, and their social impact should be carefully monitored.

3. *What can be done to deal more effectively with drought to replace the current crisis-driven approach?* Participants emphasized the need for better information and sharper definition of the most vulnerable areas, and for the establishment of holistic national drought management strategies supported by a permanent institutional and technical infrastructure nation-wide. Eleven potential components of such a strategy were identified, with

emphasis on early-warning and monitoring systems, water development, diversification of land use, closer crop-livestock integration and related market measures for destocking and restocking in drought emergencies, judicious allocation of emergency feed, examination of crop insurance options, support to community self-help measures, and action to upgrade the earning capacity of low income people both on and off farms. Assisted migration was not excluded.

4. *What are the requirements for technology adoption?* Concern was felt at the redundancy of imported on-farm technology for the LRAs, and the limited understanding of their resource potential and problems resulting from past concentration of research in the higher rainfall and irrigated areas. The participants felt that the type of growth at the expense of the environment being promoted by perverse incentives to cultivate and overstock rangelands was ultimately unsustainable, confirming a warning in the commissioned papers that the existing LRA system may be in danger of collapse.

   Nevertheless, since extricating themselves from these policies could create a social dilemma for policy-makers: precipitous change should be avoided, and savings from withdrawal of subsidies should be channeled into applied research to find more efficient and sustainable technologies; as well as to the education of local people, improvement of rural infrastructure, and other measures to help the poor. These measures should be integrated into comprehensive regional development plans, formulated with the participation of farmers and rural communities.

5. *How can property rights reform contribute to the 3 E's?* While secure property rights alone will not necessarily solve all of the problems of sustainable development in the LRAs, appropriate tenure security was seen as virtually indispensable to the success of policies and technologies to improve resource management, promote equity, and raise living standards there. Better knowledge and understanding of the existing situation is needed to clarify current uncertainties and provide the basis for establishment of legal rights to grazing lands and water resources in participation with local communities, and credit to support investment in their sustainable management.

III. FINAL CONFERENCE RECOMMENDATIONS TO THE INVITED AUDIENCE; INCLUDING HIS EXCELLENCY, THE MINISTER OF AGRICULTURE OF JORDAN, POLICY-MAKERS, DONORS AND REPRESENTATIVES OF THE FARMING COMMUNITY

These recommendations emphasize the need for stronger government support to the social as well as the economic development of the LRAs, the complementarity of public and private investment, the importance of closer collaboration of government and local communities in their implementation, and the establishment of a safety-net to protect the poor against structural adjustment measures. The conclusions are summarized below.

A. *Public and Private Investment.* Priority areas for public investment in the LRAs are: agricultural research on natural resource management; water resource development, water harvesting, and watershed management; rural infrastructure, including access roads, electricity, and rural service centers; and investment in people, especially education and training of poor people and women. All public investment should be developed in close collaboration with the local communities, who should co-finance and help maintain investment structures.

Private investment is considered essential for sustainable development of the LRAs and for diversifying the local economy to create new employment in agriculture, agroindustry, and non-farm activities. However private and public investment are highly complementary, and governments may need to create new incentives, through credit, tax policy, and infrastructural investment, to encourage private enterprise.

B. *Generation and adoption of improved technologies.* Linkages between research and extension in the LRAs must be strengthened, in close association with farmers, to enhance the efficiency of research, with a focus on crop diversification, including tree crops, water harvesting linked to range improvement and soil conservation, and agroprocessing and marketing of produce.

It is essential that social and environmental benefits be given equal weight with economic considerations when assessing the

feasibility and evaluating the impact of technology in the LRAs.

C. *Improved Crop-livestock integration* is seen as a crucial instrument for sustainable development of the LRAs, but its success requires an integrated approach involving several complementary components, including:

Establishment of secure property rights to individuals or communities, and discouragement of land fragmentation; improvement of marketing systems for livestock, inputs, and outputs, including support to producer cooperatives; promotion of fodder crop production and storage of feed at farm level.

Reinforcement of research to develop improved drought management packages that reduce dependence on government assistance in drought years.

Governments should devise protective measures compatible with the GATT agreement to safeguard barley and livestock production, and should create the necessary scientific and technological infrastructure to help farmers manage drought more effectively.

D. *Range Rehabilitation.* Measures recommended to achieve this goal are closely linked to those proposed under crop-livestock integration and drought management. They include: establishment of a range database supported by a monitoring, evaluation, and information system using modern technology (resource inventory, a Geographical Information System, and early warning capability); and improved property rights, with institutional capacity for devolving the control and management of rangeland to local communities and for implementation of such arrangements. The development of effective resource stewardship, whether through communal or private management is seen as of crucial importance.

The creation of a national authority in each country to protect the resource base and to ensure efficient and sustainable use of the natural endowment is strongly recommended.

PART II. PLENARY SESSION PAPERS

CURRENT SITUATION AND OUTLOOK FOR AGRICULTURE IN THE LOW RAINFALL AREAS OF WEST ASIA AND NORTH AFRICA

Adel El-Beltagy[3]

ABSTRACT

The nations of West Asia and North Africa (WANA) face challenging problems: a limited resource base of arable land and especially of water, low and erratic rainfall with frequent droughts, rising human population, poor productivity growth, large disparities in income and increasing rural-urban migration. The growth in demand for food and fiber puts increasing pressure on the natural resources, with concurrently increasing poverty and resource degradation.

This brief introductory paper is set in this background and covers the following points:

i) An introduction to the region: its population, food production, and poverty.

ii) Some conservative, yet alarming, projections of rising food imports and increasing pressure on natural resources.

iii) The role of the International Center for Agricultural Research in the Dry Areas (ICARDA) as a research partner with the national programs and other Consultative Group on International Agricultural Research (CGIAR) Centers, and donor agencies in facing the challenge of optimizing agricultural production in balance with safeguarding the natural resources for future generations.

iv) Identified issues that need critical consideration by this conference for achieving the desired agricultural growth and poverty alleviation, while sustaining the natural resource base in the low rainfall areas (LRAs) of WANA.

---

[3]Adel El-Beltagy is Director-General of the International Center for Agricultural Research in the Dry Areas (ICARDA).

BACKGROUND TO THE WANA REGION AND ITS COMMON PROBLEMS

The WANA region (Figure 1) is vast and diverse, ranging from Morocco in the west, to Pakistan and Afghanistan in the east, Turkey in the north, and Ethiopia and Sudan in the south. The newly independent republics of Central Asia are included because of their similar agro-ecologies and farming systems.

ICARDA's headquarters are in Syria, at the geographic center of the vast steppe eco-zone, which stretches from Morocco to Mongolia. There are common threads that tie this enormous region together:

- It has low and erratic winter precipitation, and hot and dry summers;
- It is the region of origin of important cereals (wheat and barley) and legumes (lentil, chickpea and forage legumes), the wild relatives of which are still found there today;
- There are limited areas of arable land, and severely limited water resources for further development of irrigation;
- The dry-area agricultural systems are dominated by cereal farming, sometimes in rotation with leguminous crops, and small-ruminant livestock with seasonal grazing of crop-residues and heavy use of degraded rangelands.

All the WANA countries must use their limited resources more efficiently and sustainably. Their similarities point to the logic of collaborative research that promotes development, and the sharing of ideas and technologies.

WANA has rapid population growth (Figure 2). Human numbers are expected to rise by 71 percent from 1995 to 2025, from 642 million to 1.1 billion people. We will return to the implications of population growth for food supply a little later. First, we will look at poverty in WANA.

The view of poverty in WANA is often distorted by averaging the poor countries with the rich ones. The oil-exporters of the Arabian Peninsula have only 5 percent of the region's population and, consequently, the region's highest per capita Gross National Products (GNPs), averaging just over US$ 9,900 (Table 1). The remaining 95 percent of WANA's population has far lower per capita income. The four most economically disadvantaged states (Eritrea, Ethiopia, Somalia and Sudan) have per capita GNPs of only US$88 per annum. Seventy-six percent of WANA's population almost 500 million people have mean per capita GNPs of less than US$2 a day. In fact, 42 percent of WANA's

total population some 270 million people have per capita GNPs of less than US$1 a day.

There is greater absolute poverty in rural areas than in urban areas. For example, 59 percent of the combined populations of Afghanistan, Eritrea, Somalia, Sudan and Yemen live below the dollar-a-day poverty line, and 90 percent of these live in rural areas. Economic disparities will continue to fuel migration from rural to urban areas and from poor to rich countries.

Across WANA, women account for about half of the agricultural labor force, well above their share of the total labor force. Rural incomes are directly associated with per capita wealth in natural resources, that is, land and water. This is true not only at the national level, but also among regions within a country, though other factors are important, such as infrastructure, distances to market, and human factors such as policies and land property rights.

Does a broad statistical relationship between rural poverty and poor natural resources mean that it is inevitable that the populations of LRAs must be poor and must remain so? Our answer should be "Certainly not!" This is where the technical and the policy and institutional factors discussed in this conference have such important roles to play, because the knowledge generated through research can enable economic returns even from poorly-endowed natural resources.

THE WIDENING FOOD GAP IN THE REGION

Let me return to the agricultural situations in WANA, focusing on the Mashreq and Maghreb countries. We used FAO data on consumption of all grains, including pulses, to calculate five-year averages for the two periods 1971-75 and 1991-95. The data for Tunisia (using UN population data) are cited as an example (Figure 3). The data include grain for livestock feed, but most is for direct human consumption. There has been a rise in total grain consumption over the past 20 years, which is projected to continue to the year 2025, with the conservative assumption that per capita *consumption* will remain constant at the 1991-95 level. Per capita *production* of all grains has declined since the early 1970s, due to a more rapid increase in population than in production. Four rates of production growth, and the UN's population projections, allow us to project upper and lower limits for per capita production in 2025 (Figure 4). Sustaining a 3 percent yearly production growth rate to the year 2025 may not be feasible. Even a 2 percent rate of growth would require concerted technological and policy advances and may not be economic if all costs (including environmental

ones) are taken into account. In national terms, a 2 percent growth rate in grain production in Tunisia will probably not keep up with increasing consumption because of population growth. By this projection, imports of nearly one million tonnes of grain a year would have to continue between now 2025.

Syria's situation is similar to Tunisia's, except that the projected grain imports will be five times larger about five million tonnes by 2025 (Figure 5.)

For Morocco, 2 percent growth in production would only partly reduce the volume of imports (Figure 6). However, with a similar production growth rate projection, Algeria, Iraq, Lebanon, Jordan, and Libya will have to expand their food imports in the coming decades.

Widening food gaps may not be as serious a problem as they may appear, if the countries adopt appropriate economic policies. For example, Jordan has recently curbed its subsidization of grain imports destined for sheep owners. The distortions caused by subsidized grain prices encouraged farmers to keep, and to import, far more sheep than they would have done if facing the higher world feed prices. The greater numbers of sheep put greater pressure on the country's fragile rangelands. So, both efficiency and the environment will benefit from the reform, but poor farmers will suffer along with commercial sheep-fatteners.

Egypt should be seen as a separate case. While its overall grain import gap prospects resemble Tunisia's, unlike the eight Mashreq and Maghreb countries, Egypt's agriculture depends almost entirely on irrigation. Benefiting from research results partly as an outcome of active partnership with advanced research institutions and International Agricultural Research Centers and policies aimed at putting these to good use, grain production has improved but not kept pace with population growth.

Assuming no change in per capita consumption of all foods from that in 1995, domestic production must grow at well over 2 percent annually to close Egypt's food import gap by 2020 (Figure 7). Income growth and concessionary pricing have enabled imports to fill the gap. Egypt's approach has been to allow crop prices to match the world market.

Other WANA countries have more serious problems. Pakistan, Afghanistan, Sudan and Ethiopia import little grain though their population growth has out-paced production growth. Thus their figures for per capita consumption were lower in 1995 than in 1975, and about half those of many countries of the region. In contrast, Turkey is the only substantial net exporter of grain in WANA.

If per capita consumption of all grains remains constant at 1995 levels to the year 2020, and UN population projections come true, we expect grain consumption to reach 295 million tonnes across 24 WANA countries by that time. With this scenario, the grain gap will increase from 38 million tonnes in 1995 to 82 million tonnes in 2020.

However, if Turkey is excluded from the calculation, the grain gap for the remaining 23 countries would increase from about 51 million tonnes in 1995 to 109 million tonnes by 2020 (Figure 8). Again, this is a conservative estimate that assumes no growth in per capita consumption. Assuming grain will be priced at only $130 per tonne, 109 million tonnes of grain per year would cost US$ 14.2 billion. To visualize the quantity of 109 million tonnes of grain, imagine a railroad train 16,000 kilometers long!

National food gaps and large import bills understate the predicament of the poorer segment of any country's population. The poor spend a major part of their income buying food. Unless their incomes are increased well above the poverty line, they will be forced to over-exploit available natural resources.

THE ROLE OF INTERNATIONAL AND NATIONAL RESEARCH PARTNERSHIPS IN RESOLVING THESE PROBLEMS

Rates of productivity growth need not remain static. ICARDA and collaborating national partners are seeking, through application of new science, technological breakthroughs to open the potential for jumps in productivity. Likewise, policy changes could improve the situation. Some alterations would change the incentive structure facing farmers, removing constraints to investment, and allowing an increase in production potential.

Heading the list of scarce natural resources in the region is water, the commodity that, if cheaply accessible, can fundamentally alter the potential of a low rainfall area. Despite its scarcity in WANA, water continues to be misused. On-farm and community water-use efficiency must be improved, blending technical and policy options toward a demand-management approach.

ICARDA's research on water-harvesting, supplemental irrigation and on-farm water-use efficiency, has been very rewarding for improving the sustainable use of this resource. Use of crop cultivars with better water-use efficiency developed through biotechnology, and application of remote-sensing and Geographic Information Systems (GIS) technology in the management of water, are offering new opportunities.

Maintenance and operation cost-recovery for irrigation systems must be an element of policy for sustainable water use.

Land is a natural resource which is fragile in the dry areas of WANA, and the increasing pressure of population is subjecting this resource to degradation. Inheritance traditions and land-tenure laws have caused land fragmentation and under-investment in farmland, and unrestricted heavy use of rangeland.

Rangelands cover about 30 percent of the land and provide a third of the diet of some 420 million small ruminants in WANA. They are typically open to grazing and are in poor condition. Traditional grazing management, which integrates crop by-products and rangelands, is under serious stress.

Exacerbating this is loss of soil and biodiversity from wind erosion, water runoff, and other causes; there has been loss of nutrients and seed-banks through inappropriate management. Loss of range vegetation over vast areas also means a reduction in carbon sequestering, with implications for global warming and climate change.

ICARDA has worked with national agricultural research systems (NARS) in developing systems for rehabilitating degraded range and marginal land, by encouraging the establishment of natural vegetation and by devising appropriate grazing systems.

Large numbers of poor people live in rural areas that have low potential because of land and water constraints. Their poverty, coupled with over-exploitation of resources leading to desertification, encourages rural urban migration. When producers' conditions and welfare are improved through better policies, security for land tenure and productive capital investment, infrastructure for communication and transportation, schools, clinics, rural credit, as well as more efficient technologies and extension systems, not only will people be more productive but also more satisfied to stay on the land. This can help prevent rural-urban migration and avoid consequent political and social upheaval.

Living below the 'investment poverty line,' the poor can devote little effort or expense to resource rehabilitation or maintenance of biodiversity. Financial institutions such as the World Bank have consequently shifted their policies toward promoting rural community self-help.

Wise use of natural, human and capital resources, and investment in technology development will allow agriculture to make sustainable contributions to food security. The uneconomic goal of food self-sufficiency must be dropped in favor of economic self-reliance. Given the productivity fluctuations inherent in rainfed farming systems, the storage and importation of grain stocks must be improved.

Countries that are dependent upon food imports will face rising food bills, as developed countries reduce production and export subsidies under the General Agreement on Tariffs and Trade (GATT). Greater integration with world markets will become essential.

ISSUES REQUIRING CRITICAL CONSIDERATION BY THIS MEETING

- The role of land registration, use-regulation and more secure property rights needs critical examination. Where pastoralists and farmers are insecure tenants, or where range and water rights are not well defined, people cannot be expected to take long-term responsibility for the natural resources they use. How can we increase security of tenure and the stability of such systems?
- What are the roles of state versus communal or private investments, and how can these enhance and stabilize the conditions for production and social development?
- Agronomic practices for sustained productivity and improved water-use efficiency should be developed that are socially, economically and environmentally appropriate.
- To meet the needs of the poorest who have small ruminants and to help them make optimal use of rangelands and crop residues, research on livestock management and nutrition should increase.
- Conservation of biodiversity and enhancement of plant and animal genetic resources are essential to the future of not only WANA but also the whole planet's food-production system.
- Informal seed sectors should be enhanced by strategic research on methods, followed-up by well-informed and supported extension.

It is no coincidence that ICARDA's mandate is focused on these areas of strategic research aimed at yielding international public goods for the sustained benefit of the human race. Partnerships with, and among the NARS of WANA, and their collaboration with international centers like ICARDA and the International Food Policy Research Institute (IFPRI) and other advanced institutions, are essential for bringing resources and critical masses of research skill to bear on these issues.

Agricultural development must help stabilize national prosperity and growth with increased productivity that fulfills the potentials of comparative advantage and stewardship of natural resources for the

satisfaction of future generations. Because of rapid population growth in the region, we cannot be complacent about the consequences of inaction or of short-sighted partial measures, for dealing with the heavier demands on the natural resource base and larger food-import bills. Achieving food security will require continued research and development efforts.

The socio-political costs of doing nothing in the LRAs can be devastating. On the other hand, just doing something, such as a project or new regulation, does not guarantee success. Short-sighted, partial measures can create worse problems. This is why a comprehensive view is needed in studying the likely consequences of policy options, not only the technical aspects, but in terms of human behavior, its effects on the natural resource base, social balance and harmony.

The challenges to agriculture and natural resources are tremendous and ever-increasing. Research is needed to support equitable and sustainable agricultural development. This should be aimed not only at filling future import gaps, but also at overall social development, part of a balanced approach to reducing poverty and conserving natural resources vital for the future.

Carl Sagan (1977) wrote, "Science by itself cannot advocate courses of human action, but it can certainly illuminate the possible consequences of alternative courses of action."

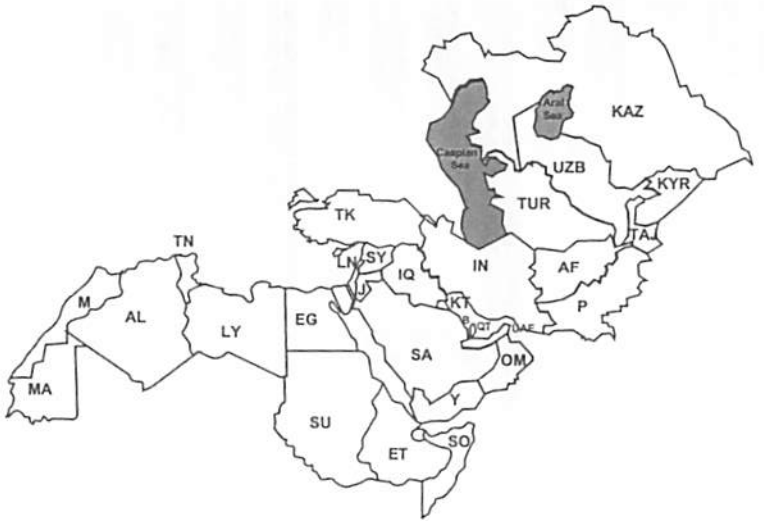
This conference should proceed in this spirit of exploring the likely consequences of all the options of technical, socio-political and policy aspects related to agricultural growth and sustainable resource management of the LRAs.

Table 1: GNP and population of seven groups of WANA countries

	Average per capita GNP (US$)	Population (millions)	
	1992	1995	2020
Oil-exporters with small populations (Bahrain, Libya, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates)	9,016	30	59
Oil-exporters with large populations (Algeria, Iran, Iraq)	1,929	116	222
Fast population growth (Syria, Jordan)	1,000	19	41
Transitional population growth I (Lebanon, Mauritania, Morocco, Tunisia, Turkey)	1,520	103	150
Transitional population growth II (Egypt)	586	63	89
East WANA (Afghanistan, Pakistan, Yemen)	379	175	313
South WANA* (Ethiopia, Eritrea, Somalia, Sudan)	88	96	191
Total population		598	1,065

Sources: GNP data are from World Bank database for 1993 except *, which is from FAOSTAT.PC.1995; population projections are from UN 1993.

Figure 1: The West Asia and North Africa (WANA) region, including Central Asia



AF = Afghanistan; AL = Algeria; B = Bahrain; EG = Egypt; ET = Ethiopia + Eritrea; IN = Iran; IQ = Iraq; J = Jordan; KAZ = Kazakhstan; KT = Kuwait; KYR= Kyrghyzstan; LN = Lebanon; LY = Libya; M = Morocco; MA = Mauritania; OM = Oman; P = Pakistan; QT = Qatar; SA = Saudi Arabia; SO = Somalia; SU = Sudan; SY = Syria; TEJ = Tajikistan; TK = Turkey; TN = Tunisia; TUR = Turkmenistan; UAE = United Arab Emirates; UZB = Uzbekistan; Y = Yemen

Figure 2: Human population (1975-1995) projections to year 2025 for the Central and West Asia and North Africa region

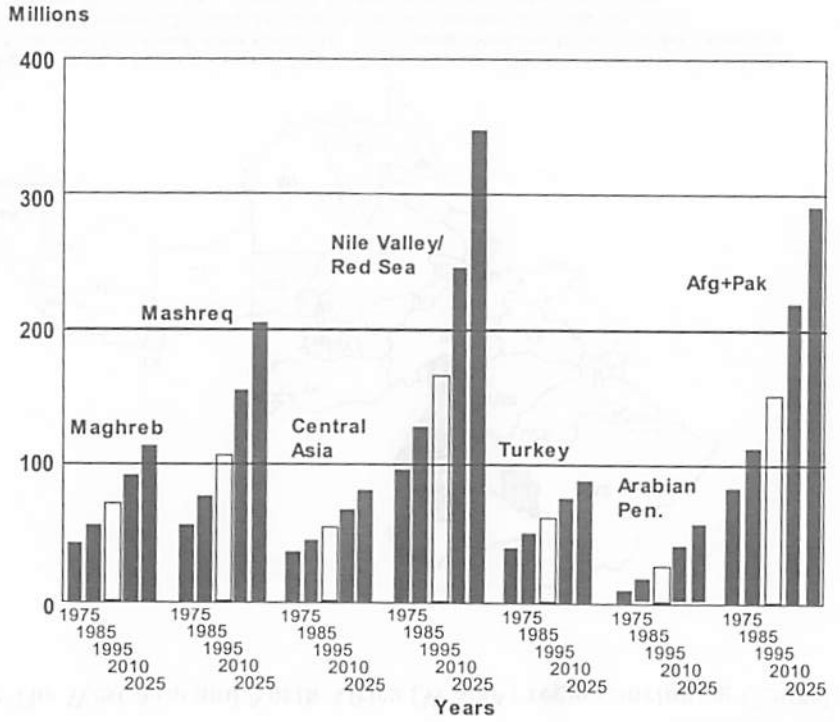


Figure 3: Per-capita grain production and consumption in Tunisia

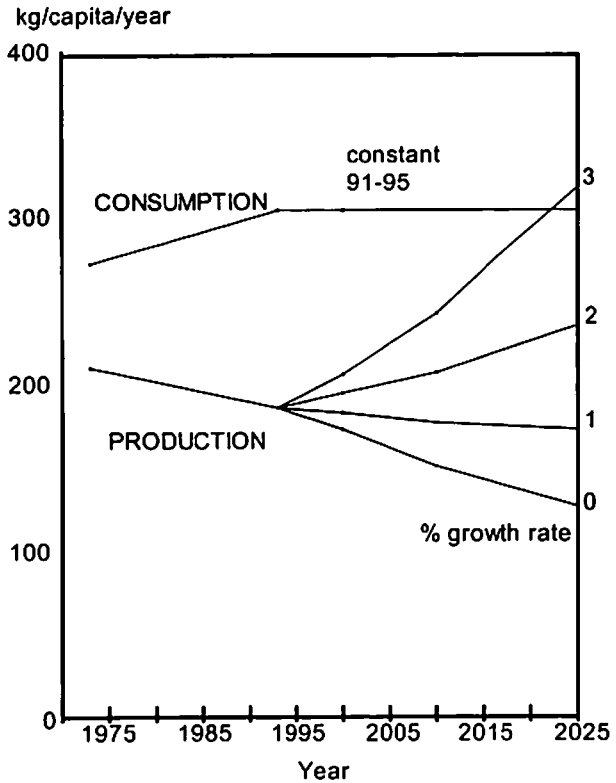


Figure 4: National grain production and consumption in Tunisia

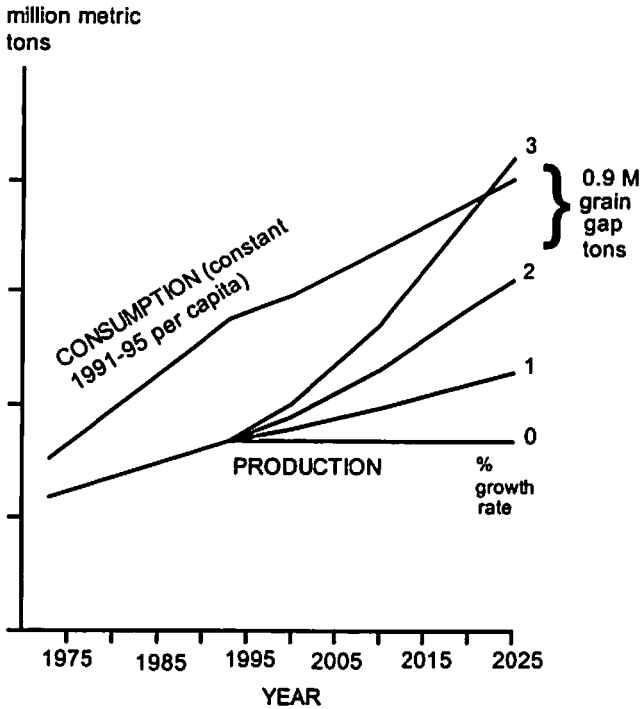


Figure 5: Grain production and consumption in Syria

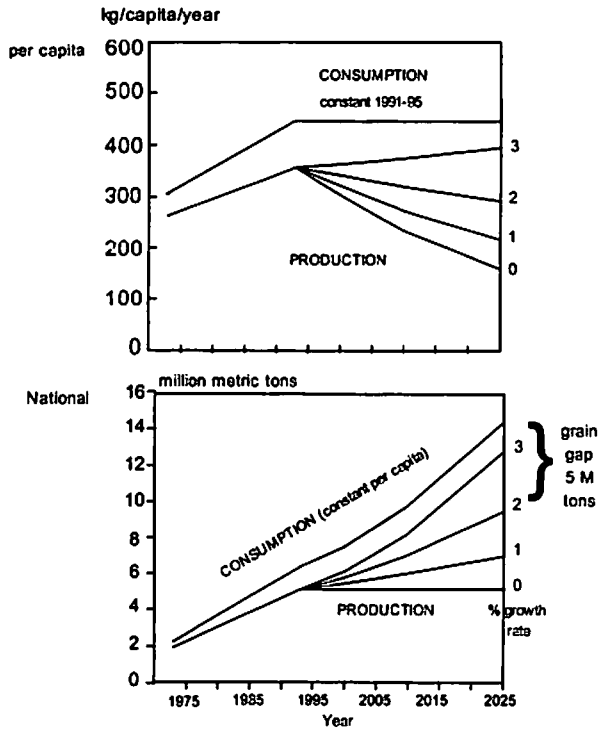


Figure 6: Projected national grain import gaps (consumption - production)

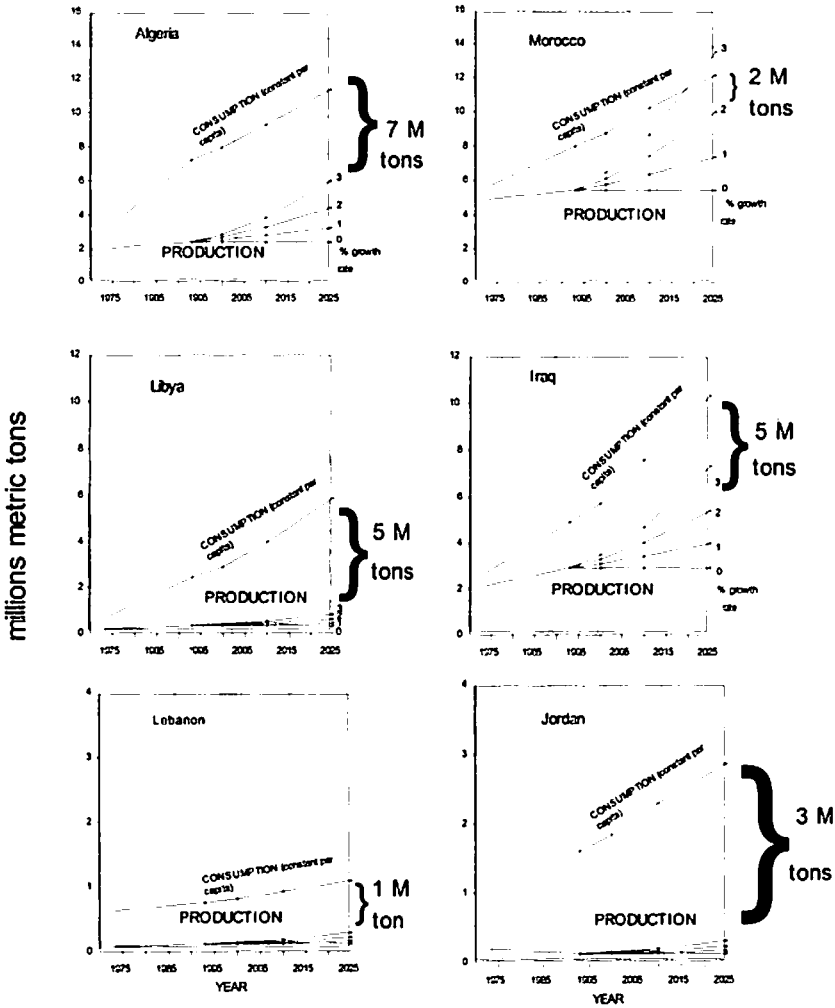


Figure 7: Per-capita production and consumption of all food in Egypt

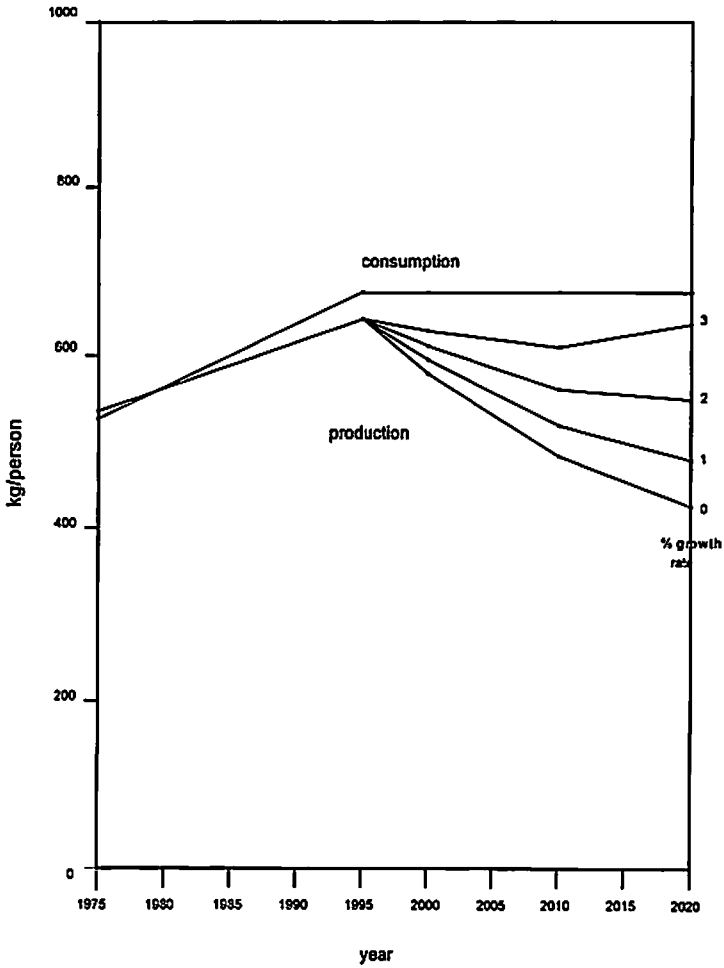
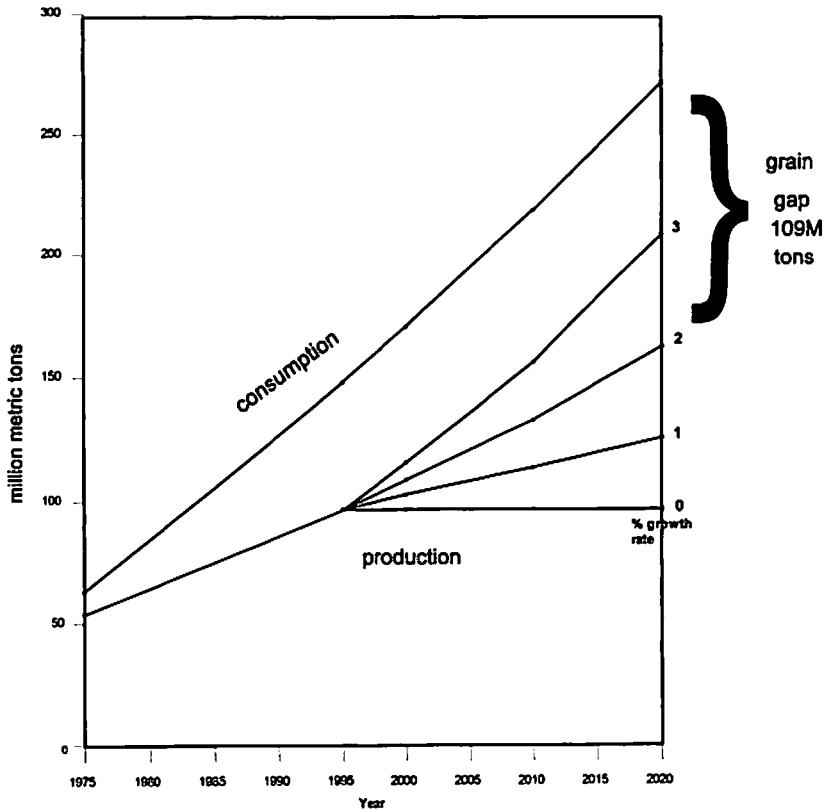


Figure 8: Production and consumption of all grains in 23 WANA countries (excluding Turkey)



ENVIRONMENTAL THREATS TO THE LOW RAINFALL AREAS AND THEIR CAUSES

Awni Taimeh[4]

ABSTRACT

Desertification, as a multiple process, threatens about 75 percent of the total global arid and semi-arid lands, including 83 percent of world range area, 60 percent of rainfed agricultural area, and a significant share of the irrigated area. Soil and water salinity is another process degrading world resources which is prevalent in low rainfall areas (LRAs).

Desertification and salinization are of particular significance to the Mashreq and Maghreb countries because almost 90 percent of their land is in these environments. Current severe pressures of population on the resource base there are leading to degradation; contributory factors include reckless mechanization, overgrazing, cutting of forests for fuelwood, soil and water pollution, rapid urbanization, and outmigration from rural areas. Historical evidence of the decline and fall of ancient civilizations in these regions due to resource mismanagement highlights the need to adopt sound and sustainable land and water use practices to halt current degradation and, if possible, to improve productivity.

Important issues explored in the paper include the nature and contribution of natural factors, especially climate and soil, to desertification; and their interaction with anthropogenic influences. It is important to distinguish the impact of natural and anthropogenic factors, but not always easy, as their influence varies with the stage and degree of equilibrium among the natural components of the ecosystem. Climate is of primary importance because it controls the physical and chemical properties of soils, hence the nature and density of vegetation cover. While it is concluded that climate has not changed significantly in recorded history, rainfall records from the recent past show marked periods of wet and dry cycles in WANA.

In conclusion, the paper reviews ongoing natural and anthropogenic influences with adverse environmental effects on the Mashreq and Maghreb regions. Active natural processes include water erosion on

[4]Awni Taimeh is the Director-General of the Jordanian National Center for Agricultural Research and Technology Transfer.

sloping lands, wind erosion, sand dune formation, and degradation of soils and water, especially salinity and chemical pollution.

Adverse effects of these natural processes are exacerbated by anthropogenic influences, which are increasingly becoming the dominant contributory factors to environmental devastation, threatening water quality, soil fertility, loss of biodiversity, and destroying range and forest vegetation and wild-life. Examples are given from all Mashreq and Maghreb countries highlighting the need both for closer monitoring to understand these inter-relationships and the pressure for urgent action by governments if massive near-term loss of productivity of agricultural lands and the further inroads of desertification are to be prevented.

THE GLOBAL MAGNITUDE OF THE PROBLEM

The resources of the world have been subjected to various processes causing their deterioration, both as a result of the increasing demands of the world population and due to natural factors. Among the former are urbanization, pollution, and poor resource management. Drought and climate fluctuation are cited among the natural processes leading to deterioration of productivity.

Desertification, as a multiple process, poses a major threat to the resources of the arid and semi-arid ecosystems. This process is attracting attention because of its global impact and direct linkages with other important issues such as global warming, displacement of inhabitants, and the degradation of biodiversity. Desertification is active in all continents except Europe. Some studies suggest that about 43 percent of the land surface is affected by desertification.

Arid and semi arid land represents about one-third of the earth's surface. It occupies 45-50 million km^2, of which 29 million km^2 occurs in arid regions, including 14 million km^2 of natural desert. Of the latter, sandy desert occupies about 33-50 percent or 4.7-7.0 million km^2. According to the United Nations Conference on Desertification (UNEP, 1978), the area threatened by desertification in 1977 was about 34.75 million km^2. This represents 75 percent of the total arid and semi-arid land, and was inhabited by 850 million people in 1977 or 19 percent of the world population. An estimated 60 percent of those inhabitants were directly affected by this phenomena, since they depend on rainfed agriculture and range resources for their living.

Of the total global range area of about 37 million km^2, an estimated 31 million km^2 (83 percent) is affected by desertification; while of the total rainfed agricultural area of 5.7 million km^2 about 3.35 km^2 (60 percent) is threatened. Nor is irrigated land immune from desertification;

about 400,000 km^2 is under threat, out of a total 1994 area of about 2.5 million km^2 (FAO, 1995).

Desertification is estimated to progress at a rate of 50,000-70,000 km^2/year. Land with declining productivity is estimated to be 210,000 km^2/year out of 14-15 million km^2. Studies indicated that, in 1984, more than 30,000 km^2 of land was becoming unproductive in the developing countries annually (Mile, 1984). According to UNICOD 1977 (cited in UNEP, 1979), desertification has been responsible for converting 650,000 km^2 to unproductive land south of the Sahara. It is reported that the drought which occurred there during 1980-1985 affected about 150 million people in 21 countries, including the African Sahel.

Soil salinity is another major process causing degradation of world resources. Salt-affected soil occupies about 950 million ha worldwide while the area affected by salinity is estimated to be 42 million ha (Zubaidi, 1994). 15,183 million ha of Saline and Alkaline soil is found in the Mashreq and Maghreb counties (Table 1) (Masood, 1995).

LAND RESOURCES AND POPULATION PRESSURE IN THE ARAB COUNTRIES

LAND RESOURCES AND THEIR CHARACTERISTICS

Arid and semi-arid land in these countries is characterized by extreme temperature fluctuation, high temperatures, low rainfall, a high evaporation rate, and prevalence of strong winds. It is dominated by physical weathering, which enhances natural processes such as wind or water erosion. These processes are largely responsible for the natural degradation occurring in many countries. In some areas, wind erosion has advanced to a level whereby sand dunes dominate the land surface and cover an extensive area in the Asian and African flanks, including both interior and coastal regions. The threat imposed by sand dunes is extending to surrounding areas.

The total area of the Arab countries is 14.4 million km^2, of which arid land occupies 12.8 million km^2, representing 89 percent of the total area. Approximately 9.9 million km^2, or 69 percent of the total area receives less than 100 mm of annual rainfall, while 2.9 million km^2, or 20 percent of the total land receives 100-400 mm of annual rainfall. Areas where rainfall exceeds 400 mm comprise 1.5 million km^2, or only about 11 percent. Those areas are the home of forests and of rainfed farming. Unfortunately, most of the population centers are also located within the wetter regions.

Within the Arab countries as a whole the Maghreb region comprises 4.75 million km^2 (475 million ha), and the Mashreq has an area of

723.110 km^2, (72 million ha) (Table 5). Approximately 68 percent of this land is located in areas receiving less than 100 mm of annual rainfall.

According to FAO (1995) the area cultivated (arable plus permanent crops), was 24.46 million ha and 12.00 million ha in the Maghreb and Mashreq regions respectively in 1995. Of this land, rainfed areas comprised approximately 20.55 million ha and 8.47 million ha in those regions; while an estimated 2.67 million ha in the Maghreb and 3.78 million ha in the Mashreq was irrigated.

Forest areas occupy 14.24 million ha in the Mashreq countries and 1.21 million ha in the Mashreq region. Productive rangeland occupies 95.2 million ha in the Maghreb and 12.5 million ha in the Mashreq, while range with poor productivity covers 8.4 million and 3.1 million ha respectively.

Water Resources

The estimated total 1990 water demand for the Arab world is 435 mcm, while that for agricultural use is 337.6 mcm, compared to 300 mcm in 1986. For the Mashreq and Maghreb countries the total demand is 125.3 and 94.3 mcm respectively. The total quantity of water originating from rainfall in those countries is 178.3 mcm in the Mashreq region and 585.5 mcm in the Maghreb (AOAD, 1990).

The Impact of Population Pressure on the Natural Resource Base

Based on an annual increase of 3 percent the population of the Maghreb and Mashreq region has risen from 48.1 million in 1965 to about 99.0 million in 1990, and is expected to reach 184.0 million by 2020 (Tables 2 and 3) (UN, 1996).

Increasing population density in those regions and throughout the Arab countries is associated with the intensification of agricultural activities and a dramatic increase in the number of livestock, particularly small ruminants (Table 6). Related factors include changes in dietary preferences (especially for livestock products), as a result of income growth and rapid urbanization, and attempts by government to achieve a measure of self-sufficiency through import substitution polices.

These trends have imposed severe pressures on the natural resource base, leading to increasing degradation. Numerous contributory factors have been identified including:

- The expansion of mechanized wheat and barley cultivation to areas receiving less than 200 mm of annual precipitation, leading to high rates of erosion. Annual soil losses of 200-250

tons/ha are reported, causing high sedimentation in areas such as Avida in Tunisia at the edge of the Sahara, and Qasaba in Algeria (Meurer, 1987).

- The rapid growth of the small ruminant animal population, especially between 1950 and 1973, putting heavy pressure on range resources, sometimes to a stage beyond recovery. As a result grazing activities have shifted to new areas, including those under forest.
- Cutting of forests for fuel wood for heating and cooking. It is estimated that at various times 50 to 60 percent of the population living in the arid and semi-arid areas of the Mediterranean region have depended on this source of energy (Qunaimi, 1980). The invasion of forests for grazing compounds the problems of sustainable forest management.
- Pollution of soil and water from several sources including intensive use of chemicals in agriculture and other detrimental agricultural practices; over-exploitation of ground water; salinization of soil and irrigation water; accumulation of large quantities of waste water; and pollution with plastic waste.
- Urbanization, and migration from rural areas have contributed to several of these problems. Intensive migration is reported from many rural areas, including Jaraba and the Jafar coastal region in Tunisia, Hefna in Libya, Suse and Al-Goof in Morocco, and to the major cities in Jordan. According to the United Nations (1994), the urban population of the Mashreq countries will increase from 65 percent of the total in 1990 to 86 percent by 2025; and from 65 percent to 82 percent of the total over the same period in the Maghreb region (Table 4). This projected distribution of the population is likely to have a negative impact on the capacity of the resources to cope with various types of pressure.

In the light of these problems, it is alarming to note that food security and/or self-sufficiency is declining progressively in the Arab countries. While those countries currently import about 60 percent of their food requirements, their import needs will be magnified early in the next century when their total population is projected to reach 285 million, and that of the Mashreq and Maghreb regions 155 million (Table 3). This highlights the crucial importance of sound and sustainable agricultural and natural resource management practices to prevent further degradation of the environment, and if possible to improve its productivity.

UNDERSTANDING AND COMBATING ENVIRONMENTAL DEGRADATION

HISTORICAL BACKGROUND: LAND UTILIZATION AND CAUSES OF DEGRADATION

Land utilization and increasing reliance on irrigated and rainfed cultivation has evolved since the time of ancient civilizations in Syria, Eupharatus, and the north Mediterranean coastal areas. The Phœnicians had settled along the Syrian coast bordering a long narrow mountain strip. This region was very fertile, which allowed the production of cereals, vegetables, and fruits. They also traded wood with northern Mediterranean countries, thus increasing the rate of erosion and stripping the land. The replacement of the forest by annual cultivation of land, and especially of slopes, helped to accelerate geologic erosion. Due to scarcity of resources, the Phœnicians moved their agricultural activities towards northern Mediterranean counties and established cities on the Tunisian coast (Kurtage). Afterwards, those countries witnessed successive waves of Greek and Roman invasions.

Within the Eupharatus civilization the key problems were not erosion but salinity and maintenance of the irrigation canal networks. Laws were introduced by Hamorabi encouraging the people to invest in better agricultural practices. When land degradation started in this area, the whole civilization collapsed and was associated with massive desertification.

In Syria the situation was rather different since activities were centered around Tadmor and Damascus. The location of these cities within arid and semi-arid zones (Shackaterh, 1997) restricted the expansion of agricultural activities. Syria was colonized for at least 10,000 years. However, this era was associated with poor measures to protect the environment since the emphasis was directed toward trading. The existence of 175 human ancient settlements near Antakia, reduced to less then 10 at the present time, is a clear example of such changes. The presence of thick sediments, large areas of exposed rocky slopes, and the burial of cities below wind sediments is another indication of ancient degradation. Similar land surfaces now exist in extensive areas in Jordan and Palestine, which were covered with forest during the last 400 years.

Investigation indicates that dry climate was the primary cause of desertification and the expansion of desert, until 3000-5000 BC. Since that time, the influence of climate has become inferior to the influence of man. Recent studies (Sheridan, 1981) indicate that approximately 9.1 million km^2 of land was converted to desert and attribute this change to

human activities; while according to FAO (1984), desertification attributed to human activities has increased 2.5 fold since man first practiced agriculture, and is considered responsible for the degradation of approximately 20 million ha.

Desertification or drought has caused the collapse of ancient civilizations. Nevertheless, ancient inscriptions indicate that some of these civilizations were aware of the effects of drought, the dangers of mismanagement of land and water resources, and the failure to maintain irrigation canals, and attempts were made to conserve soil fertility, and to reduce salinization. Water harvesting structures were constructed in Jordan in 3000-4000 BC. Dams were also constructed to collect flood water in the Sab'a Kingdom in 800 BC. In Syria, the Kananites 1200-586 BC, and the Romans 64-300 AD were very active in employing soil and water conservation measures, crop rotation, etc. Afforestation activities were also practiced to counter continuous cutting during the rule of the Tadmor kingdom which ceased in 274 AD. Under the Roman rule, steps were taken to prevent cutting of several forest plant species which were about to be extinct, despite the fact that during the Roman era, forests were also cleared on a large scale (Le Heouérou, 1977).

THE FACTORS INFLUENCING THE ENVIRONMENT WITHIN THE LRAS

Low rainfall lands occupy extensive areas within the Mashreq and Maghreb countries (Table 5). Generally speaking, most people have associated the areas of low rainfall with range areas without any distinction based on natural land capability. Therefore, the terms LRAs and range areas are used interchangeably in the literature.

Factors causing deterioration of the resources within the LRAs are numerous, but can be classified either as natural or artificially induced. The following have been cited as causing deterioration of range resources: overgrazing, cutting of shrubs for fuel, converting range land for annual cultivation, fire, over-pumping of ground water, excessive services, lack of appropriate projects, improper methods employed for housing local people (nomads), lack of suitable legislation and poor land use.

Among indicators cited for deterioration of these resources are loss of range biodiversity, dominance of undesirable species, extinction of trees usually associated with range shrubs such as Pinus halepensis and Pistacia atlantica, destruction of forest, change of uses, acceleration of erosion, high flood frequencies, effective wind erosion, degradation of wild animals, deterioration of the ecosystem, and dominance of poor soil.

Unfortunately, investigations of the mechanisms relating deterioration of plant cover to specific environmental processes are not available. Nevertheless, scattered research relating the indirect or direct influence of climate to the degradation processes is available.

The Influence of Climate

Climate can be considered as a primary factor causing, directly or indirectly, various types of degradation. Some people consider the formation of deserts to be man-made. They base their claims on clues provided by climatologists who conclude that the current climate has prevailed for 2,000 years (Le Heouérou, 1969).

Climate is also considered to be the most important factor that determines directly or indirectly the soil types that dominate any area. The climate controls the physical and chemical properties of soil. Thus, the type of vegetation cover, its distribution and intensity, depends exclusively on the climate-soil, jointly, or individually. Understanding the effects of both climate and soils on the type of vegetation cover is the key to understanding the processes that contribute to the existence of rich or poor vegetation cover.

Soil Properties

The Mashreq and Maghreb countries are dominated by arid and semi-arid climates. Thus Aridisols, a group of soil types that develop under an arid climate, dominate a large portion of both regions (89 percent of the total area). The Aridisols can be saline, rich in gypsum (201,000 km^2), ca/careous (469,000 km) of coarse texture, or shallow. Sandy soils also cover an extensive area in these countries. Normally, under equilibrium, climate-induced changes in soil properties proceed at an extremely low rate that not be detected over a short period of time. Therefore, a change in the agronomic characteristics of these soils, which is expressed as desertification, is minimum, and their desertification rate will be low relative to other soils.

However, if the properties of soils occurring under a dry climate have not reached the equilibrium stage, changes in these properties will proceed rapidly, reflecting a high desertification rate. Such high rates have been observed within the semi-arid to arid zones.

Natural Versus Anthropogenic Causes of Desertification

The distinction between the natural and anthropogenic factors contributing to desertification has caused intensive discussion among scientists working in this as well as related fields. Accepting either of

these points of view has a significant implication. If it was induced by human action, then measures to combat desertification must concentrate on changes in the behavior of the population, while if it was naturally induced, then measures to combat desertification must concentrate on adapting to the prevailing conditions.

Distinguishing between the naturally or artificially induced processes causing desertification is not an easy task. In many cases, the explanation has not been convincing, because related research had dealt with single processes and little attempt was made to consider an integrated system approach that deals with the various elements of the ecosystem. In many cases, it has not been considered that desertification represents a specific status of the ecosystem influenced by certain degradation processes, characterized by lower soil productivity as one of the ecosystem detectable changes. In order to understand the mechanism of desertification it is therefore vital that relationships between degradation of any of the ecosystem components, whether due to natural or artificially induced factors, be considered collectively rather than treating each of the degradation processes separately.

To understand the influence of climate and its relationships with degradation and the mechanism of desertification, the nature of climate changes, at the present time as well as in the past, should be evaluated.

MECHANISMS OF DESERTIFICATION

Soil in any area is affected directly by the type of climate and indirectly by plants. A model of soil changes which reflects the type and the sequence of climate influencing the soil can be extrapolated. If climate has changed over more than one episode, at a given location, a certain specific distribution of soil properties and changes in that soil reflect the type and the sequence of climate that took place. If these changes in the soil properties are not detected, the climatic sequence can not be established and gap(s) would exist, thus the environmental record of that area, would be incomplete.

Accordingly, establishing the history of soil development, including the associated climate, can be considered as one of the best means to evaluate the climatic sequence that has prevailed in a certain area. In some cases, the occurrence of a certain sequence can be used to project general climatic trends that could prevail in the future assuming the continuation of existing conditions. Furthermore, when a new type of climate prevails in a certain area, a series of ecological changes take place. The first ecosystem elements to interact with such changes are plant population, density, and species distribution.

Reduction in the plant density and type triggers soil degradation such as erosion by wind and water. Such changes are indirectly related to the influence of climate on soil. Nevertheless, there are numerous soil degradation processes which take place and are directly related to climatic changes.

Paleoclimatic Changes and Fluctuations

Several studies have indicated that many regions were affected by more than one cycle of climatic change during the Quaternary period. For example, a climatic sequence of humid-arid-humid and arid-semiarid-sub-humid was established for some regions in Jordan (Taimeh, 1984). Investigation on arid soils of Jordan (Irani and Taimeh, 1992) confirmed the occurrence of climatic changes from humid to semi-arid and again to arid within areas receiving less than 250 mm of annual rainfall. Paleosoles with properties reflecting such a climate sequence were reported in Jordan (Taimeh, 1993).

Regarding the time during which the latest climatic changes occurred, evidence indicates that the climate in the Southern part of the Jordan Valley was arid since the evolution of the Dead Sea 11,000 years ago (Taimeh, 1988). It is also postulated that climatic changes started 11,000 years ago at the Southeast corner and gradually spread towards the Northwest, being marked by the prevalence of the current climate since 5,000 years ago.

In Libya, recent studies indicate that some regions have been subjected to climate changes, the most recent being a humid to arid sequence which has occurred since the preglacial age. Since then, aridity has gradually started to prevail, as expressed by less rain and higher evaporation. Such changes have also caused higher salt concentration in lakes, which have infiltrated to the underground reservoirs (Sha'er, 1990).

Climatic Fluctuation

Seasonal and annual rainfall fluctuation plays a significant role in determining the potential capacity of the ecological system to withstand stress. The annual rainfall variation can take place as successive dry and wet cycles, or as a general decline in the amount of annual rainfall.

Rainfall trend analysis in Libya (Megili, 1981) during the period of 1957-1986 shows that from 1964 to 1972 the climate was dry followed by a wet period from 1972-1984. Wet and dry cycles, seven years long were observed. The trends during the 1990s indicate a higher level of aridity and thus the possibility of a higher rate of desertification.

The analysis of rainfall records for the Jazirah, Iraq, during the period of 1941-1985, shows rainfall variation of the magnitude of 28 percent in the Musil and Singar areas (Biati, 1991). The variation was not only annual, but was also seasonal.

The analysis of rainfall records for several stations in Jordan indicates a high degree of annual variation. Coefficients of variation (CV percent) for areas with rainfall less than 200 mm ranged from 40-79 percent (Hadidi and Taimeh, 1996). The value of 5-year moving averages suggests a cyclic pattern of annual variation. The length of the cycle seems to endure for 20-25 years. Moreover, the computed annual average indicates that average rainfall has been lower for the most recent cycles. The analysis of short term rainfall changes indicates a systematic reduction in the precipitation of the semi-arid to sub-humid regions. The magnitude of the reduction is highest for the ecosystem with the higher rainfall (Hadidi, and Taimeh, 1996). Comparing the differences between the computed and actual average rainfall indicates about a 20-30 percent reduction in the annual averages during the last 30 years.

The key issue is whether such a pattern represents real permanent change or a cyclic fluctuation. Unfortunately, concrete conclusions cannot be extrapolated from a 60 year climatic record. Therefore, other ecosystem elements closely associated with climate should be used.

DESERTIFICATION VERSUS CLIMATE CHANGE

If a climate that was dominant in a certain area has changed from humid to arid, two significant issues are to be considered:

First: How long is the transitional period that elapses before such a change is completed?

Generally, this period is in hundreds or thousands of years during which every element of the ecosystem will react through a sequence of changes that match the changes from one climate to another, and

Second: What is the nature of the ecological changes that occur under the most recent climate?

Usually some of these changes may be a continuation of a previously initiated pattern, which continues under the influence of the prevailing climate. For example, when the climate is arid, physical weathering dominates, and silt and salt will accumulate at the surface of the soil. Consequently, erosion by wind will dominate the ecosystem. But if the climate is humid, chemical weathering will dominate, more clay will accumulate, and the salt content will be very low. Consequently, erosion by water will dominate the ecosystem.

Accordingly, changes in the components of an ecological system (soil and plant) would occur both during the transitional period and after the prevalence of the new climate. The sequence of these changes would be completed when an equilibrium between the climate and the other components of the environment was reached.

Generally, there are no rules as to the time needed to reach or complete such a stage. The above principles represent the mechanism under which changes can occur during and after climatic changes. Those changes that take place when climate changes from humid to arid are basically degradation processes, since they are associated, for example, with lowering soil productivity. The combined effect of different degradation processes is called desertification. The rate of degradation will, however, increase until an equilibrium is reached. The rate of change, or degradation, during this stage is very slow but steady.

As pointed out earlier, soil properties can provide the best information regarding climatic changes. When interest is restricted to the most recent climatic changes, and the possibility of their continuation, analysis should be restricted to changes of the soil properties within the upper surface. Such changes represent the most recent climate-soil interaction. For example, the accumulation of calcareous silt in the top soil layers indicates sedimentation by wind. If such sediments are salty or rich in gypsum, then it is clear that the sedimentation is associated with the overwhelming effect of an acidic climate. If this process was not continuous, no sedimentary accumulation would be detected in the soil. Thus, it can be deduced whether the observed pattern was permanent or not.

The distribution of some soil properties can be used to establish possible regional climatic changes or trends, and their relevance to degradation. For example, the thickness of the soil layers that reflect such an effect depends on the nature of the processes and the length of the period during which they have been operating. If the degradation process was erosion by water, the thickness of the upper layer would be inversely related to the intensity and the length of time during which erosion was active. Other features which could be related to changes induced by climate are landscape and plant cover characteristics. However, these processes could also be attributed to anthropogenic activities. Nevertheless, in many cases, evidence exists to distinguish between natural and artificially induced changes.

Degradation occurs during the transitional period of climatic change. Initially, the rate of degradation will increase until climatic change is completed and a state of equilibrium is reached. The initial changes introduced during the transitional period could have little influence on

the ecosystem. This is called the "incipient" stage. As time progresses a higher rate of degradation occurs when a threshold point is crossed beyond which the influence of the degradation cannot be halted or reversed. Afterward, degradation proceeds at low rate. This stage represents an equilibrium status between the components of the ecosystem. The different stages for the pre-incipient, incipient, to the equilibrium stages are characterized by a specific combination of climate, water balance, evolution of soil properties, specific combination of vegetation, and landscape features that interact actively with each other.

The change in the degradation rate, as described, is attributed to natural factors. The time needed to cross from one stage to another depends on the original status of the ecosystem, its ability to withstand new changes, and the rate of climatic change. At a given stage, any ecosystem possesses the capability to withstand external forces, whether natural or anthropogenic. The ability of anthropogenic factors to alter this equilibrium at any stage, depends on that stage itself. For example, at the pre-incipient or incipient stage, the equilibrium between the elements of the ecosystem is strong. If, however, anthropogenic interference takes place at stages during which the ecosystem is experiencing higher rates of change, called a fragile ecosystem with low recovery capability, the anthropogenic influence will be maximum and could increase the rate of degradation. But at the advanced stage, when a state of equilibrium is attained, the rate of change is low, the recovery is poor, and the anthropogenic influence will be negligible.

Generally changes caused by anthropogenic factors start in localized areas and may be completed in a short period of time. However, natural changes require a longer period, operate on a regional scale, and are associated with landscape changes which cannot be produced by any anthropogenic activity.

In some cases, it is difficult to differentiate between the influence of natural and anthropogenic factors. This is especially true when the equilibrium of the ecosystem is weakest and when the rate of natural degradation is maximum. This stage is marked by poor recovery capability, and the ecosystem will also be highly vulnerable to anthropogenic activities.

Nevertheless, the distinction between natural and human influence can sometimes be determined with certainty. For example, high soil salinity within a certain area could be reached within a few years in a semi-arid to arid region if the land was irrigated with poor quality water. That is a clear example of a specific ecosystem change consequent on anthropogenic activity. On the other hand, such rapid soil salinity

accumulation would not take place if the climate was humid. The difference is specifically related to the capability of the ecosystem to cope with salt flux in the soil system.

CLIMATE VERSUS HUMAN INFLUENCE AS SOURCES OF DEGRADATION

Rap (1974) reported that, during the past 20,000 years, the climate of the Saharan region has probably changed several times passing through wetter periods, called pluvial periods, and drier or interpluvial periods. He considers that all studies lead to more or less similar conclusions. No major climatic changes have been recorded during the past 2000 years, but there seem to have been frequent minor fluctuations. Sherbrooke and Paylore (1973) state that marginal areas may not recover from short term weathering patterns induced by uncertain rainfall followed by cyclic drought, if they are subjected to continued intensive use during a succession of dry years. However, Le Heouérou, (1959) has suggested that it is man who creates desert, the climate only provides the right conditions.

Many other scientists are convinced that human activities are the main factor causing desertification. Among reasons advanced to support such claims is the impact of the recent great urban explosion on areas which cannot support such an increase in demand: population has increased more during the last 40 years than throughout the period since man first existed (Milc, 1984, Keyfitz, 1989). Whatever the historic factors bearing on desertification may be, this relatively new influence cannot be ignored, and the need to improve understanding of the interaction between natural environment processes and anthropogenic factors and to monitor these trends more closely will be essential to sustainable management of the LRAs.

ENVIRONMENTAL AND ANTHROPOGENIC THREATS TO THE RESOURCES OF THE LRAs

Desertification, climatic risk, changes in the fluctuation of climatic parameters, high evaporation rates, declining rainfall, various forms of erosion, and physical weathering are among the natural factors influencing agriculture, natural vegetation, and wild life habitat. However, as discussed above, the interaction between human activities, vegetation cover, and wild life plays a major role in the environmental balance, and anthropogenic influences are likely to become more pervasive as population increases in the 21st century. These issues will be summarized briefly in this concluding section.

Environmental Processes

Several environmental processes, which can lead to desertification, have an adverse influence on resources within the LRAs. However, quantitative data regarding the rate and hazard of each of these processes is limited. Table 7 summarizes the distribution of areas threatened in the Mashreq and Maghreb countries. The following sections summarize the nature and impact of the most dominant of these processes.

Erosion by Water

Erosion by water is active in steeply sloping and range lands. The dominance of rock outcrops is seen as a clear indication of this process, which is active in about 211,000 km^2 of the West Asian Arab countries. Jordan is one of those most affected, while 21 percent of Iraq and about 66 percent of Syria and Lebanon is affected by erosion. In the Maghreb region, 10,000 ha of fertile land is lost annually in Tunisia.

Wind Erosion

Wind erosion dominates arid land. Sand dunes and sandy land forms represent an advanced stage of environmental degradation. However, in terms of changes in the elements of the environmental system, very little can be observed. That is to say, possible environmental changes are already completed and a steady state has been reached. These lands forms occupy 1.1. million km^2 of the Arab countries in West Asia (28.1 percent), and about 1.5 million km^2 of the Maghreb countries (17.5 percent of the total area). In some countries, for example Jordan and Syria, they have increasingly been developing as dune series. Data available from individual countries is cited below:

Iraq — sand source land occupies about 1.4 million ha or 3 percent of the total land, of which 800,000 ha (1.9 percent) is sand dunes.

Jordan — Ninety-one percent of the country is classified as sandy land influenced by sand dune movement, which is estimated to cover about 100,000 ha of the Wadi Araba. Sand dunes have also started to develop at the south-eastern strip of the border with Saudi Arabia.

Syria — sand dune movement has started to affect areas located south of the Syrian Badia region.

Algeria — Eighty-four percent of the total land (1.99 million km^2) has an arid to semi-arid climate associated with extensive sand dune coverage (ACSAD 1990).

Libya — coastal and continental sand dunes cover very large areas.

Tunisia — 80 percent of the country is exposed to weathering, including both coastal and interior regions.

Biological Degradation

Biological degradation is reflected in thinner vegetation cover and reduction of the organic content of soils. No regional studies regarding this process are available.

Physical Degradation

Physical degradation is a combination of several natural processes. The mode and rate of physical degradation within an area is totally related to the type of climate. Usually this proceeds at a rate hard to detect within a short period of time, but the long term impact of these processes can be devastating.

The transportation of fine calcareous sediment from one region to another is an example of such natural processes. This process is very slow, but the cumulative results over centuries can lead to striking changes in the agro-ecological properties of soils that make them highly vulnerable to degradation. This slow process can proceed under the same type of climate, but changes in the associated agro-ecological system are gradual. Furthermore, this phenomena can affect a large area with little human influence. Nevertheless, human interference can influence the agro-ecological properties of soils, especially if it takes place at a stage when the ecological system is fragile. For example, this process is responsible for converting about 10 percent of the total area in Jordan to a fragile state. In this case, human interference was very active and its effect has been felt within a short period of time. (Taimeh, 1993).

Results of other types of physical degradation are related to the dominance of calcareous, sandy, and gypsic soils, poor drainage, and surface crusting due to soil structural degradation. No exact figures regarding the areas covered with each type of soil are available.

Chemical Degradation

Chemical degradation is related to an increase in soil salinity or to the accumulation of toxic materials. Contributory factors include a high salt content of soils, a high ground water table, high evaporation rates,

high temperatures, and over-pumping of ground water. Table 1 (Masood, 1995), gives recent data on the distribution of saline soils in the Mashreq and Maghreb regions.

This table indicate the severity of this problem, which is confirmed by other reports from individual countries. For example:

> Iraq - an estimated 70 percent of the alluvial land is affected by such processes (708,000 ha or 1.6 percent of the total land area); while it is reported that 60 percent of the irrigated land in alluvial basins is considered saline with about 1 percent of the total irrigated area being lost annually (25,500 ha). Another report states that, by 1953 75 percent to 85 percent of the irrigated land in Iraq had become saline (Sam, 1990).
>
> Syria - it is estimated that 366,000 ha (about 2 percent of the total land area) is affected by soil salinity.
>
> Libya - in 1972, 22,300 ha of soil was estimated to be salt-affected in the Wadi Shati (Balba, 1980).

Various explanations are given for soil salinization. Among these reasons are indigenous soil salinity as in Iraq and Jordan, poor surface and ground water quality, as in Libya, Southern Iraq, and Tunisia, and the absence of a good drainage network as in Iraq, Jordan, and Syria. FAO has estimated that 50 percent of the land in Iraq, and 50 percent of the Euphrates basin in Syria is affected by secondary salinization due to poor drainage (Balba, 1980). The intrusion of salts into soils of the coastal areas, especially in the Maghreb countries and in areas surrounding the Dead Sea in Jordan; and poor soil management have also been considered as primary causes of soil salinization.

ANTHROPOGENIC THREATS TO AGRICULTURE, NATURAL VEGETATION, AND WILD LIFE

THREATS RELATED TO THE UTILIZATION OF WATER RESOURCES

The deterioration of water availability or quality, whether from surface or ground water, presents a serious threat to agricultural production, the sustainability of vegetation cover, soils, and wild life in many countries of the region.

For example, over-pumping of ground water has resulted in an increase in the salinity of irrigation water, so that accumulation of salt in the soil has become a significant indicator of soil degradation in many countries. Over-pumping has also lowered the water table in some areas, leading to drying up of natural springs, and the destruction of palm trees in oases (Sha'er, 1990). as well as to other adverse effects on natural vegetation and wild life.

These problems are likely to be accentuated by competition for water between agricultural and non- agricultural uses, implying an increasing allocation to the latter. Thus irrigation may have to rely more and more on water of marginal quality including that derived from urban sewage; a valuable but environmentally hazardous resource.. Measures to reduce wasteful use of irrigation water, and to prevent water-logging, increased salt accumulation, salinization, alkalization, soil degradation, soil erosion and sand dune accumulation in irrigated areas will therefore be absolutely crucial.

Threats to Rainfed Farming and Rangeland Areas

Overgrazing and cultivation of marginal areas, as well as monoculture of annual crops, pose threats to the natural vegetation, loss of biodiversity, reduce soil fertility, and present an erosion hazard. Poor land preparation, ploughing on steep slopes, or use of improper mechanization and cultivation equipment can create erosion and degradation even of better soils. Lack of agricultural inputs can contribute to declining soil fertility, while their misuse may cause pollution.

Factors not directly connected to physical mismanagement of rainfed land can also create environmental threats. These factors include uncertainties over property rights and lack of appropriate legislation, especially with respect to rangelands, leading to open access and free-for-all competition for grazings, as well as to rental or crop-sharing systems for farm land which encourage its exploitation. Poorly planned urbanization and road development also lead to loss of good agricultural land and/or its pollution.

Threats to Forested Areas

Destruction of vegetation cover, especially forest, has been severe in the Mashreq and Maghreb countries, although information from studies relating the disappearance of wide areas of forest to either human or environmental features is scattered. At most, the available studies indicate the geographic distribution of forest during the last two to four centuries. Agro-ecological changes within areas covered in the past with forest have not been adequately investigated as it has been easier to attribute the destruction solely to human activities because geographic reference of the forest coverage during past centuries is available, and since destructive practices continue to this day.

Extensive forest destruction has been reported in Morocco. The area of forest there during the third century A.D. was 13.5 million ha or 36.5

percent of the total area, while it was 4.2 million ha in 1940, an annual reduction of about 5,000 ha year. During the period 1940-1981, the rate of forest losses was estimated to be 25,000-30,000 ha/year (Shakhatreh, 1987).

In Tunisia, forest land used to cover about 300,000 ha, while currently it occupies about 170,00 ha. The rate of cutting is estimated at 1,800 ha annually in the Qabis area alone. In the Mashreq region, Pistacia atlantica forest once occupied about 300,000 ha in Syria, now it is reduced to 40,000 ha.

Fires have been cited as a cause of extensive forest destruction. It is reported that about 4 million ha of natural forest was burnt in Algeria alone during the independence war. Furthermore, 300 million tons of dry weeds and shrubs are lost annually by fire (Shakhatreh, 1987).

Over exploitation of forests, uncontrolled grazing and cultivation of marginal lands, forest cutting and fires, lack of alternative sources of energy, rising land prices, lack of legislation, inadequate law enforcement, poor afforestation programs, misuse of agricultural machinery and intensive traffic movement on fragile lands, and the spread of insects and diseases may all be associated with improper practices and loss of plant cover.

It is important to note that forested areas are often situated in mountainous regions, hence their destruction or degradation may have repercussions well beyond their immediate location. At the same time it may be more difficult to manage forests or to monitor or control their exploitation in upland areas because they are less accessible.

Mountain regions present particularly difficult management problems, which if not solved can pose serious threats to watershed areas, including severe run-off and erosion, flooding downstream, and siltation of dams and reservoirs. Factors which contribute to these adverse effects include: deforestation and forest fires, ploughing with heavy tools on steep slopes and cultivation of marginal lands, excavation of rocks on slopes, uncontrolled grazing, inappropriate or insecure systems of land tenure, and poorly conceived land use planning.

Recent Evidence of Damage and Loss of Biodiversity

As a result of these various threats the natural vegetation cover has been destroyed or seriously damaged, and wild life has also suffered severely. Examples of resource destruction in the Mashreq and Maghreb regions are cited below:

Mashreq Region

In Syria, as a result of the intensification of agricultural development and pollution, wild life is encountering an increasing level of hardship. For example, at the Profit Mountain, east of Latakia, plant species such as Cedrus cilic and Cedrus libani are close to extinction due to cutting and to converting land for cultivation. The area occupied by these species has been reduced from 5,000 ha to 3,000 ha at the present time. Another example, is the reduction of Juniperus exelsa, which is considered to be a rare plant at a global level, from 40,000 ha to a scattered 13,000 ha. Pistacia atlantica has encountered similar problems. This species used to occupy 300,000 ha within the coastal and interior mountains. Currently, it covers only a few thousand ha of scattered forest (AOAD, 1994).

Some references indicate that the estimated area of range plants and shrubs lost during the 1970s was around 200,000 ha/year. In Syria, the number of uprooted Haloxylon articulatum was estimated at 40 million trees annually. In Jordan, the Hamad Basin lost about 30 million trees in 1981. (ACSAD, 1990). The natural flora of Jordan includes 2,300 and 2,400 species, of which 100 are endemic, 200-250 are considered rare, and 100-150 species are threatened, while 10-20 are extinct(Al-Eisawi, 1985). Many of the species which appeared in historical records are now extinct or threatened.

A main factor leading to the extinction of wildlife is the deterioration of the vegetation cover due to urbanization. The most destructive period was during the First World War. Over grazing, hunting, and drought have also contributed to deterioration (Al-Eisawi, 1985). Over-pumping has resulted in the absence or the reduction of spring flow. This has disrupted the growth of a wide range of wild plant species and led to the migration or extinction of many animals and birds which co-existed in this environment.

Maghreb Region

Tunisia. Tunisia has 5,500 plant species of high genetic value, of which 307 are considered rare, and 99 are very rare. Most of these animal and plant species used to exist in Sabasib Al-Taleh which covered 3,800 ha in 1953, while at the present time, it covers only 10 ha with some scattered trees (AOAD, 1994).

Morocco. Morocco is considered one of the richest countries of North Africa botanically, with 4,200 wild plant species. Due to intensive agricultural activities, 273 species are close to extinction, despite the fact they originated in Morocco. As an example, the Arkana forest area, a globally unique resource, is threatened by urbanization and agricultural

activities, while the palm Oasis is threatened by soil salinity and diseases. The flora and the fauna have become impoverished during the last 120 years, lion, panthers, ostriches, and antelopes have disappeared, while moufflon, hyenas, and gazelles have become rare (Le Heouérou, 1959).

REFERENCES

Al-Eisawi, D. 1985. Vegetation in Jordan. Study No.8. Faculty of Science, University of Jordan.

ACSAD. 1990. *Damascus. Arab Center for the Studies of Arid Zones and Dry Lands*. Annual Agrostatic.

Arab Organization for Agricultural Development (AOAD). 1990. Preliminary studies, Arab World Organization.

Arab Organization for Agricultural Development (AOAD). 1994. *The Interaction Between Environment and Agricultural Development* Khartoum.

Balba, A. 1980. *Reclamation and Land Improvement.* Alexandria: Al-Matbaah New Press.

Biati, A. H. 1991. Control of Soil Erosion in Jazirah Area, Iraq, Agricultural Development in the Arab World. Arab Organization for Agricultural Development No.4, Khartoum.

FAO. 1978. *Production Yearbook, Vol. 32.* Rome: Food and Agriculture Organization.

FAO. 1984. Protect and Produce-Soil Conservation for Development. Food and Agriculture Organization, Rome.

FAO. 1995. *Production Yearbook, Vol. 49.* Rome: Food and Agriculture Organization.

Hadidi, L. and A. Taimeh. 1996. Evaluation of Desertification Risk in Jordan Using Some Climatic Parameters. M.Sc. Thesis, University of Jordan.

Irani, K. and A. Taimeh. 1992. Properties and Formation of Some Aridisols in Jordan. M.Sc. Thesis University of Jordan.

Keyfitz, N. 1989. The Growing Human Population *Scientific American* 261 (11): 71-77.

Le Heouérou, H. N. 1959. *Recherches Ecologiques et Floristiques Sur*

la Végétation de la Tunisie Méridionale. Alger: Université D'Alger, Institut de Recherches Saharaiennes. 510 p. + maps (Rapport Spécial).

Le Heouérou, H. N. 1969. La Végétation de la Tunisie Steppique,*Ann. Inst. Nat. Rech. Agron. Tunisie* 42, fasc. et 6.

Le Heouérou, H. N. 1977. Man and Desertification in the Mediterranean Area. *AMBIO* 6: 363-365.

Masood, F. 1995. Productivity of Irrigated Land in the Arab World and Projects to Improve It, AOAD Statistics 1993.

Megili, M. A. 1981. Trend of Rainfall Fluctuation and Potential Desertification in Jafara Region, North East Libya. *Journal of Desert. Studies* 1 (11): 23-27.

Meurer, M. 1987. Ecological Pressure and Site Compatibility of the Mediterranean Subtropics: The Example of NW Tunisia.*Applied Geology and Development* 29: 107-125.

Milc, S. 1984. Desert and Population Boom, Desertification Control. UNEP Bulletin No. 11: 7-16.

Qunaimi, M. 1980. *Desertification Problem in Islamic Countries.* Geography Dept. No. 21. Kuwait, University of Kuwait and Kuwait Geographic Society (Ref. 14).

Rap, A. 1974. *A Review of Desertification in Africa: Water, Vegetation, and Man.* SIES Report, p. 77. Stockholm: Secretariat for International Ecology.

Sam, S. 1990. Ground Water: Drainage and Soil Salinization Alluvial Plain of Eupharatus Basin *Irrg. Agricultural Magazine*Ministry of Agriculture and Irrigation, Iraq: 38-40.

Sha'er, M. 1990. Climate of North Africa During the Quaternary. *Journal of African Studies* 2: 28-44.

Shakhatreh, M. 1987. *Desertification in the Arabic countries causes and results*, pp. 16-39. Arab Organization for Science and Education. Tunisia.

Sherbrooke, W. C. and P. Paylore. 1973. *World Desertification: Causes and Effects, a Literature Review and Annotated Bibliography* pp. 168. Tucson, University of Arizona Resource Paper, No. 3.

Sheridan, D. 1981. *Desertification of the United States.* U.S. Government Printing Office.

Taimeh, A. 1988. Genesis of Some Salt Affected Soils in Southern Jordan valley. *Dirasat* XV (11): 79-103.

Taimeh, A. 1993. Extent of and Mechanisms of Desertification in Jordan. Book under preparation.

Taimeh, A. 1984. Paleoclimatic Changes During the Quaternary in Irbid Region. *Dirasat* XI (7): 131-149.

The Hashemite Kingdom of Jordan. 1991. *National Environmental Strategy for Jordan*, pp. 62-63. Dept. of Environment, Ministry of Municipality and Rural Affairs and Environment.

United Nations. 1996. World Population Prospects: The 1996 Revision. Population Division. New York, N.Y., U.S.A.

UNEP. 1978. *Desertification Control.* Bulletin No. 11. Nairobi, Kenya. United Nations Environmental Program.

Zubaidi, A. 1994. *Reclamation of Saline Soils in the Arab World*, pp. 41-46. Arab Organization for Agricultural Development.

Table 1: Distribution of saline and alkaline soil in the Mashreq and Maghreb countries (000 ha)

Country	Solonchak	Saline	Solonetz	Alkaline	Total
Iraq	6,679	47	X	X	6,726
Jordan	74	106	X	X	180
Lebanon	X	X	X	X	X
Syria	X	532	X	X	532
Total Mashreq	6,753	685	X	X	7,438
Algeria	1,132	1,889	X	129	3,150
Libya	905	1,552	X	X	2,457
Morocco	42	1,106	X	X	1,148
Tunisia	990	X	X	X	990
Total Maghreb	3,069	4,547	X	129	7,745
Total M&M	9,822	5,232	X	129	15,183

Source: Masood, 1995 (Productivity of irrigated land in the Arab World and Projects to Improve It, AOAD Statistics 1993).

Table 2: Population distribution–Mashreq and Maghreb countries, 1965 and 1984

	1965 - (000's)			1994 - (000's)		
Country	**Total**	**Rural**	**%**	**Total**	**Rural**	**%**
Iraq	7,976	3,936	49.3	19,925	5,165	25.9
Jordan	1,128	651	57.7	5,198	1,516	29.2
Lebanon	2,151	1,087	50.5	2,915	390	13.4
Syria	5,325	3,195	60.0	14,171	6,817	48.1
Total Mashreq	**16,580**	**8,869**	**53.5**	**42,209**	**13,888**	**32.9**
Algeria	11,293	7,439	62.4	27,325	12,295	45.0
Libya	1,623	1,179	72.6	5,226	765	14.6
Morocco	13,323	9,077	68.1	26,488	13,804	52.1
Tunisia	4,630	2,801	60.5	8,734	3,717	43.2
Total Maghreb	**31,499**	**20,494**	**65.1**	**67,773**	**30,641**	**45.2**
Total M&M	**48,079**	**29,363**	**61.0**	**109,982**	**44.529**	**40.5**

Source: United Nations. World Urbanization Prospects: The 1994 revision. Department for Economic and Social Information and Policy analysis, Population Division, New York, 1995.

Table 3: Population development and the share of agricultural labor force

	Total population (000's)			Agricultural labor as % total 1990 economically active population
Country	**1990**	**2010[1]**	**2020[1]**	**1990[2]**
Iraq	18,078	30,422	38,013	16.1
Jordan	4,259	8,458	10,735	15.3
Lebanon	2,555	3,742	4,193	7.3
Syria	12,388	20,468	24,563	33.2
Total Mashreq	**37,280**	**63,090**	**77,504**	**21.3**
Algeria	24,935	38,636	44,428	26.1
Libya	4,545	8,724	11,448	10.9
Morocco	24,043	33,483	37,801	44.7
Tunisia	8,162	11,410	12,832	28.1
Total Maghreb	**61,685**	**92,253**	**106,509**	**33.8**
Total M&M	**98,966**	**155,343**	**184,013**	**29.7**

Source: Masood, 1995 (Productivity of irrigated land in the Arab World and Projects to Improve It, AOAD Statistics 1993).

Notes: [1]Population Growth to 2010 and 2020 is based on the UN medium variant.

[2]The percentage share of the economically active population in agriculture of the total economically active population for all of the above countries is almost identical to that of the total agricultural population in the total population.

Table 4: Projected increase of urban population in the Arab countries (% of total)

	Rural		Urban	
Countries	**1990**	**2025**	**1990**	**2025**
Mashreq	35	14	65	86
Peninsula	42	14	58	84
Nile Basin and African Horn	61	30	39	40
Maghreb	35	18	65	82
Average	**46**	**21**	**54**	**79**

Source: United Nations, World Population Prospects: The 1996 Revision. Annex 1. Demographic Indicators, New York, October 1996.

Table 5: Land use in the Mashreq and Maghreb countries 1965 and 1994 (000 ha)

	1965						1994					
	Total land	Arable land	Pasture	Forest	Other land	Irrigated land	Total land	Arable land	Pasture	Forest	Other land	Irrigated land
Iraq	43,397	4,810	4,060	1,953	32,574	1,030	43,737	5,750	4,000	192	33,795	2,550
Jordan	9,718	1,177	100	125	8,316	57	8,893	405	791	70	7,627	64
Lebanon	1,023	276	8	94	645	49	1,023	306	10	80	627	88
Syria	18,457	6,523	8,298	446	3,190	579	18,378	5,527	8,299	487	4,065	1,082
Total Masheq	**72,595**	**12,786**	**12,466**	**2,618**	**44,725**	**1,715**	**72,031**	**11,988**	**13,100**	**829**	**46,114**	**3,784**
Algeria	238,174	6,863	37,780	2,549	190,982	259	238,174	8,043	31,597	3,950	194,584	555
Libya	175,954	2,509	7,400	491	165,554	123	175,954	2,170	13,300	840	159,644	470
Morocco	44,634	7,066	12,500	5,302	19,766	199	44,630	9,291	21,000	8,970	5,369	1,258
Tunisia	15,536	4,406	3,250	674	7,206	74	15,536	4,952	3,103	676	6,805	385
Total Maghreb	**474,298**	**20,844**	**60,930**	**9,016**	**383,508**	**655**	**474,294**	**24,456**	**69,000**	**14,436**	**366,402**	**2,668**
Total M&M	**546,893**	**33,630**	**73,396**	**11,634**	**428,233**	**2,370**	**546,325**	**36,444**	**82,100**	**15,265**	**412,516**	**6,452**

Sources: FAO Yearbooks, Published by FAO Arab Agristatistics 1995. Agristatistics Year Book 1995, Published by AOAD.

Table 6: Ruminant livestock population of Mashreq and Maghreb countries (000)[1]

Countries	1965*			1994**		
	Sheep	Goat	Camel	Sheep	Goat	Camel
	Mashreq					
Iraq	11,040	1,845	330	9,005	1,506	6
Jordan	803	651	19	2,211	814	32
Lebanon	87	442	1	682	876	2
Syria	5,075	1,380	17	11,257	1,035	6
Total Mashreq	**17,005**	**4,318**	**367**	**23,155**	**4,231**	**46**
	Maghreb					
Algeria	5,580	2,642	225	17,842	2,544	114
Libya	949	1,475	64	5,614	1,350	147
Morocco	15,150	7,500	185	15,595	4,431	30
Tunisia	3,767	527	190	6,137	1,351	37
Total Maghreb	**25,446**	**12,144**	**664**	**45,188**	**9,676**	**328**
Total M&M	**42,451**	**16,462**	**1,031**	**68,343**	**13,907**	**374**

[1]Excluding cattle
Source: Compiled from FAO Statistics Yearbooks.

Table 7: Desertified and threatened areas in Mashreq and Maghreb countries

Country	Desertified area		Area threatened by desertification		Total area Km²
	km2	(%)	km2	(%)	
	Mashreq				
Iraq	166,687	38.10	237,365	54.30	437,500
Jordan	75,000	81.52	15,230	16.45	92,000
Lebanon	X	X	X	X	10,400
Syria	18,500	9.99	109,020	58.87	185,780
Total Mashreq	**260,187**	**35.85**	**361,615**	**49.83**	**725,680**
	Maghreb				
Algeria	1,970,000	82.74	230,000	6.99	2,381,000
Libya	1,625,877	90.00	380,635	10.00	1,806,530
Morocco	455,000	64.10	195,000	27.43	710,850
Tunisia	65,000	39.73	59,000	36.06	163,610
Total Maghreb	**4,115,877**	**81.31**	**864,635**	**17.08**	**5,061,990**
Total M&M	**4,376,064**	**75.61**	**1,226,250**	**21.18**	**5,787,670**

Source: Nour Eddien Akrami, 1994. Desertification in the Arab Countries Studies on the Environmental Impact on Range Resources in the Arab World, AOAD, Chap. 3, p. 59.

GROWTH, POVERTY AND THE ENVIRONMENT IN THE LOW RAINFALL AREAS OF WEST ASIA AND NORTH AFRICA

Per Pinstrup-Andersen, Peter Hazell, Peter Oram[5]

ABSTRACT

In an ideal world sustainable agricultural development would be achieved by means that simultaneously contributed to productivity growth, poverty alleviation, and sound environmental management: the 'critical triangle'.

This paper examines progress towards the attainment of this goal in the low rainfall areas (LRAs) of West Asia and North Africa. It finds that while agricultural output from these areas has increased, growth has been achieved largely by means that have favored the more affluent farmers and herders, and at the expense of environmental integrity. Those means include national and sectoral policies (cheap fuel, cheap credit for machinery, subsidized supplementary feed, producer and consumer subsidies, and high levels of protection on cereals and meat), which have created perverse incentives to exploit the natural resources. Nationalization of rangelands and lack of secure property rights have opened the steppe to mechanized cultivation and acted as disincentives to sustainable investment. Yields per hectare of arable land or per head of livestock have not risen: if anything they have declined. Research and extension policies have favored the high rainfall and irrigated areas, and failed to find solutions to equitable agricultural growth of the LRAs.

Two hypotheses are postulated for discussion. These are:

- That current patterns of agricultural growth in the LRAs have been of greatest benefit to the larger farmers and herders; and
- That environmental degradation there is driven more by inappropriate policies and insecure property rights than by poverty.

---

[5]Per Pinstrup-Andersen is Director-General of the International Food Policy Research Institute (IFPRI), Washington, D.C., Peter Hazell is Director of the Environment and Production Technology Division at IFPRI, and Peter Oram is Research Fellow, Emeritus, at IFPRI.

The paper concludes that continued agricultural growth along these lines threatens the collapse of the entire farming system, and proposes a major realignment of government policies to achieve a different pattern of agricultural growth which is more efficient, equitable, and environmentally sustainable, and less dependent on subsidies. This strategy would rest on seven pillars which are elaborated in the final section.

Successful implementation of these measures would probably reduce the total value of crop and livestock production from the LRAs, but at lower costs, so that net incomes might not suffer. Subsidy costs to governments would decline, thus releasing funds for research and for productive investments beneficial to small farmers and herders and to the quality of the environment. In the long run, however, the number of people dependent on agriculture there must decline, and governments must find ways to reduce population growth, diversify the rural economy, and invest in rural people to enhance their opportunities for self-advancement.

THE CRITICAL TRIANGLE: LINKAGES BETWEEN GROWTH, POVERTY, AND THE ENVIRONMENT

It is now widely recognized that agricultural growth, food security, and poverty alleviation are closely linked, but that their achievement over the long term depends on sustainable management of the environment. Nevertheless, these linkages are often complex and cannot be taken for granted; it is necessary to understand their nature and how they interact under specific social, economic, and agro-ecological circumstances in order to frame policies which capitalize on their interactions and avoid attaining one goal at the expense of the others. It may be relatively easy to promote rapid short-term agricultural growth by manipulation of exchange rates, taxes, subsidies, and interest rates, and by concentrating investment selectively on certain sectors or ecological zones; but at risk of creating long-run environmental problems, or leaving significant areas of a country in poverty.

In WANA the LRAs embrace a significant share of the arable land in the region, virtually all of the steppe rangelands, and much of the upland watersheds. In addition to being the main locus of poverty they are reported to be severely degraded, largely as a result of human activity. While degradation is not solely of recent origin, there is strong evidence from the work of the M&M teams and other recent studies that it is accelerating. Key issues to be explored in this paper are the forces driving these changes, the role of government policies, and what

combination of measures might be required to reverse existing negative trends through linking growth and poverty alleviation while preserving the integrity of the natural environment.

AGRICULTURAL GROWTH IN THE LRAs

Rainfed production in the LRAs has risen unevenly; growth has been achieved principally by expanding the area cultivated, especially of barley; by raising the numbers of small ruminants on rangelands, and by dramatically increasing the use of purchased feedgrains. Productivity growth through yield increasing technology is largely confined to ecozones with mean annual precipitation between 300 and 400 m, as is diversification of annual cropping systems; below 250 mm, use of modern varieties, fertilizer and herbicides has been small, and the cropping pattern is dominated by cereals. There has been little or no improvement in rangeland productivity, in fact the converse is the case.

Principal reasons for continued low productivity include:

- The aridity of the climate, with highly variable precipitation both between and within years and frequent droughts;
- Risk-aversion to adopting new crops or unfamiliar cultivars, and to expenditure on purchased seeds and fertilizers, especially by low-income farmers; and
- Resource degradation: a 'chicken-egg' situation resulting from the incursion of cultivation into marginal lands and an increase in animal numbers on a shrinking area of natural grazings.

Inadequate research and extension effort on problems of the LRAs, and weak links between technology and the social sciences have impeded the adoption of a holistic approach to resource management and the establishment of a research strategy which balances growth, equity, and sustainability. Piecemeal technical solutions, for example breeding more drought-tolerant barley cultivars, increasing fertility of sheep, and unselective supplementary feeding may actually encourage ploughing of steppe areas and overstocking of rangelands, thus trading the long-term wealth of the resource for an ephemeral gain in production and increased exposure to drought losses.

Other disincentives to invest in improving the resource base include nationalization of rangelands, insecure property rights which inhibit significant long-term investments, and distortionary policies and subsidies creating perverse incentives to unsustainable resource management (Ngaido et al., 1996).

POVERTY IN THE LRAs

Largely because of the region's oil resources there is a popular concept that WANA is a land flowing with milk and honey, with very little poverty, but a recent World Bank report shows that the percentage of the population below the poverty line is greater there than in Latin America or East Asia (World Bank, 1992). That report does not disaggregate poverty by ecological region, however in WANA it is generally believed that it is most prevalent in the low rainfall rural areas with less than 300 mm of mean annual precipitation.

The principal causes of poverty include:

- Insufficient access to land in most countries, with the majority of arable farms being under ten hectares in size, while the bulk of the cultivated area is in the hands of a few large landowners. A similar asymmetric relationship exists with respect to flock size and ownership. Those who have limited access to land or to irrigation in this harsh environment are condemned to poverty unless they can find alternative employment. Recent surveys show that a significant number of farm families are virtually landless.
- Lack of secure tenure, particularly in the rangelands which have historically been a main source of sustenance for the small ruminant livestock that are the mainstay of agricultural income in the LRAs. Nationalization of these lands by governments after World War II, together with measures to resettle tribal nomads, have created a vacuum of responsibility for the sustainable management of the resource which the states have not been able to fill. This has been a disincentive to private investment in range conservation and technological change, and opened the way to mechanized cultivation of the range and to escalation of animal numbers on the remaining steppe grazings. A further obstacle facing land-scarce people is lack of collateral for loans to acquire land or for other means of adding to their income, such as planting olive trees or cottage industries.
- Low agricultural productivity due to low and unstable rainfall, lack of appropriate technology, uncertain property rights, and reluctance of small farmers to put their families at risk by investing in unfamiliar crops or production inputs.
- Losses of crops and livestock from drought. In Morocco 25 percent of the cattle and 30 percent of the sheep perished or were sold prematurely in the 1981-82 droughts, in Syria 2.5

million sheep (25 to 30 percent of the national flock) were lost in the 1983-84 droughts (Oram, 1997). Cereal crop yields have been cut by 50 percent during droughts in several countries; in Iraq there was almost a complete failure, both of crops and of range vegetation, in 1983 (Adary, 1997).

The impact of drought is especially severe on small livestock owners whose animals are often their only source of savings as well as of income. Larger flockmasters, especially those with arable land may be able to store forage from good years to tide them over, as well as to buy supplementary feed if necessary. They are also better equipped with trucks, water tankers and farm machinery, and can move stock around to avoid drought and search out better grazings, or to market animals before they lose condition or die. Small farmers may lose everything and become destitute.

- Difficulties of supporting large nuclear families on small farms. Population in the region is growing at over 2 percent per year, and life expectancy is increasing. Despite a decline in the share of agricultural population in the total population from 58.5 percent in 1960 to only 24.9 percent in 1995, the number of people in the sector has risen by 2.2 million over that period (FAO, 1996). One result has been a massive exodus of adult males from small farms to seek work on other farms, in urban areas, or in other countries.
- Governments have largely neglected investment in the LRAs, compared to the higher rainfall and irrigated regions: both with respect to infrastructure and to research/
- extension. Given the remoteness of many rural communities in these areas and the lack of social amenities there, the improvement of basic local services and access to markets may be one of the most important steps that governments could take to improve the lot of the poor, and especially that of women.
- Inequality of opportunity within farm households, especially with respect to women. Women play a particularly important role in care of livestock, but do not necessarily reap an equal share of the returns: they generally have lower levels of literacy and poorer health care than men, and in many outlying villages are forced to spend much of their time collecting fuel-wood and water. When male heads of households leave for work elsewhere the burden on their wives may increase. Women suffer more than men from lack of education,

inexperience in commercial dealings, and limited access to extension and credit; but both sexes suffer in seeking job opportunities elsewhere from the lack of investment in education in those areas.

ENVIRONMENTAL DEGRADATION

It is now widely believed that environmental degradation in the LRAs has increased progressively over the last 50 years, to the point of crisis. A recent World Bank study estimates that rangeland area in the Maghreb countries has decreased by about 10-13 percent since the mid-1970's, and that less than 20 percent of the total remaining is considered to be in satisfactory condition (World Bank, 1995). The contribution of natural grazings to animal feed supply has declined in many countries, increasing the need for grain supplements and resulting in dietary imbalances (Nordblom and Shomo, 1995). Wind erosion and loss of seedbanks are particularly grave symptoms in the steppe: water erosion and runoff from watersheds cause serious downstream externalities. The latter include siltation of dams, reduced stream flows, lower recharge of groundwater tables, flash-floods in *wadis*, and pollution of drinking water.

The major causes of degradation are:

- Small ruminant numbers have approximately doubled since 1950 despite a significant shrinkage of the total range area, reflecting strong pressures of demand for red meat, high tariff protection and price distortions, subsidized supplementary feed; and, in West Asia lucrative livestock export markets.
- Encroachment of mechanized barley production on to the steppe for livestock feed; expansion of continuous barley with elimination of fallow and no added fertilizer, thus mining soil fertility, creating crop disease hazards, and exacerbating wind erosion.
- Urbanization, road construction, and a considerable expansion of drought-tolerant tree area has put further pressures on rangelands.
- Fuelwood collection from steppe and upland grazings, as a primary fuel source for heating and cooking: annual wood consumption per family in Morocco being estimated at over 4 tons.
- Lack of appropriate technology for sustainable range management in a situation where private investment is discouraged by lack of secure land rights, and traditional

conservative nomadic systems of animal husbandry have largely been abandoned.

- Invasion of the grazing areas by trucks and water tankers, causing damage from wheel traffic; and enabling graziers to keep animals on the range for longer periods than in the past, with supplementary feed X even in drought years.
- Damage to natural vegetation from overgrazing, and erosion from mechanical cultivation interact with drought to create a downward spiral of degradation which raises the risks from future droughts.

An important question is why farmers pursue these practices when the resultant resource degradation may be costly to themselves and their families. The driving factors include several of those that contribute to low productivity growth and poverty. They fall into four categories:

1. Sectoral and national policies which encourage extension of mechanized cereal cultivation into fragile low rainfall soils these include producer subsidies on cereal prices and inputs, consumer subsidies on bread, and subsidized fuel prices;
2. Policies which provide incentives to farmers to keep more animals on the range for longer periods: cheap fuel and credit for trucks and water tankers; untargeted subsidies for feed distributed on a per animal basis under drought relief programs; tariff protection of imported meat, and encouragement of exports of live animals to neighboring countries.
3. Inadequate property rights and outdated legislation which discourage investments in land improvements and technological change, and open the rangelands to uncontrolled abuse by inappropriate cultivation and livestock mismanagement.
4. Population pressure, and skewed distribution of land within the LRAs, leading to impoverishment and inability of small farmers to adopt sustainable crop and livestock practices or to maintain enough animals to meet their family income needs.

LINKS BETWEEN AGRICULTURAL PRODUCTIVITY, POVERTY AND THE ENVIRONMENT

Normally, one expects to find a high degree of complementarity in less-favored lands between the goals of agricultural growth, poverty alleviation and the sustainable management of natural resources. However, the pattern of agricultural growth in recent decades in the

LRAs of WANA has worsened poverty and environmental degradation. Moreover, while the poor have been negatively impacted by environmental degradation, they have not been the major cause of that degradation.

To elaborate on these linkages more fully, it may be useful to summarize the issues in the form of key hypotheses for discussion at this Conference.

Hypothesis I: Agricultural growth in the LRAs has been of greater benefit to large farmers and herders than to small farmers and herders. This results from a set of policy and property rights interventions, and agricultural research priorities that are biased in favor of larger farms and herders and of more capital intensive production systems.

Several government policies have favored large flock sizes (e.g., feed and sheep subsidies) and highly mechanized farming (e.g., credit and fuel subsidies), encouraging excessive consolidation of land by the few, and excessive displacement of labor by machines in farming practices. Poorly defined ownership rights over the range, and ineffective regulation of nationalized grazing areas, have contributed to the loss of traditional access rights for many small herders, particularly nomadic and transhumant groups, reducing or eliminating an important source of feed for their flocks. Similarly, policies that encourage excessive mechanization have contributed to crop encroachment on the steppe, which in turn has led to increasing privatization of land and loss of access by many of the poorer herders. Agricultural research and extension has been underfunded, and has focused principally on the problems of farms that rely on subsidized mechanization and subsidized feeds, thus inadvertently contributing to a large farm bias.

Hypothesis II: Environmental degradation in the LRAs is driven more by inappropriate policies and insecure property rights than by poverty.

By distorting economic incentives in favor of barley and sheep production, and encouraging excessive mechanization, government policies have encouraged farmers to keep too many livestock in the LRAs, and have increased their dependence on supplementary feeds and water trucked in from higher rainfall areas. This has led to excessive stocking rates on the steppe, and to year-round grazing that is particularly destructive to the indigenous species of forage plants, and induces soil erosion. Drought assistance programs that rely on feed and sheep subsidies add to the problem because farmers no longer have the incentive to reduce flock sizes in drought years, which traditionally provided a natural check on the growth of stocking rates. These same

policies have also encouraged farmers to plow up rangeland for continuous barley production, which is leading to pest and disease buildup and to soil erosion. The problems are exacerbated by property rights systems that encourage plowing as a way to assert land rights, and discourage proper management or improvement of the range.

If these hypotheses are correct, then continued agricultural growth in the LRAs without major changes in policy and property rights systems seems destined to lead to worsening poverty and environmental degradation, possibly to the point where the entire farming system collapses. A major realignment of government policies to achieve a different type of agricultural growth is urgently needed; one that is efficient and not dependent on government subsidies, that is beneficial to the poor and is environmentally sustainable.

There are seven pillars to the needed strategy.

First, to correct policies that distort economic incentives and encourage farmers to over-stock and over-cultivate the range, and to pursue excessively capital intensive production practices. Ongoing structural adjustment programs and market liberalization polices should help, although additional attention may be needed to modify drought relief programs so that they do not inadvertently encourage farmers to over-stock the steppe.

Second, to correct property rights problems and empower local herders to promote better management of grazing on the steppe, and investments in improving and rehabilitating rangeland.

Third, to redirect agricultural research and extension towards the problems of smaller farmers and herders, assuming that appropriately modified policies and property rights will make supplementary feeds and mechanization relatively more expensive, and will increase farmers= concern about environmental sustainability. This will require higher priority to integrating social and biological research so as to improve understanding of the complex linkages and tradeoffs between growth, poverty alleviation, and the environment, and to target research and extension more effectively to productive but less exploitive low rainfall land use systems linking crops, livestock, and markets across ecozones. Opportunities for increasing farm incomes through planting drought tolerant tree crops appear promising, but will require improved tenure, better access to credit, and technical support for their successful adoption by small farmers.

Fourth, to invest more in rural infrastructure, and to improve access to credit, marketing and input services for small farmers.

Fifth, to strengthen livestock markets, particularly for live animal transactions across ecozones. Current practices of slaughtering young range-reared sheep at very low weights are extremely wasteful, and *in situ* fattening depends on use of subsidized feedgrains trucked into the LRAs. Removal of price protection and feed subsidies should encourage greater fattening off the range.

Sixth, to invest more in the education and health of poor people to increase their opportunities for self-advancement, either through better farming (including diversification into high-value crops like olives), migration to jobs in other regions, or development of local nonfarm activities.

Seventh, to the extent that the above strategies do not fully resolve problems of continuing degradation of the steppe and soil erosion in cropped areas, to introduce appropriate regulations and taxes on the misuse of natural resources in the LRAs, and targeted subsidies to encourage investment in sustainable resource management by farmers and communities when important off-site environmental costs will otherwise be incurred.

If the above strategies were followed, significant changes in the farming systems of the LRAs should occur. Use of feedgrains to supplement grazing would become less profitable, and there would be a shift towards more extensive livestock production systems with increased dependence on the range as a source of forage, but at lower stocking rates. This might lead to a sharp reduction in fattening in the LRAs, with weaned lambs being sold to farmers in higher rainfall areas for finishing. With lower stocking rates and improved control of grazing, the value of range production would increase relative to plowing for barley, while the costs of the latter would become more expensive. This should lead to a decline in plowing of the steppe for barley production, and increased investment in rangeland improvements. Better endowed cropland in the landscape (e.g., *wadis*) would also become more valuable for feed and forage production, and farmers might find it economically worthwhile to invest in improving these resources, (e.g., through water harvesting, small scale irrigation, reseeding, phosphate application, and fencing.

Economically, there would be a decline in the total value of agricultural production produced in the LRAs. However, with the shift to more extensive farming practices, costs should also decline and the net impact on farm income (ignoring the value of subsidies lost) might still be positive. Since large subsidies would no longer be required to sustain unprofitable activities there would be substantial financial savings to government. These savings could be used for other purposes, such as

direct assistance to the poor through the kind of investments in LRAs mentioned above. Small farmers and herders would benefit more under the new system, and the environment would be improved rather than further degraded.

Given their difficult agroclimatic conditions and scarce water, the potential for continuously raising agricultural productivity in the LRAs is limited. Therefore in the longer term, the number of people dependent on agriculture in these regions must diminish, otherwise per capita incomes will stagnate and fall further behind the rest of the eceonomy. There may be possibilities for diversifying the regional economy in the LRAs to increase nonfarm sources of income. But reduced population growth and out-migration will also need to play important roles. Both require increased investments in rural people in order to enhance their opportunities for self advancement. Both also require time. For these reasons, governments must play an active role in managing the transition problems of the LRAs.

REFERENCES

Adary, Adnan. 1996. Drought Management in the Jazeera of Northern Iraq. Contribution to M&M Project. Baghdad, IPA Agricultural Research Center, P.O. Box 39094. Abu-Gharib.

FAO. 1996. Production Yearbook, Vol. 50. Rome Food and Agriculture Organization of the United Nations.

Nordblom, T. and F. Shomo. 1995. Food and Feed Prospects to 2020 in the West Asia/North Africa Region. ICARDA Social Science Paper No. 2. Aleppo. International Center for Agricultural Research in the Dry Areas.

Ngaido T., Nordblom, T., Gintzburger, G. and A. Osman. 1996. From Nomads to Rangelands. Proc. IFAD/MEPA/MAW International Workshop on Sustainable Use of Rangelands and Desertification Control. Jeddah, Saudi Arabia.

Oram, P. 1997. The Influence of Government Policies on Livestock Production and the Environment in West Asia and North Africa. Proceedings from the FAO/World Bank/IAC International Conference on Livestock and the Environment, Ede-Wageningen, The Netherlands.

World Bank. 1992. *World Development Report: Development and the Environment.* Chapter 1, Table 1.1. Washington D.C.: The World Bank.

World Bank. 1995. *North Africa and Iran. Rangelands Development in Arid and Semi-arid Areas: Strategies and Policies.* Main Report. No. 14927 MNA/ November 1995. Washington, D.C.: The World Bank.

IMPACT OF MARKET REFORMS ON THE LOW RAINFALL AREAS IN WEST ASIA AND NORTH AFRICA

Nabil Chaherli, IFPRI-ICARDA

with contributions from the M&M Project Teams and, in particular:
Mohamed Bendaoud, CRRA, Morocco
Mohamed Moussaoui, ENAM, Morocco
Lassaad Lachaal, INRAT, Tunisia
Boubaker Thabet, INAT, Tunisia
Laiech Mahfoudhi, INAT, Tunisia
Amer Jabarin, UOJ, Jordan
Tom Nordblom, ICARDA, Syria

ABSTRACT

This paper summarizes results obtained from research activities conducted in the Mashreq/Maghreb Project (M&M). The specific objective is to look at the impact of market liberalization in the context of structural adjustment at the sector and the community level, with particular emphasis on barley and sheep production in the low rainfall (or low potential) areas (LRAs) and the possible effect on incomes, resource management, and technology adoption. The paper provides a descriptive analysis of structural adjustment programs in the region and presents results from multi-market and community model simulations for selected WANA countries.

A comparison is made between Tunisia and Jordan on the basis of price policy changes in the crop and livestock sectors. Results from multi-market models show that market liberalization has a substantial impact on incomes, production and consumption in the LRAs. However, the impact seems to be less severe in Tunisia than in Jordan because of potential income generating alternatives to the traditional crop and livestock activities. The impact on imports is particularly important and more so for livestock products than for wheat and barley.

At the community level, simulations were made on the impact of trade reforms such as changes in tariff structures for key crop and livestock commodities. Results show that market liberalization generates an important trade-off between income growth and income distribution. When substantial income increases are obtained at the community level, price policy changes tend to also generate a less equitable revenue

distribution between farm types. To ensure that they benefit from the new liberalized environment, it is particularly important to establish direct income transfers to those farmers with limited potential.

THE NEED FOR POLICY RESEARCH

Policy research in WANA is justified on grounds that the current situation of the agricultural sector in countries of the region is difficult. Rising populations, expanding gaps between food consumption and production (filled by greater dependence on import markets), and perceived acceleration of resource degradation in the LRAs have alerted many to the need for policy review. There is a real need to identify and analyze alternative national and even regional policies for meeting food needs on a sustainable basis and for sounder management of natural resources. In order to make full use of this analysis, research results have to be made available to those in positions to apply or use them. There is a need to strengthen institutions conducting research on agriculture policies (e.g., NARS), as well as those in a position to apply such results (ministries, local government agencies, NGOs, etc.). The combination of appropriate policies and improved agricultural technologies can make it possible to achieve the goals of sustainable improvement in the productivity of agriculture, as well as diversification and substantial increases in rural incomes (IFPRI, 1996). This is why policy research is vital. Not only can it maximize positive impacts on human welfare of technological innovations in crop and livestock production, and water and rangeland resource management, but it also has the potential to provide solutions to some of the broader problems confronting the region, such as poverty reduction, improvement of human nutrition, and sustainable development of the dry areas.

The eight WANA countries have pursued various mineral or industry-led growth strategies; a service and light manufacturing based economic development, emphasis on import substitution, or a combination of these strategies. Government participation and involvement in production and distribution activities is a feature found in all WANA countries. Though the dominance of the State ranges from the most radical intervention to a less substantial role, the impact has been widely felt in all sectors of economic activity and, in particular, by agriculture because of its strategic nature. Government involvement has been expressed in diverse forms: ownership of enterprises, price controls, import and export controls, market regulation, and the planning of production, distribution, and consumption of goods.

Implementation of recent economic and market reforms in WANA countries such as Morocco, Tunisia, Algeria, Jordan and Syria has suffered from a lack of understanding of how different approaches to reform affect food security, rural welfare, and poverty. As a result, market liberalization or even limited output and input price reforms have not been as effective as hoped, particularly for the poorer low rainfall segments of agriculture. Quantitative policy information related to rural development with a focus on human welfare and natural resource management is especially needed during times of economic transition, (for example from centrally planned to market economies) when the options and impacts are often not clear or well understood. Limited or inadequate knowledge about the effect of economic transitions can have a negative impact on how new agricultural technologies are obtained and used.

Agricultural policy in WANA countries has now entered a phase where fundamental market reforms and changes in income support policies are necessary. It is important for policy-makers to gather reliable information on the impact of GATT on agricultural trade when coupled with structural adjustment. The transition from a planned agricultural sector to a dynamic agro-food system closely integrated within a global and open market economy involves a complex process of institutional, structural, and behavioral change not only for the private sector but also for the governments. WANA countries have moved along this transition at different paces and to different degrees. This paper will examine these early reform measures in a comparative perspective, with particular interest in identifying how economic liberalization is conducted and how it affects the low potential areas associated with rainfed agriculture, the LRAs.

The above list of problems faced by rainfed agriculture provided the motivation to undertake a historical and cross-country comparative analysis of the impact of current and future market reform policies on the feed-livestock sector in a macro and micro context. The main focus of this paper is on domestic input/output price reforms and trade policy. Though other aspects related to investment, infrastructure, and monetary and exchange rate management have an impact on agriculture, the emphasis here will be on measures related to subsidies, taxes and tariffs. The specific objective is to look at the impact of market liberalization on barley and sheep production in the low rainfall or more specifically the low potential areas, and its possible effect on incomes, resource management and technology adoption. Section I provides a descriptive analysis of structural adjustment programs in the region while Section II

presents results of multi-market and community model simulations for selected WANA countries.

MARKET REFORMS IN WANA

What have we learned from structural adjustment in the region and what are the implications for the future? Can we substantiate the claim that the LRAs will be hit disproportionately harder than other eco-zones as a result of policy reforms? In order to address these questions, a description of the policy reforms is required. This description starts with the past and current economic context of a sub-group from the eight WANA countries that have initiated and/or implemented market liberalization. Countries in this sub-group include Morocco, Tunisia, Algeria, and Jordan. The other four countries have started reforming their agricultural sectors but within less ambitious structural adjustment packages.

PRE-REFORM ANALYSIS

In order to understand the financial and economic environment in which structural adjustment was implemented, as well as the determinants of the new policy in the reform-group, it is important to review the broad lines of economic policy making that prevailed before the adoption of the reform packages. For most WANA countries, balance of payment and large budget deficit problems required improving the efficiency of the institutions despite externally generated shocks (e.g., second oil shock, drop in phosphate prices, rise in the value of the dollar, and high interest rates). Reliance on foreign debt increased year after year and its service drained the Treasuries even further. Reserves in foreign currencies reached a low point when they covered import costs for only two weeks. This led inevitably to drastic restrictions in imports and major cuts in public spending. That situation can be characterized by: (1) excessive borrowing by inefficient State-owned-enterprises, and (2) discrimination against traded and exportable goods. Agricultural price policies were designed with the following objectives to:

- provide food for low income urban populations at affordable prices;
- set prices at a level that would provide just enough incentive for farmers to produce;
- maintain farm income at socially acceptable levels;
- increase farm productivity and production with input subsidies;

- protect consumers and producers from the adverse effects of high international price volatility; and
- accommodate changes in consumer demand by developing the marketing system.

In order to maintain a competitive edge and promote exports, governments put significant emphasis on the relation between labor costs, producer prices, and consumer prices. Though efforts were made to maintain consumer prices at a Asocially≅ acceptable level, the State tried also to secure profit margins that would encourage farmers to increase production and yields. Direct government intervention in agricultural marketing involved either setting low prices or defining quantities that must be sold to para-statals, and fixing producer prices at a level judged sufficient to achieve desired levels of production, while keeping retail prices at relatively low levels. Differences between low retail prices and producer prices were met through high financial transfers to processors and wholesalers.

State intervention in the region ranges in strictness from situations where the government fixes retail, wholesale and farm prices to a milder role where the governments permit various forms of private markets. In the latter category, prices for some commodities produced in the LRAs are set by the free market (e.g., pulses, lamb meat, and forage). For commodities where prices have been set at different layers of the marketing system (farm, wholesale, processing, or retail), this has generated a complex, inefficient, burdensome, and costly system of government transfers to compensate some segments of the product channel often without any real justification and/or need.

On the input side, government intervention has been through price fixing, often at relatively low levels for fertilizer, feed concentrate, seed, irrigation water, and credit. Subsidies for inputs have taken different forms, levels, and, in some states, preferred beneficiaries, depending on the kind of economic system in place. In Algeria, socialist sector farms had direct access and priority to subsidized inputs. In Syria, factors of production were distributed to the farms that agreed to fulfill the State production requirements. In some countries cooperatives tend to have priority in input allocation, even when inputs were available through private markets. Discriminatory prices and preferential input allocations limited their accessibility to ordinary farmers, especially those in the LRAs.

The main features of a centrally controlled agricultural sector (particularly for Astrategic≅ commodities) were dictated by the need for government coordination through plans that distorted relative prices.

Prices for wheat, barley, livestock, milk, vegetable oils, etc., played an accounting role and, based on recommendations from the more specialized ministries, were set up in accordance with a central plan prepared under the auspices of the Planning Ministry. In this setting, implicit trade margins were often low and prices of final goods (e.g., flour, bread, meat and milk products) did not reflect differences in distribution costs. This high interventionism led to huge budget deficits, especially when mineral resources started to become scarce and when oil prices declined.

The need to re-orient agricultural policy in WANA arises from these problems of previous systems, whether within a centrally planned economy where farmers follow government plans in land allocation and crop choices, or a relatively liberal economy with strong government intervention in the agricultural sector on the pricing side. The next section discusses how this need materialized in some of the WANA countries.

AGRICULTURAL SECTOR ADJUSTMENT: MOTIVATIONS, RATIONALE AND OBJECTIVES

Agricultural Sector Adjustment Programs (ASAPs), have been designed in Morocco, Tunisia, Algeria, and Jordan in order to remedy the following problems (Thabet et al., 1992; Tyner and Arndt, 1996; World Bank, 1994, 1997):

1. A bias in favor of commodities produced under-irrigated rather than rainfed conditions, reflected by gaps in protection levels for the two types of commodities. For rainfed agriculture, prices were often set below world prices, leading to slow growth in production, a lack of incentives for technology adoption, and undercutting the subsidies given to inputs. Furthermore, access to those inputs was often limited in the LRAs;
2. Low levels of domestic production combined with high demand spurred by rapid population growth opened the way to costly imports (wheat, barley, meat, vegetable oils, and sugar);
3. The lack of competition in a sector burdened by state intervention through controlled or semi-administrated prices and quotas for the Astrategic≅ products leading to: (a) market distortions and rent generation, mainly benefiting some privileged individuals and (b) limited competitive behavior;
4. Direct subsidies for Astrategic≅ commodities (wheat, meat, milk, vegetable oils, and sugar) benefiting primarily the

medium- and high-income level groups and draining the government budget unsustainably.

ASAP have therefore been designed to stimulate production, increase efficiency in the sector, and remove the bottlenecks existing at different levels of the production and distribution processes. The market-led modernization of the agricultural sector and, in particular, rainfed agriculture required the implementation of a strategy based on the efficient use of resources and minimal government intervention by dismantling or transforming the para-statals and state agencies for the sake of sounder and more transparent financial management. With this major change in the role of para-statals products should circulate freely across regions. This free flow of goods across regions within a country leads to higher market integration and allows more efficient allocation of resources, not only across commodities but also among the different agro-ecological production systems (irrigated, favorable rainfed and low rainfall).

With the above strategy in mind, Morocco, Tunisia, and Jordan (and to a lesser extent Algeria with its Avoluntary≡ adjustment program) formulated their ASAPs with the following objectives:

- Major restructuring of public investment to favor short-term investments with high profitability levels, but without jeopardizing the financing of maintenance-related operations;
- Optimal allocation of resources supported by appropriate price-policy-induced incentives;
- Modification of the role played by the State by rationalizing its involvement in activities, where the private sector might provide more efficient management, and an increase in fees recovered for services still administered by the State;
- The development or the establishment of an agricultural policy analysis unit in the Ministry of Agriculture; and
- The establishment of a natural resource and environmental protection agency with close links to the Ministry of Agriculture.

IMPLEMENTATION AND IMPACT OF ASAP

THE RECORD OF ASAP IN THE REGION

Two important questions which need to be addressed are: (i) Has ASAP led to the liberalization of the agriculture sector with clear signs and effects of competition, and massive dismantlement of the State

production and distribution structure? (ii) Has it also induced a radical transformation in the rural economy and the emergence of an organized and efficient food and feed system in production, marketing, and consumption?

The next section examines the achievements and impact of the reform process, focusing on both the crop and livestock sectors, with particular emphasis on the commodities produced in the LRAs.

The implementation of ASAP in most countries has involved two stages. Stage one focused on domestic reforms and, in particular, the reshuffling of activities under state control, preparing the ground for deeper market reforms in stage two. The second stage has been based more on international trade reforms and market liberalization measures aimed at introducing more flexibility in the way goods are allocated between producers and consumers though market mechanisms. These two different, though related, stages coincided with the conditions associated with loans disbursed by the World Bank.

The Moroccan experience in structural adjustment was the most comprehensive of the three WANA countries with a full structural adjustment program for the agricultural sector. In the first phase (1985-87), the adjustment package included 61 measures, three of which were designated as necessary conditions for the first loan release, and five as necessary conditions to release the second loan (Moussaoui, 1996). All conditions mentioned above were met and prices were in some cases increased to even higher levels.

With preliminary measures satisfactorily implemented, both Morocco and Tunisia commenced deeper reforms in the late 80s. These packages involved new policies affecting production, marketing, and food consumption, which changed the relation between (1) domestic and world prices; (2) state, para-statals and private sector institutions; and (3) different operators at various levels of the marketing chain (Moussaoui, 1996; Thabet, 1996). The reforms implemented were:

- Liberalization of the fertilizer market by freeing imports, removing subsidies and marketing controls, and allowing private operators to handle the market;
- The use of world prices as reference prices and liberalization of food/feed imports instead of the quantitative restriction policies followed by para-statals, ministries, or affiliated agencies;
- Liberalization of the grain sector from production to distribution (for wheat, maize, and barley);

- Liberalization of agro-industrial products (mainly sugar, vegetable oils, and flour);
- Liberalization of the marketing process for animal feeds;
- Liberalization of the milk sector;
- Privatization of animal health services;
- Revision of investment codes for the agricultural sector and, in particular, those directed to the non-irrigated sub-sector (Arainfed agriculture≅) and a revision of the types of state intervention in rainfed zones (as opposed to irrigated lands); and
- Removal of consumption subsidies for some goods and limits on some others (e.g., bread) and establishment of compensation schemes for the poorest segment of the population affected by staple food price increases (DPAE, 1997; Thabet, 1996).

INDIVIDUAL NATIONAL EXPERIENCES WITH ASAP

MOROCCO

The way public structures handled their relations with other operators in the sector changed substantially. The State released some activities to the private sector and started charging users for the services provided (e.g., animal health) or increased existing charges (e.g., water). Important accomplishments were made in the irrigated sector where farmers were given freedom to farm without having to abide by plans dictated by the Ministry of Agriculture.

Trade in agricultural products has been extensively liberalized for both exports and imports with the exception of some strategic products. At this level Morocco opted for some protection measures in conformity with new World Trade Organization (WTO) rules. Products such as sugar, vegetable oils, milk, meat, and cereals are now freely traded but with high protective tariffs. It has proved particularly difficult to liberalize the wheat sector given the powerful interests involved.

On the domestic side, though some progress has been made, the liberalization process has been relatively slow. A new law reorganizing the market structure in grains has yet to be implemented, and is being contested from all sides (farmers, millers, bakers, etc.). A similar situation prevails for the seed sector (Tyner and Arndt, 1996).

Producer prices, for durum wheat, barley, corn, rice and milk, sugar beet pulp and bran, are no longer controlled and fixed; however, price control continues on bread wheat, cotton, sugar, and vegetable oils.

(Moussaoui, 1996). The situation on the consumer side is analogous; prices of "high quality" flour, sugar, and oils are still controlled and in some cases subsidized.

On the input side most prices have been liberalized with subsidies reduced and to be finally removed completely. Seeds, fertilizers, pesticides, and machinery are no longer subsidized or price controlled. Water charges have increased substantially, reducing the burden covered for many years through the government budget.

However, a new strategy is emerging in government support. So far, subsidies have been geared more towards small farm investment financing than particular inputs or outputs. A new form of financial aid from the State is apparent in rural areas. To be eligible the beneficiaries financial resources have to be directed towards agricultural equipment, land and water use improvements, genetic improvements, storage, conservation, or other defined activities (World Bank, 1997).

TUNISIA

Reforms have been undertaken since 1989 supported by two World Bank loans, as in Morocco. There has been substantial progress with the removal of input subsidies for fertilizers, animal feed, pesticides and herbicides, seed, irrigation, and mechanized services. However, measures related to the reduction of price supports and deregulation of state-run marketing monopolies and farm extension services are only being implemented slowly.

Progress towards reducing State intervention in the food marketing system has been very slow. For wheat, private imports have been allowed, but the dominance of the State marketing board, the "Office des Cereales" (OC), remains strong. Given the size of OC's operations and its storage facilities, it is difficult for private operators to compete with the state agency. The State also intervenes, through price support to domestic producers via OC, by offering prices that are 30-40 percent higher than international prices. Meat and milk imports were liberalized in 1990/91 but subsidized sales by State-owned-enterprises have made it very difficult for the private sector to gain any market share (World Bank, 1995).

Thus, there is a need to reassess progress made in agricultural policy reforms and especially those reforms related to price supports and credit subsidies to cereal production. It has even been suggested that price supports and subsidies should be replaced by direct income support to those cereal farmers producing with very low yields in marginal lands.

Given the relatively new experience with structural adjustment, it is still premature to evaluate progress. Discussions are currently being held on how best to efficiently implement domestic and international reforms. The projected policy reforms under ASAP (CATAD, 1996) that are most relevant to the LRAs are to: 1) eliminate livestock feed price subsidies and adopt a plan for withdrawal of the public sector from barley trade; 2) eliminate the procurement subsidy on domestically produced cereals; 3) eliminate import restrictions for agricultural production; 4) implement a new pesticide regulatory framework; 5) adopt and implement revised regulations for rangeland use and access; 6) eliminate the public sector monopoly on mutton/lamb slaughter; and, 7) remove controls on price and margins of major fresh and processed agricultural commodities.

A QUANTITATIVE ASSESSMENT OF THE IMPACT OF MARKET LIBERALIZATION ON THE LRAs

MULTI-MARKET MODELING: METHODS

The tool selected to analyze the impact of market liberalization on the LRAs of WANA in the context of structural adjustment is commonly referred to as a multi-market modeling framework. This approach extends the partial equilibrium analysis where the impact of policy instruments is measured with respect to a single commodity to an analysis where interactions among markets on the output, as well as the input side, are explicitly recognized (Braverman et al. 1987). It allows: (1) the dis-aggregation of a country into several regions, provinces, farming systems, or consumer groups; (2) explicit substitution and complementarily relations between outputs on the production side and the consumption side; and (3) the identification of economic and technical relations between outputs and their related factors of production (Sadoulet and de Janvry, 1995). It is also possible to trace the impact of particular price and non-price policies and reforms or shocks on production, consumption, and incomes by region and government revenues and expenditures.

The different output producing regions constitute the basic units of the model (Table 1). Each country was divided into low (LRA), intermediate, and high rainfall areas (HRA). This distinction is more than just a geographical characterization: these zones are different in terms of socio-economic characteristics. While the HRA is a potentially favored area when it comes to economic opportunities, the LRA is limited with regard to the crops that can be produced and the type of

activities that can be undertaken. The provinces or governorates in the LRA rely primarily on barley and livestock for their livelihood, while the HRA draws its agricultural income from vegetables, fruit trees and horticultural products in addition to cereals. Because the focus of this research is on the LRA, no attempts have been made to introduce HRA-specific commodities. On the demand side, the distinction is usually made between rural and urban zones to reflect different consumption patterns. When this distinction is not warranted, a national demand is considered. There are tradable commodities (wheat, barley, and lamb) and non-tradable goods (e.g., cheese in Jordan; pastures, forage, and sheep in Tunisia) in the country models. For a non-tradable commodity, the balance between demand and supply determines the equilibrium price and quantity. On the other hand, for a tradable commodity, the equilibrium between demand and supply is obtained through quantity adjustments with prices being the exogenous border prices corrected by the relevant trade distortions (taxes, tariffs and subsidies).

The small country assumption is used in this analytical framework. Most WANA countries face an infinitely elastic demand and imports could be supplied in unlimited amounts. Various policy scenarios are presented as alternative packages in the market liberalization scheme and evaluated with respect to a baseline scenario. This baseline represents the government strategy for a base year chosen differently for the countries included in the study (more details on the specific features can be found in Lachaal et al., 1997; Jabarin and Chaherli, 1997; and Moussaoui et al., 1997). The policy options investigated fall into three major packages:

Package 1: Removal or reduction of feed subsidy. This package is used to analyze the importance of the feed subsidy policy instrument for the low rainfall economy;

Package 2: Alignment of domestic prices on international prices through reduction in price support and/or tariffs (along with GATT support reduction measures);

Package 3: combined reduction or elimination of producer and consumer price support depending on the commodity (along with ASAP measures). For Tunisia, three different scenarios for this package are considered. Scenario 1 is the standard scenario with reduction in consumer price subsidies. Scenario 2 has a further reduction in producer price, while Scenario 3 looks at a situation with no gap between barley user price and the world price.

MULTI-MARKET MODELING: RESULTS FOR TUNISIA AND JORDAN[6]

The specific price changes for each package and country are reported in Tables 2 and 3. While numerous outputs from multi-market models have been generated, the comparative analysis in this paper emphasizes key outcomes from the policy simulations. These results are presented in Tables 4 and 5.

SPECIFIC IMPACTS

Agricultural income. The magnitude of the overall impact of the different market liberalization packages on the LRA tends to be country specific. While reduction in price support and feed subsidy removal has a substantial impact in Jordan (reduction in income between 8 percent and 21 percent), similar policy reforms in Tunisia lead to a drop in profits ranging between 2 percent and 10 percent. One explanation is the possible substitution effects arising from alternative agricultural opportunities such as olive production in the LRAs of Tunisia.

Sheep population. The removal of feed subsidies has a relatively limited impact on sheep population and livestock production and differs with the country. An increase of 25 percent in costs of production lead to a decrease of less than 1 percent in livestock production and stock of animals in the LRAs in Tunisia, and a drop in sheep meat of 8 percent in Jordan. While inter-regional permanent and temporary migration patterns are expected to occur in Tunisia (from the LRA to the rest of the country but not to the HRA), feed subsidy removal in Jordan tends to be followed by higher flows of live animals and meat from outside the country.

Feed from non-LRA sources. Removal of feed subsidies may encourage movements of feed from the HRA to the LRA as farmers try to find opportunities for substitution between forage and barley. However, with a substantial reduction in price support to crop and livestock production, demand for forage tends to fall because of the shift away from sheep related activities. In Tunisia, for example, demand for forage is expected to fall by 1 percent to 2 percent.

Employment and input use. Given the low elasticities of inputs in the short run, demand for labor, fertilizer, and capital tends to be moderately affected by the reduction of producer support. In relative terms, labor is likely to be the most responsive factor of production with an increase in

[6] This section draws from joint research conducted by Lachaal-Thabet-Mahfoudhi in Tunisia, Jabarin in Jordan and Chaherli based on prototypes developed in the M&M Project.

out-migration from the LRA. Even so, the different policy packages yield a reduction of under 1 percent in labor needs for agricultural activities in Tunisia.

Prices of non-tradable commodities. Market liberalization tends to put a downward pressure on non-tradable prices for sheep, forage, pasture output, whereas cheese prices may rise. In Tunisia, reduction of price support for wheat, beef, and barley (Package 2) induces a decrease of 11 percent to 18 percent in sheep and forage prices, while in Jordan prices of cheese go up by 13 percent. The removal of barley subsidies alone (Package 1) affects non-tradables substantially in Jordan (+17 percent for cheese prices), but less so in Tunisia (-3 percent for sheep prices).

Consumption. There are important changes in consumption patterns arising from changes in relative prices in Jordan. When income and price effects are jointly considered, meat consumption in the urban areas could rise substantially (+37 percent) due to the lower taxation on meat and lower subsidies on wheat (Package 3). Consumption of cheese in urban areas is expected to drop (-36 percent) because of substitution effects. In the LRA different changes emerge as a result of substantial declines in incomes (-21.9 percent) with consumption of cereals and meat going down (-7 percent and -44 percent respectively) and cheese increasing by 44 percent. In Tunisia, national demand tends to be less responsive to changes in prices, given the low contribution of agricultural profits to national income. Overall, total changes in final demand goods are less than 5 percent.

Trade. The impact of feed subsidy removal and output price support reduction is particularly substantial on the trade balance. The various policy packages tend to yield rather different outcomes in terms of import and export magnitude changes. In Jordan, the feed subsidy removal alone increases lamb imports by 10 percent but reduces barley imports by 12 percent while keeping wheat imports unaffected. In Tunisia, more expensive barley at the user level generates a reduction in crop and livestock imports by 3 percent to 5 percent.

The trade outlooks are quite different with general reductions in price support and consumer subsidies. The changes in relative prices push consumers to make substitutions in their demand schedule. These market reforms tend to favor consumption of livestock products over cereals and generate gaps between domestic supply and demand that need to be filled with imports. Lamb imports in Jordan may go up by more than 65 percent if producer prices are lowered and consumer subsidies are

reduced. In Tunisia, imports of beef increase by 10 percent to 50 percent with durum wheat imports going up by more than 40 percent.

Government budget and balance of trade. Market liberalization through price policy instruments generates substantial savings in absolute terms. The removal of feed subsidies, price support, and increased tariff proceeds on lamb imports has been calculated to be roughly in the order of JD 20.000.000 for Jordan. This amount could be channeled through direct income transfers to the poorest segments of the rural population in the LRA to compensate for the loss of JD 22.000.000 in reduced support for wheat, barley and livestock (preliminary figures from Jabarin and Chaherli, 1997).

Summary Of Results

1. The direct effect of market liberalization on the LRA through reductions in support and subsidies is a drop in agricultural income. This drop could largely be compensated by direct transfers from savings made (1) at the border from higher tariff proceeds on livestock imports and (2) from lower producer and consumer subsidies.
2. The LRAs in Jordan seem to be hit more negatively by the liberalization measures than in Tunisia. This might be due to the lack of alternatives to agricultural strategies based largely on livestock, whereas in Tunisia, there appear to be alternative possibilities for crops and livestock.
3. There are potential environmental benefits from market liberalization in Tunisia. With sheep migration from the LRA to the other regions of the country and lower forage prices, overgrazing on the rangeland could be reduced. The situation is different in Jordan where livestock have limited access to feed from the HRA. Reduction in feed subsidies might create even more pressure on the rangeland due to lack of alternative sources of feed other than barley. However, with the declining contribution of the LRA to total livestock needs in Jordan, and substitution by imports of live animals and meat, there is an ameliorating effect with respect to rangeland overuse.

Community Modeling: Methods

The objectives of this research component in the M&M Project are:

- to evaluate the effects of market liberalization and structural adjustment programs on selected communities in LRAs of WANA;
- to analyze effects on total community income;
- to identify, compare, and evaluate impacts of feed subsidy removal on the nature of the livestock feed mix;
- to analyze the effects of those adjustments on technology adoption, resource allocation, and crop mix.

In order to achieve these objectives, the M&M Project National Teams conducted surveys on farms located in Ait Ammar (Khouribga Province, Morocco), Naouayel (Sidi Bouzid Governorate, Tunisia), Falha (Amman Governorate, Jordan) and Jub Aljame' (Aleppo Province, Syria). These study areas have high spatial and temporal variability of crop and livestock outputs and input use, significantly related to annual rainfall irregularity. Diversity of farm structures and the complexity of farming systems also characterize these areas; complexity is related significantly to the existence of different land tenure systems and to fragmentation of holdings. This calls for a community focus. The strong links between the activities, through their competition for the inputs provided by the household and transfers among those activities, are magnified by the integration of livestock and cropping.

Data used were synthesized from household/community surveys in the different countries, for the base 1996/97 agricultural campaign. The models used are mathematical programming models, including the most significant features of profit-maximizing behavior for an average season, and also season-uncertainty and farmer response to such uncertainty. The models represent (a) rainfall variability and its effects on yields; (b) farmers' decision-making flexibility; (c) different levels of farmers' aversion to risk.

To allow the representation of such factors, models are based on the MOTAD or EV framework. This is to capture the effects of income risk from cash crop yield variability, and animal purchase and sale variability, and of cost risk from adjustments in livestock feed mix and purchases of feed concentrate on farm returns. The model objective function is to maximize for the whole community farm gross margins associated with crop and livestock activities and resource use across ecosytems. The maximization of the community objective function is achieved through selection of an optimal set of farm activities (land, labor and capital allocation). The activities draw upon the farmer's arable and rangeland resources, machinery and labor, and also feed availability. Included in the set of optimal activities are decisions about crop rotation, livestock

feeding, machinery, and labor use transactions. Seasonal variation is approximated by three to five ecoregions to distinguish between low, medium, and good rainfall.

A set of optimal farm plans was obtained by maximizing the expected total net revenues. Optimization was made subject to constraints relative to a probability of occurrence for each ecoregion. In each model, different product and input prices were considered, taking in account different scenarios of market liberalization and technology adoption. Crop activities in the model were based on cereals for grain and grazing, legumes, forages, trees and pastures. Also introduced in the Tunisian community was a set of irrigated activities (watermelons and tomatoes), since farmers in Naouayel have access to a nearby canal. Animal activities are based on different production technologies and marketing strategies for sheep. Pasture production levels and variability affect herder returns. Even though the rangeland contribution and its level of degradation are not easy to evaluate, an estimate has been made of the supplementary feed range access could provide.

COMMUNITY MODELING: RESULTS

Given the case specific nature of the community modeling economic analysis, the focus in this section is on results obtained from the Ouled Si M=hamed ben Aissa (OSIMBA) community in Western Morocco.[7] This community is used as a case study for the impact of market liberalization and technology adoption on resource use, poverty and income growth in the LRAs.[8]

The M&M Project Team in Morocco prepared a baseline for the OSIMBA Community. This will serve for future comparisons involving policy, property rights and technology adoption scenarios. The preliminary summary of results at the community level looks at the introduction of new technologies developed by the technical component of the M&M project in the context of trade liberalization with respect to grain and livestock price reforms. In particular, the analysis combines the availability of a new barley technology tested in the Ait Ammar region (Khouribga province, Morocco) with reduced tariff rates on wheat, barley, sheep and beef at the border level. These developments are evaluated with respect to potential changes in selected crop allocation patterns, livestock activities, labor allocation, resource use and income

[7] This section draws from joint research conducted by Bendaoud-Moussaoui-El Mzouri-Chaherli based on a prototype developed by Bendaoud-Boulanouar-Boughlala.

[8] More specific results on other WANA communities are presented in the reports of poster sessions at the Amman Conference.

levels and their variability. It is assumed in this analysis that price changes at the border have significant impacts on local prices. The analysis involved the whole community as well as specific farm types (see Table 6 for the farm-specific characteristics).

Crop production. There are important modifications in the land allocation patterns across farm types, with less soft wheat, more durum wheat and most importantly more barley with the introduction of the new M&M new technology. Barley assumes even more importance with a liberalized trade environment.

Livestock production. The increased barley productivity from M&M technologies has an important impact on livestock related activities for the small to medium size farms and also the large labor intensive ones practicing extensive livestock rearing. These two types of farms are able to increase their sheep flocks. However, with lower sheep prices, gross product value is lower for all but the small-to-medium size farms. There are also different feeding patterns with a higher use of stubble and lower quantities of straw, concentrates and barley. Large farms with large flocks tend to increase their use of the range, contrary to the other types.

Labor. With the new technology being introduced and lower prices for crops and livestock, larger farms with high levels of agricultural intensification tend to use more labor while small and small-to-medium size, farms have to rely more on off-farm income. The latter will hire labor only for seasonal tasks. The other two farm types do not appear to change their labor balance in response to the new production environment.

Income. The combination of technology adoption and price policy reforms has a positive impact on total and individual incomes. While the contribution from livestock decreases, it is the increase in crops gross product and the drop in feed costs that explain the substantial increase. Total community income goes up by 25 percent. However, this increase is not evenly distributed across farm types. While the poorest farms gain only 13 percent, the rich farms with extensive livestock activities are able to increase their income by 28 percent. Income for the more integrated crop-livestock farms increases by 17 percent. It is the small-to-medium size farms that tend to benefit the most from the situation, with the highest income growth (+30 percent). This uneven impact is reflected in the relatively small increase in the Gini Index (a measure of disparity in income distribution) from .25 to .26. It does not seem that the poor gets poorer and the rich gets richer in the context of market liberalization where better barley technologies are available. The type of production system and farm characteristics tend to be the more important

determinants of the benefits to be gained from more productive barley technologies with falling crop and livestock prices.

The common thread across farm types is increased income variability. The variance of income increases by 25 percent to 50 percent depending on the farm type. The highest increases are for large and medium-size farms with livestock activities more geared towards beef production. Farmers with livestock activities more oriented towards sheep tend to have more stable incomes. This is an important feature of the contribution of sheep in dryland systems. Farmers in the OSIMBA community tend to forgo potentially higher revenue levels of income for a more stable income. Because of high-risk aversion behavior, the more profitable activities are not necessarily chosen when stability of income is also considered.

Resource use. The introduction of more productive barley technologies tends to substantially increase the fallow area for small-to-medium size farms, large labor-intensive farms with extensive livestock production, and the medium agriculture-oriented farms. The slight reduction in fallow area came only from the large rich intensive farms and the small poor farms. Overall, the entire area registered as fallow increases. There is also lower recourse to the range as a source of feed due to increased crop residues. All farmers tend to reduce their use of the rangeland, with the exception of the large extensive farms with limited endowment in arable land to benefit from higher barley productivity where range use increases by 20 percent.

SUMMARY

These preliminary results for the OSIMBA community have important implications for agricultural sustainability, growth and poverty alleviation. The introduction of new M&M technologies in an environment characterized by a more liberal trade policy for grains and livestock has a positive impact on incomes at the community level as well as the farm level. More sustainable cropping patterns seem to emerge in the area as barley substitutes for wheat, fallow land increases, and rangeland use goes down without jeopardizing levels of crop returns.

Though the analysis requires investigation of further policy and technology scenarios, these preliminary results show the difficulty of reaching a positive outcome simultaneously on the three fronts. While positive impacts are obtained on the environment and growth front, there are some limitations with respect to equity. The poor farms have the lowest income growth while other farm types are able to achieve twice the increase in revenue levels. There is a clear need to design direct

income transfers so that the poorest segment of the rural population can benefit from improved crop and livestock technologies without being adversely affected by unfavorable output prices. In this case, poor farms represent 28 percent of the community population. The profile of the farm type with the lowest income increase shows that benefits from technology adoption and market liberalization are strongly correlated with initial resource endowments. With an average 2.6 ha of marginal land, a single nuclear family, limited labor force availability, low consumption levels, small flocks, high cash constraints, and very small grain and feed stocks, they have quasi-dependence on off-farm revenues for survival. This poor segment of the community was able nevertheless to increase its income with the introduction of new barley technologies. This shows that there are niches that could be explored if higher levels of growth are sought. One possibility for this segment of the population would be to provide access to financial resources not linked to initial land holdings or flock size.

The first hypothesis postulated by Pinstrup-Andersen, Oram, and Hazell (1997) for discussion at this conference, linking growth in the LRA to higher benefits for the larger farmers and herders, is supported by our research done at the community level. Even with less distortion in the pricing system, trade liberalization in the form of reduced tariffs combined with new barley technologies generates higher income increases for the more affluent segment of the Moroccan community studied. This hypothesis, however, finds mixed support when the impact is analyzed at the regional level. In Tunisia, for example, the decline in profits due to market liberalization is greater in the higher rainfall than in the LRAs, while in Jordan the situation is the opposite.

REFERENCES

Bendaoud, M., B. Boulanouar and M. Boughlala. 1997. A Whole-Farm Model for Economic Analysis of Crop-livestock Integrated Farming Systems: A Methodological Contribution. M&M Project Unpublished Manuscript.

Bendaoud, M, M. Moussaoui, H. El Mzouri and N. Chaherli. 1997. The Impact of Agricultural Price Policy Reforms in the Low Rainfall Areas: An Application to a Rural Community in Western Morocco. M&M Project Unpublished Report.

Braverman, A., J. S. Hammer and A. Gron. 1987. Multi-market Analysis of Agricultural Price Policies in an Operational Context: The Case of Cyprus. *The World Bank Economic Review* 1 (2): 337-356.

Center for Advanced Training in Agricultural and Rural Development (CATAD). 1996. A Qualitative Impact Monitoring of Agricultural Structural Adjustment in Jordan. Report published by Humboldt University Berlin, Amman/Berlin, December.

DPAE. 1997. Impact du Programme d'Ajustement Structurel sur le Developement du Secteur Agricole: Rapport Principal. MAMVA-FAO, May.

IFPRI. 1996. Medium-Term Plan, 1998-2000. Unpublished Draft Document, IFPRI, December 5.

Jabarin, A. and N. Chaherli. 1997. Multi-market Modeling in Jordan: Model Documentation. M&M Project, June.

Lachaal, L, B. Thabet, and L. Mahfoudhi. 1997. Multi-market Modeling in Tunisia: Model Documentation. M&M Project, July.

Moussaoui, M. 1996. The Impact of Structural Adjustment Measures on Prices and Incentives in the Agricultural Sector in Morocco. Draft manuscript from MAMVA-FAO Project.

Moussaoui, M., R. Doukkali, M. Bendaoud, and N. Chaherli. 1997. Multi-market Modeling in Morocco: Model Documentation. M&M Project, July.

Pinstrup-Andersen, P., P. Oram, and P. Hazell. 1997. Growth, Poverty

and the Environment in the Low Rainfall Areas of West Asia and North Africa. Paper prepared for the International Conference on Agricultural Growth, Sustainable Resource Management and Poverty Alleviation in the Low Rainfall Areas of West Asia and North Africa, Amman, Jordan, September 2-6, 1997.

Sadoulet, E. and A. de Janvry. 1995. Quantitative Development Policy Analysis, Ch. 11. Baltimore, Md., U.S.A.: Johns Hopkins University Press.

Thabet, B., M. Boughzala, and B. Ben Ammar. 1992. Agricultural and Food Policy in Tunisia. In *Cahiers Options Mediterraneennes, Vol. 4,* ed. M. Allaya, Montpellier-CIHEAM.CGE-DGI. Proceedings of the Workshop on Food and Agricultural Policies, held in Montpellier, Nov. 15-16, 1992.

Thabet, B. 1996. The New Role of Government in Agricultural and Food Policy in Tunisia. Unpublished Manuscript.

Tyner, W. E. and C. Arndt. 1996. Moroccan Policy Reform in Cereals, Sugar and Oilseeds. Associates for International Resources and Development, July.

World Bank. 1995. The Hashemite Kingdom of Jordan, Agriculture Sector Adjustment Operation. Report No. P-6382-JO, Nov. 15, Washington, D.C.

World Bank. 1995. Republic of Tunisia, Towards the 21st Century: Country Economic Memorandum, Vol. I, Main Report, No. 14375-TUN, October, Washington, D.C.

World Bank. 1997. Rural Development Strategy: Integrating the two Moroccos (1997-2010). Synthesis Report, Yellow Cover Draft, January 29, Washington, D.C.

Table 1: Multi-market modeling in WANA: Features and model specification

	Morocco	Tunisia	Jordan	Iraq
Wheat	T	T	T	T
Barley	T	T	T	T
Lamb	T	T	T	T
Beef	T	T		T
Milk	T		T	T
Forage	T	T		
Range		T		
Other		Olive		Pulses
Inputs	Fertilizers Seeds	Fertilizers Machinery Labor		
Social Groups	Urban Rural	National Demand	Urban Rural	Urban Rural
# of Regions	3	3	2	4

M&M National Collaborators:

Morocco: M. Moussaoui, R. Doukkali, M. Bendaoud;

Tunisia: L. Lachaal, B. Thabet, L. Mahfoudhi;

Jordan: A. Jabarin;

Iraq: K. Shideed

Table 2: Changes in price policy instruments for Tunisia

Commodity	Type	Package 1	Package 2	Package 3		
				Scenario 1	Scenario 2	Scenario 3
		(in % change)		(in % change)		
Durum	Producer		-10	-10	-13	-13
Barley	Producer		-10	-10	-13	-13
Beef	Producer		-10	-10	-13	-13
Olive	Producer				15	15
Durum	Consumer					
Barley	Consumer			-15	-15	-15
Beef	Consumer			-15	-15	-15
Olive	Consumer			5	5	5
Barley	User	25	12.5	12.5	8.75	-15

Table 3: Changes in price policy instruments for Jordan

Commodity	Type	Package 1	Package 2	Package 3
		(in % change)		
Barley	Producer		-7	-7
Lamb	Producer		-10	-10
Wheat	Producer		-8.5	-8.5
Barley	User	31.25	22	22
Wheat	Consumer			50
Lamb	Consumer			-25

Note: For Tables 2-3, the signs of the price changes should be interpreted with caution. A negative change on the producer side means that producers receive lower prices as a consequence of lower subsidies. For consumerS and users, a positive price change means that they have to pay higher prices as a result of lower subsidies.

Table 4: Results of policy simulations for Tunisia

	Baseline	Package 1	Package 2	Package 3		
				Scenario 1	Scenario 2	Scenario 3
		(in % change)		(in % change)		
LRA supply (in physical units)						
Durum	350,500	0.3	-1.2	-1.2	-6.8	-7
Barley	159,133	-0.3	1.5	1.5	1.6	1.8
Lamb	21,473	-0.2	0.6	0.6	1.5	1.7
Beef	11,270	0.6	2.3	2.3	-4.1	-4.6
Sheep	1,209,800	-0.3	1.5	1.5	1.7	2
Forage	76,585	-0.1	1.7	1.7	2.7	2.8
Range	194,593	0	0	0	0.4	0.5
Olive	44,436	0.2	4.8	4.8	2.2	2
LRA intermediate demand (in physical units)						
Barley	120,749	-1.7	-2.5	-2.5	-3.8	-2.1
Sheep	475,800	-0.7	0.3	0.3	-0.1	0.6
Forage	106,961	0.2	-1	-1	-2	-2.3
Range	199,824	0	-0.3	-0.3	-0.4	-0.3
Price of nontradable goods (in TD/unit)						
Sheep	40	-3.2	-11.6	-11.6	-1.5	1.6
Forage	150	0.7	-17.9	-17.9	-25	-25.7
Range	150	0.2	-15.7	-15.7	-20.4	-20.6
Import (in tons)						
Durum	70,869	-3	-3.9	-6.9	38.8	41.7
Barley	98,162	-5.2	-13.5	-13.4	-14.9	-10
Beef	6,158	-4.5	-18.8	10.2	49.4	53.6
Exports (in tons)						
Olive	60,727	0.7	12.1	14.6	9.8	9.1
Agricultural profits (TD)						
High	249,768,267.1	-1.3	-11	-11	-15.7	-14.5
Low	223,968,480.7	-2.4	-9.1	-9.1	-8.4	-6.1
Other	74,822,239.7	-5.7	-2.8	-2.8	5.8	11.2
Final demand (in tons)						
Durum	938,769	-0.1	-0.4	-0.6	-0.6	-0.5
Barley	37,914	0	-0.1	0.1	0.1	0.1
Lamb	49,871	-0.2	0.6	0.6	-0.3	-0.1
Beef	56,628	-0.1	-1.2	1.9	2.3	2.4
Olive	74,165	-0.1	-0.5	-2.6	-2.6	-2.5
LRA intermediate good balance			**(all numbers in physical units)**			
Barley	30,435.11	32,124	35,776	35,760	37,444	35,839
Sheep	734,000	733,988	750,645	750,645	755,524	755,536
Forage	-30,376	-30,692	-28,001	-28,001	-26,119	-25,818
Range	-5,231	-5,241	-4,586	-4,586	-3,697	-3,687
LRA input use (in physical units)						
Fertilizer	18,595	0	0	0	0.1	0.1
Capital	8,414,150	0	0	0	0.1	0.1
Labor	17,411,300	-0.1	-0.4	-0.4	-0.9	-0.8

Package 1 Feed Subsidy Removal (FSR)
Package 2 FSR + Price Support Reduction (PSR)
Package 3 FSR + PSR + Consumer Subsidy Reduction (CSR): see Table 1 for details of scenarios

Table 5: Results of policy simulations for Jordan

	Baseline	Package 1	Package 2	Package 3
LRA profits (in JD)	103,890,000	-8.51	-8.74	-21.38
HRA profits (in JD)	692,950,000	0	-0.1	-0.1
Imports outlook (in tons)				
Wheat	567,000	-0.65	-0.43	-22.39
Barley	459,100	-12.49	-11.01	-27.32
Lamb	13,800	10.8	17.11	64.74
Domestic prices (in JD)				
Wheat	147	0	-8.5	-8.5
Barley	105	0	-7	-7
Lamb	2,500	0	-10	-10
Cheese	2,000	17.17	13.71	-45.44
LRA supply (in tons or heads)				
Wheat	11,000	0	-0.41	-0.4
Barley	11,000	0	-1.11	-1.11
Lamb	12,000	-7.11	-15.66	-27.49
Cheese	11,100	-10.81	-8.77	-20.6
HRA supply (in tons or heads)				
Wheat	36,000	0	-1.61	-1.6
Barley	36,000	0	-0.82	-0.82
Lamb	0	0	0	0
Cheese	0	0	0	0
LRA demand (in tons)				
Wheat	67,540	-3.77	-3.17	-7.28
Lamb	2,838	8.86	6.17	-43.83
Cheese	1,220	-8.63	-8.07	43.93
HRA demand (in tons)				
Wheat	67,540	-1.72	-1.38	-13.21
Lamb	2,838	13.4	10.65	-22.52
Cheese	1,220	-6.87	-5.55	26.15
Urban demand (in tons)				
Wheat	478,920	0	0	-23.75
Lamb	20,124	0.03	0.02	37.36
Cheese	8,660	-11.68	-9.32	-36.28

Package 1 Feed Subsidy Removal (FSR)
Package 2 FSR + Price Support Reduction (PSR)
Package 3 FSR + PSR + Consumer Subsidy Reduction (CSR)

Table 6: Farm structures and production systems in the Ouled Si M=hamed ben Aïssa Community (Morocco)

FARM CHARACTERISTICS

The production system in each farm type is identified by input uses and outputs. Most of the farmers do not own any machinery and use all of their private land. Some of them share or rent land owned by non-residents. Total area belonging to non-residents is 46 ha and this is the main supply for rented and shared land.

Farm Type 1

These are *small to middle size* farms with an opportunity to increase their crop production by sharing and renting about 30% of the cropping area used. Even though the household is usually small, the number of adults is high enough to increase labor availability. This allows an important contribution from off-farm labor. Family consumption is low. The herd size is small. This type of farms has low cash availability and heavy debts. Wheat production has the highest share in the total area cropped. When barley is produced, an important part is grazed. Land direct costs represent the highest amount and percentage in total cropping cost while salaries represent the lowest share in the entire sample. These farms have a small herd size and the share of livestock gross product is the smallest in the sample (only 33%). On the labor side, these farms have limited recourse to hired labor.

Farm Type 2

These are *large farms* using exclusively private lands. An important part of total land endowment (11%), is non-arable land used as private range. The household is quite large with more than 14 people and includes several nuclear families with numerous children. These farms have the highest availability of labor. Family consumption levels are among the highest. Revenues generated from non-agricultural sources are substantial. Herd size is the largest and the number of cows is relatively important. Credit is sought to cover crop production expenses. At the start of the campaign, grain and feed stocks are high. A large part of the cropping area is used for feed production, fallow, forage barley and dual-purpose barley. Salaries paid to hired labor represent the highest share in total costs (54%) while inputs and land costs are the lowest (39% and 2% respectively). These farms have a crop system relatively more oriented towards wheat (durum and soft) than the others (46%) making the contribution of barley production rather low (26%). The livestock system is also more oriented towards beef production, which represents 52% of the livestock gross product. The feeding system is more dependant on the market since feed purchases represent 66% of the feed budget despite the large area reserved to fallow and dual purpose barley. These farms have an important positive cash flow from live animal sales.

Farm Type 3

These are also *large farms* using private and rented lands (13% of total cropping area is rented). The household is not large but does generally include several old persons and a limited number of children. Family consumption is the highest and a larger "target" revenue is needed. The highest numbers of sheep, goat and draft animals in the sample are for this type of farm. Cash availability is superior to amounts held by other farm types, but even though these large farmers have access to credit, it is rarely used. The stock of grains and feed (straw and barley) is the most important in the community. The contribution of off-farm income to total income is limited. An important part of the cropping area is used for grain barley (50%). It is in this cluster that the highest levels of crop production and cost are observed. Livestock gross product and costs are very high and an important part of the feed budget is spent on barley grain, sugar beet pulp and subsidized concentrates, due largely to the small area allocated to dual-purpose barley. These farms are very labor intensive and an important portion of the labor pool is hired (44%). Farm revenue is one of the highest, with a major contribution from crop related activities.

Farm Type 4

Despite their relative *small* size, these farms do not rent or share land to enlarge an average 2.6 ha cropping area. The household is a single nuclear family, with limited labor availability. Family consumption needs are low. Sheep, goats, and draft animal numbers are the lowest in the community. For these farms, the cash constraint is substantial and access to credit is limited. Stocks of grains and straw are low. There is a high degree of reliance on off-farm income. Barley production for grain or dual purposes and straw production, essentially dominate the cropping system, with a contribution to crop gross product of 50% and 35% respectively. Crop costs are the lowest, in particular for land (sharing & renting) and machinery. Given the limited land availability, crop production is also very low. Livestock provide around 2/3 of the farm gross product. The feeding system relies heavily on straw making total direct costs for livestock very low. Labor needs are largely met by family labor.

Farm Type 5

These are *medium size* farms. They increase land endowment by sharing 10% of the total cropping area. Families are usually large. Households have no other revenues than farm production. Inputs (seeds) represent the largest share of costs (50%) and the percentage of total costs related to machinery is the highest in the sample (8%). Beef share in livestock gross product is relatively high and is associated with a more intensive production system (calves remaining longer on the farm). These farms tend to increase herd size during the cropping season by buying more animals than they sell.

Source: Bendaoud-Boulanouar-Boughlala (1997)

LAND IMPROVEMENTS AND SOURCES OF INCOME IN LOW RAINFALL AREAS OF THE MASHREQ AND MAGHREB REGION: DO PROPERTY RIGHTS MATTER?

Tidiane Ngaido, IFPRI/ICARDA

With the collaboration of:
Marouane Abbassi, INRA, Tunisia
Ahmed Baalbaki, ISS, Lebanon
Mohamed Salah Bachta, INRAT, Tunisia
Mohamed Boughlala, INRA, Morocco
Peter Hazell, IFPRI, Washington, DC
Ali Khnefis,
Mustapha Malki, ITGC, Algeria
Fatima Nassif, INRA, Morocco
Chabab Nasser, MAAR, Syria
Karim Nesheiwat, MOA, Jordan
Tom Nordblom, ICARDA, Syria
Noureddine Redjel, HCDS, Algeria

ABSTRACT

The concerns of the Mashreq and Maghreb countries regarding efficiency, equity, and sustainability issues are reflected by the wealth of institutional and legal reforms undertaken in the past 40 years. The mechanisms were similar though differing among the countries in the rights they granted to local communities and individuals. Land rights have direct effects on the ability of farmers and communities to improve their resources, and they also influence the income generation options of rural households. This study investigates the effects of property rights on land improvements and income shares between cropping, livestock, and off-farm income in Jordan, Morocco, Syria, and Tunisia. The results indicate that in the low rainfall areas (LRAs) of the Mashreq and Maghreb regions, property rights are an important factor in farmers' decisions to invest in more productive land improvements. In all countries we observed a positive relationship between land rights and land improvements, both in the case of complete (*mulk taam*) and incomplete (*mulk naqqis*) ownership rights. The propensity to improve,

however, varies from country to country, reflecting the policy environment under which farmers make their productive decisions.

In Jordan, where the *Meeri* rights are registered and secure, and in Morocco where tribal members hold perpetual use-rights to tribal collective land, right holders have the possibility to invest in their lands and are able to reap the full benefits of their production. The importance of tenure security is confirmed by the higher propensity to invest in these lands. Moreover, the Moroccan farmers, with perpetual use rights, are now acting as defacto private owners of these lands and are developing them. This shows that, at the individual level, farmers have already made their choices. In some Moroccan communities, such as Ould Bou Ali, farmers have informally divided all the land among the tribal owners. In Syria, we found that farmers are investing more in their leased state lands and inherited-divided agrarian reform lands. This suggests that they expect to secure ownership rights over these lands in the long term.

Property rights play an important role in the livelihood strategies of rural producers in the LRAs. Generally completeness of land rights and owned use-rights are positively associated with crop income. This has many implications for the capacity of right holders to intensify their cropping systems. On the other hand, it is clear that farmers with less complete use-rights rely on off-farm activities as a major source of their income, and also invest in land purchase. The debate between completeness and incompleteness of land rights in WANA is really on the different options that are allowable under each tenure regime. The best way to address some of the efficiency and equity issues may be to develop land markets that facilitate transfer of resources from inefficient to more efficient producers. Furthermore, this would encourage better tenure arrangements, enabling tenant farmers to invest in more efficient and sustainable practices.

CHANGING GOVERNMENT ATTITUDES TO PROPERTY RIGHTS IN THE LRAs

State development policies in the Mashreq and Maghreb countries have neglected LRAs in favor of high potential areas (Barghouti and Hayward, 1992) and the rare technical interventions in rangelands have often been failures (Sidahmed, 1991; Oram, 1995; World Bank, 1995). Most of the state interventions, however, have focused on institutional policies geared towards redefining the roles of state, communities, and individuals in the management of natural resources such as land, water, and pastures. These policies, which took various routes, have often had

adverse implications for the ability of rural people to manage their resources (IFAD, 1995; Ngaido et al. 1998; Rae et al. 1996).

Changing demographic, social, economic, political, and environmental conditions highlight the limitations of present property rights institutions in LRAs. The area of arable land and pasture per capita has decreased in all the countries during the past thirty years, and population pressure has prompted a policy shift in most of the Mashreq and Maghreb countries towards finding new property rights alternatives and solutions to enhance productivity, technology adoption, and better resource management practices. This search for more efficient property rights institutions is fostering a debate that focuses on identifying the respective roles of all actors involved in the use and management of LRAs (state, local communities, individuals, donors, and NGOs).

This debate, which is at different stages in individual Mashreq and Maghreb countries, reflects state-perceived constraints over implementing resource management policies over the years. The Algerian government, for example, has abrogated the dispositions of the agrarian revolution (Malki and Redjel, 1996) and rehabilitated the rights of expropriated landowners in 1990. In 1995, the Jordanian government produced an Agricultural Policy Charter setting priorities for the agricultural sector (IFAD, 1997; Nesheiwat, 1996). The Lebanese government is examining the possibilities of enacting a rural code (Baalbaki, 1996). The Moroccan government is investigating the future of collective tribal lands and held its first national conference in December 1995 (Nassif et al. 1997; Chiche, 1997). In 1994, the Syrian government banned barley cultivation in the rangelands (Al Ahmed et al. 1996; Rae et al. 1996), depriving many communities, that were settled in these areas, of an important source of income. The government of Tunisia is pushing for the individualization and titling of collective tribal arable lands and investigating how to adjust property rights institutions to the liberalization of the Tunisian economy (Mares, 1996; Bachta and Al-Abassi, 1996).

These different policy reforms and interventions focus on both pasture and cropland property rights institutions. In the former, the concerns are to create property rights institutions that foster sustainable management of common resources and induce greater stewardship of rural communities. In the latter, the issue concerns creation of a property rights environment that enhances farmers' options for greater efficiency in the use of their productive resources and income generation. As such, land policies have efficiency, equity, and sustainability implications over

resource access and use by setting *de facto* the constraints and opportunities for individuals and communities.[9]

This paper investigates the behavior of rural producers in the use of their land under different tenure regimes focusing mainly on croplands. The major hypotheses that will be tested are a) whether current land rights inhibit farmers from investing in long-term land improvements and, b) whether land rights affect the livelihood strategies of rural households in the LRAs of the Mashreq and Maghreb countries. Data concerning long-term investments on farmers' plots made to enhance the productivity of the resource base and household income sources provide the basis of the discussion.

LAND RIGHTS IN LRAs

The objectives of property rights policies enacted in the M&M regions differed from country to country (Nassif*et al.* 1997; Bachta and Al-Abassi, 1996; Baalbaki, 1996; Nesheiwat, 1996; Redjel *et al.* 1996). However, a common underlying feature is the application of Islamic principles of property in the formulation of land policies. The Islamic land tenure system

considers property as a combination of resource ownership (*Mulk al Ayni*) and rights to ownership of its use (*Mulkal Manfaa*) (Al Maghribi, 1987). The holder of both types of ownership rights has complete ownership (*Mulk taam*), whereas holding only one of these rights confers an incomplete ownership right (*Mulk Naqqis*). The M&M countries have used this dichotomy to grant one or both types of ownership rights to local communities and individuals in LRAs (Table 1). The impact of these different national land policies are reflected in the distribution of land rights in Jordan, Morocco, Syria, and Tunisia (Table 2).

COMPLETE OWNERSHIP RIGHTS (*MULK* OR *MELK*)

Complete ownership rights means that the holder of such rights owns the resource and also its use. In other words, the owner has full rights to use and alienate the resource, as long as no one else is harmed (Al Maghribi, 1987). The latter provision prevents externalities that might arise if a landowner decided to cut the road to a neighboring farm or build a small dam on a common watercourse preventing neighbors from receiving water. In general, these rights are the most desirable because they provide to their holders a large array of resource use options. They

[9] The scope of these land policies and implications are discussed in national property rights reviews.

correspond to private property in the Western sense and the owner can sell, rent, bequest, mortgage, or grant the use of the resource.

Complete ownership rights (*mulk taam*) are therefore believed to: (i) increase credit use through greater incentives for investments, improved creditworthiness of projects, and enhanced collateral value of land; (ii) increase land transactions by facilitating transfers of land from less efficient to more efficient users by increasing the validity of contracts and by lowering enforcement costs; (iii) reduce the incidence of land disputes through clearer definition and enforcement of rights; and (iv) raise productivity through increased agricultural investment (Feder*et al.* 1988; Borrows and Roth, 1990) cited by Place*et al.* (1994). The only possible constraint on holders of such rights is access to formal credit institutions when their lands are not registered or titled. However, in the informal land and credit markets, it is relatively easy to sell or to use these lands as collateral.

Household surveys conducted by the M&M national teams in Jordan, Morocco, Syria, and Tunisia reveal the existence of both individual and tribal complete ownership rights. Individual ownership rights are acquired by many means such as first occupancy (*Istila* or *wad al yadd*),[10] inheritance, and through other contractual arrangements[11] (Al Maghribi, 1987). In Morocco and Tunisia, the state recognized individual and tribal ownership rights and proceeded early this century to register and title these lands. Tribal territories were delimited and in most cases titled in the name of the tribe (Nassif*et al.* 1997; Mares, 1996; Bachta and Al-Abassi, 1996). In Jordan, land policies favored state ownership, but incomplete *Meeri* rights were granted to farmers on croplands (Nesheiwat, 1996). In Syria, the emphasis of land policies was also on complete ownership but the state set up a ceiling on holding sizes above which land was confiscated and allocated to landshort and landless farmers (Al Ahmed *et al.* 1996). The surveys found that in the low rainfall cultivated areas, complete rights accounted for 8 percent in Jordan, 40 percent in Morocco, 58 percent in Syria and 99 percent in Tunisia (Table 2). Inheritance was the main source of complete ownership in all four countries.

---

[10] *Istila* and *wadd al yaad* refer respectively to first occupancy and appropriation. Both have the same result but require a legal basis. For example, nobody is allowed to appropriate or clear the land of another tribe. However, within one's tribal lands, the person has the legal justification to do so.

[11] There are three contractual arrangements that can grant complete ownership: purchase, gift or dowry.

INCOMPLETE OWNERSHIP RIGHTS

Ownership rights are considered incomplete (*mulk naqqis*) when right holders own the resource but not its use, or vice-versa (Table 1). The first type of incomplete ownership rights relates to lands donated for religious reasons (*waqf* or *habous* lands) where landowners retain resource ownership but grant resource use to individuals or religious institutions. Such cases were not encountered during the surveys, therefore, the following discussion will focus on owning, contracting and appropriating the use of the resource.

OWNERSHIP OF USE (*MULK AL MANFAA*)

These land rights, which are granted on state or tribal lands, give to beneficiaries the ownership of resource use (*mulk al manfaa*). Under this situation, right holders may use the land or transfer, rent, or sell the use-right, but cannot change the employment of the resource to non-agricultural uses, i.e., they do not have the right to shift land from agriculture to housing, which is possible when someone holds complete ownership. In addition, transfers of use-rights are generally limited to community members.

Meeri rights. *Meeri* rights, which are granted on state lands, are dominant use rights in the low rainfall farming areas of Jordan (Table 2). The state owns the resource and grants ownership of resource use to individuals (Table 1). These grants are generally based on proven traditional claims and membership. In the data collected from the Land and Survey Department of Jordan for 14 villages in LRAs, *meeri* rights represent 92 percent of all their agricultural lands (33,149 hectares) (Nesheiwat, 1996; Ngaido, 1997). These results are also confirmed by household surveys where *meeri* plots accounted for 69 percent of the total (Table 2). Nesheiwat (1997) argues that *meeri* land rights should not be classified as incomplete ownership rights because they offer the same opportunities as complete ownership rights. However, even if it is easy for a *meeri* rights holder to sell and alienate these lands, the holder in reality sells or bequests only the ownership of the use (*mulk al manfaa*). The ownership of the resource remains in the hand of the state and any change of status requires a legal procedure that will transfer resource ownership (*mulk al ayni*) to the *meeri* holder.

Perpetual use-rights. Perpetual use-rights, which are granted on tribal collective lands, give tribal members perpetual use rights over their plots. Household surveys in Morocco found that 49 percent of the plots

were under this tenure type (Table 2). Tribal members and their descendants have free and secured rights over granted plots (Nassif*et al.* 1997). As such, tribes hold the resource ownership (*mulk al ayni*) and individuals are granted ownership of the use (*mulk al manfaa*). Perpetual use-rights ensure the welfare of community members by providing them with means to sustain their farming and herding activities. The plots are allocated to heads of households and not to individuals. The beneficiaries cannot use these plots as collateral in formal credit markets unless endorsed by their tribe. However, in informal markets and at the level of the community, right holders can use their land as collateral to get loans from moneylenders, which is generally the first step towards selling granted fields (Boughlala, personal communication). These rights are a major source of disputes and hence represent an important concern of the Moroccan State. In Tunisia, these rights have evolved quickly to private property and presently most lands are registered or titled.

It is important to note that both of these incomplete ownership rights, *Meeri* and perpetual use-rights, provide tenure security to their holders because ownership of resource use is permanent and holders can transfer these rights under different forms of land transactions (Table 2). In Jordan and Morocco, purchased plots represented 15 percent and 2 percent respectively of the total.

Agrarian reform lands. When the Syrian State confiscated privately owned lands it changed the nature of the contract over resource use by allocating the resource ownership (*mulk al ayni*) to the state and granting ownership of resource use (*mulk al manfaa*) to farmers, who are subsequently required to become members of their village cooperatives. These use-rights, which accounted for 4 percent of the plots surveyed, were granted to tenant farmers, agricultural laborers and landless farmers. These rights are restrictive and inheritance is the only allowable transaction. Moreover, farmers are also constrained in their production options because, as members of cooperatives, they have to abide by the cooperative production system, grow the crops that are planned by the state, and obtain credit from the National Agricultural Bank through their village cooperative. These rights offer fewer options to their holders than *meeri* and perpetual use-rights because holders cannot sell the use of the resource. During the surveys in Syria, however, we found that some right holders rented or sharecropped their plots. During the past two years attempts have been made by the government to upgrade these rights to complete ownership rights.

Rented and sharecropped lands. These are the weakest land rights in the LRAs of the Mashreq and Maghreb countries. Under rental or sharecropping arrangements, landowners, who hold both resource ownership (*mulk al ayni*) and use (*mulk al manfaa*) can rent resource use to a tenant farmer. Tenant farmers, in such cases, have only use-rights that are exercised according to the terms and duration of their contracts. Rental or sharecropping contracts vary according to sol fertility, type of crop, social relations, etc, and payments range from one-third to one-half of the production depending on the owner's share of inputs, or in cash. The contracts can continue for long periods with annual or frequent renewals to enable landowners to reconfirm their ownership rights and revisit the terms of contract.

In general, tenant farmers can make short-term investments like fertilizer application to increase their production during the duration of the contract. They cannot make long-term investments (tree planting, de-stoning, digging wells) unless previously agreed with the landowners, because such investments are perceived as mechanisms for laying ownership claims. Moreover, tenants cannot use contracted lands as collateral for credit.

Rented state lands. In the Syrian rangelands, the government introduced a leasing system in the 1980s enabling farmers and herders to rent lands at about $3/ha. These lands have an ambiguous status because most of the farmers rented them in order to lay claims to and legitimize the appropriation of their tribal lands. Right holders, who plowed wide areas of the rangelands for barley, were prevented from cultivation following its complete ban in 1994.

Appropriated lands on state domain. Appropriated state lands have a different status than state rented lands. This is an important issue of legitimacy because appropriators consider that these lands are their tribal resources. In Jordan and Syria for example, farmers developed them hoping to acquire more permanent rights in the future. The Jordanian State considers these appropriations as trespass, and Nesheiwat (1997) reported that from 1990 to 1995, the State Domain Court recorded 2,394 trespass cases where individuals illegally plowed or built on state lands.

These different land rights form the fabric of the land tenure systems in the M&M region and define the constraints and opportunities faced by rural communities and individual right holders. The above discussion highlights some of the opportunities and constraints inherent in each type of land right and the importance of differentiating between resource ownership and resource use. Subsequent sections of this paper will focus

on testing the effects of these rights on farmers' decisions to invest in long-term land improvements and on how household livelihood strategies may differ according to their holding complete or incomplete ownership rights.

LAND RIGHTS, LAND IMPROVEMENTS AND INCOME SHARES

The study of relationships between land rights and investment is a growing area of investigation in agricultural and institutional economics (Dorner, 1972; Feder and Noronha, 1987; Bruce, 1988; Feder*et al.* 1988; Place and Hazell, 1993; Blarel, 1993; Besley, 1995; Gavian and Fafchamps, 1996; Carter and Olinto, 1996; Otsuka*et al.* 1997; Pender and Kerr, 1997). Feder and Ochan (1987) argue that "ownership security affects both investment incentives and the availability of the resource to finance investment" because "the supply of credit, essentially from institutional sources, frequently depends on the borrower's ownership security."

In the Mashreq and Maghreb region, land improvements, which enhance the productive capacity of the land, constitute a most important means of laying claim to a piece of land because the cultivation or improvement of unused or barren land is the basis of Islamic land ownership.[12]

This has been one of the principles by which many Muslim farmers acquired land over the centuries. Though farmers continue to use such practices to appropriate land, the principle of "cultivation" is no longer widely perceived as a legal means to acquire ownership rights. Each M&M country has defined its own rules and mechanisms for land access and ownership. Consequently, property rights today are typically considered as exogenous because these classes are fixed regardless of land improvements. The only possibility for reclassification is by adjustment to existing land policies.

Data. Surveys of households in Tunisia -110, Syria - 110, in Jordan - 75, and in Morocco – 75 were conducted from January to May 1997. Households were randomly sampled from selected villages following Rapid Rural Appraisals (RRA) of villages in Jordan - 6, in Morocco - 10,

[12] "Whoever develops a land is the rightful owner." There are many versions of the same idea that allow laying ownership claims, like (1) "If anyone makes a barren land productive, it belongs to him", (2) "if anyone puts a fence around a barren land, it belongs to him", and (3) "if anyone digs a well, he has 40 cubits of land as a resting place for his animals" (Ibn Hajar Al-Asqalani, 1996). All these rules stress first occupancy, meaning that being there first provides the rational for claiming ownership.

in Syria – 12, and in Tunisia – 12. The aim of RRAs was to evaluate the communities, assess the distribution of land rights, and identify the tenure issues affecting their inhabitants. The surveys focused on three levels of data collection (household, field, and crop) to capture the livelihood and production strategies of herders and farmers. A general questionnaire was developed and thereafter adapted to the situation of each country. Complete censuses of fields, livestock, feed sources, production and income generation strategies were carried out for each randomly selected head of household. The analysis will focus mainly on cropland data and on Jordan, Morocco, and Syria because the Tunisian data focused on the household and not the plot level.

Models. The conceptual model follows from Place and Hazell (1993) who tested the relationship between land tenure security and productivity in Sub-Saharan Africa. They argued that "farmers with more rights may have higher probability of recouping the benefits from land improvements and thus will be more inclined to make medium- or long-term improvements." In contrast to the land tenure systems discussed by Feder et al. (1988), the question in the Mashreq and Maghreb countries is of completeness of land rights rather than security. What farmers can do or cannot do on a piece of land has many implications for how they make their investment decisions. Place and Hazell (1993) found that in Africa, farmers have secure rights to land but the individual rights they have over parcels do vary. As such, the degrees of completeness of land rights were also used as their tenure variables.

Though offering different options for resource use and transfer, it is important to emphasize that both complete and incomplete ownership rights provide tenure security to their holders (Table1). For example, complete ownership rights allow right holders to choose any option they desire in the use of their resource, whereas incomplete rights, even if they can be transferred, only allow the transfer of use-rights. Even contracted land rights, which are generally perceived as precarious or insecure, can be transferred as long as the landowner agrees. This strategy is used to prevent a tenant farmer from losing access to a field that he has been cultivating for long time. For example, in Syria a tenant farmer can sublease a rented field under a sharecropping contract where he receives 70 percent and 30 percent goes to the tenant. As the first renter, the farmer pays 50 percent to the landowner and keeps 20 percent for himself. This practice allows tenant farmers some flexibility when they are unable to cultivate rented fields in a given year.

Land improvements. Land improvements include all the long-term investments made by farmers to enhance farm productivity since the acquisition of the plot. These improvements, which include de-stoning, water harvesting, tree planting, and wells, account for 27 percent of the plots in Jordan and Morocco and 46 percent in Syria. (Table 3) Investment in de-stoning and fencing are the major types of land improvement because in these marginal areas most of the plots are stony, and farmers are obliged to remove rocks which would then be used for fencing. The higher percentage of land improvements in Syria is associated with previous agricultural policies, which had favored barley cultivation on rangelands (Zone 5) and necessitated removing rocks; and with practices of supplementary irrigation. Tree planting was evidently not considered important, the percentage of plots planted with fruit trees was very low in all the countries, probably because tree crops are mainly located in the better rainfed areas.

Long-term land improvements are hypothesized to be determined by property rights and various plot specific variables as formulated in the following Probit model.

(1) I_{ij} = **f(mode of acquisition under tenure types, plot characteristics and year of acquisition),**

where I_{ij} is the index of probabilities of the i-th plot for the j-th farmer. The dependent variable is Landimp, an indicator of whether farmers made any long-term improvements since the acquisition of their fields. The other variables are mode of acquisition under different tenure systems and plot level variables. The mode of acquisition within each tenure type was used because we believe that this dictates farmers' land improvement behavior (Table 4). For example, under a specific tenure system, even where farmers are generally perceived to have absolute decision making power, right holders may be constrained in their decision making because the field is co-owned. The tenure variables were constructed using dummies and the lower categories of incomplete land rights, and contracted and appropriated state lands, were used as the base (Table 4).

Moreover, we used continuous (distance from the household and plot area) and discrete (fertility, salinity, topo-sequence) plot variables. Average plot size was smaller in Morocco (2.13 ha) than in Jordan (9.97 ha) and Syria (7.24 ha) reflecting a higher level of land fragmentation in the former. In Morocco plot size ranges from 0.1 ha to 25 ha whereas in Jordan and Syrian it ranges from 0.3 ha to 150 ha and from 0.2 ha to 100

ha, respectively. On average, the fields are closer to the households in Morocco (2.38 km) than in Jordan (4.27 km) and Syria (3.22 km). In Morocco village dummies were introduced to compare the two villages that have mainly incomplete land rights (Ould Radi and Oulad Njima) to the village that has only complete land rights (Ould Achi) (Table 4).

Specific household variables were dropped because of the difficulty of obtaining the household parameters that explain decisions to improve land at the time of the investment. Dropping household variables, however, biases the coefficients because it assumes that plots are independent of one another. To relax the independence assumption between plots and capture household effects, a Stata clustering procedure was used to replace household dummies. This procedure does not affect the coefficients but provides robust standard errors (Stata Manual, 1997).

Land rights and income shares. In the LRAs of Jordan, Morocco, and Syria and in dry areas of West Asia and North Africa in general, environmental variability and rainfall shortages are the major natural constraints to farming and herding communities. To mitigate these constraints, and ensure the livelihood of their families, farmers and herders carry out many strategies that are essentially based on mixed crop, livestock, and off-farm income portfolios. Moreover, during the past fifty years, rural communities have undergone many changes to adjust to government policies and population pressure, both in terms of resource availability and the portfolio of land rights that they hold over these resources (Ngaido et al, 1998).

These changes and the composition of their income portfolio are very dynamic because farmers and herders have always to adjust to new circumstances and respond to their growing family demands. To understand the importance of property rights in these regions, it is important to evaluate the different options, which enable farmers and herders to respond to environmental, economic, and demographic pressures.

Income shares. The estimation of income shares was dictated by the fact that in LRAs of Jordan, Morocco, and Syria, farmers have different livelihood strategies to cope with environmental variability and to ensure the survival of their families. Income shares were calculated for each household using gross household income. Gross instead of net income was used because of the 1994 ban of cultivation on LRAs in Syria and the 1996 removal of feed subsidies in Jordan. In both countries, these policies forced livestock breeders to spend additional money for the upkeep of their animals and, in many cases to incur losses.

a) Crop income and land rights. Cropping is an activity where size of land holdings and completeness of land rights are expected to play an important role in income generation, because they provide farmers and herders in the LRAs with more options on how to use their resources. This source of income accounts for 11 percent of total gross income in Jordan, 62 percent in Morocco and 63 percent in Syria (Table 6). For example, the possibility to dig wells or plant fruit trees permits agricultural intensification as well as providing farmers with more leverage to overcome rainfall shortages and avoid crop losses by supplementing soil moisture with irrigation. As such, the capacity and possibility of farmers to dig wells is in itself is an important strategy against crop and income losses. Owning land also means enjoying the totality of the production. Where farmers do not own the totality of their holdings they are obliged to pay land owners part of their production or a rental fee, which they are not always sure to recoup during periods of drought. We expect a positive relationship between completeness of land rights and crop income shares and a negative relationship with contracted or appropriated incomplete land rights.

b) Livestock income and land rights. In the LRAs, livestock rearing is a major source of income. Policies have encouraged livestock production in these areas because of the availability of pasture and also to avoid potential disputes between herders and farmers. In addition, livestock ownership is a major banking strategy for farmers and herders. The average household herd size was 177 small ruminants for Jordan, 165 for Morocco, and 20 for Syria (Table 6). Income was constructed using all the income generated from the sales of livestock products. In Jordan, the major source of household revenues was from livestock (61 percent) whereas the shares of livestock income were smaller in Morocco (6 percent) and Syria (15 percent). It is expected that the relationship between complete property rights and livestock income shares will be negative, because due to land settlement policies most of those holdings will only have incomplete land rights.

c) Off-farm income and land rights. To complement or enhance their income, all households in LRAs use this income generating strategy. The shares of off-farm income accounted for 23 percent of total income in Syria, 28 percent in Jordan, and 33 percent in Morocco (Table 6). Off-farm income was calculated by adding all the income earned by the household outside that earned from cropping their own fields and herding their own animals. The study of the relationship between off-farm income and land rights becomes important if resource poor farmers and herders use such a strategy as their main source of income. We do not

expect holders of complete rights and large livestock owners to rely on off-farm income as their major source of revenue. However, we anticipate a positive relationship between rented or appropriated lands and shares of off-farm income.

Income shares are hypothesized to be determined by property rights and various household specific variables as formulated in the following Tobit model.

(2) **Q_{ij} = f(size of holding under tenure and mode of acquisition, household characteristics and specific village),**

where Q_{ij} is the proportion of the i-th category of income (i= 1, 2, 3) for the j-th farmer. The same tenure variables, which were used to estimate the land improvement model, were used to estimate determinants of income shares from crop, livestock, and off-farm incomes. The only difference was the substitution of discrete variables by continuous variables to determine whether the size of land holding under each type of acquisition and tenure regime has an effect on the share of income from cropping, livestock, or off-farm activities.

For complete land rights, the average size of household holding for purchased land ranged from 1.49 ha in Syria to 3.75 ha in Jordan whereas for inherited-divided land the average ranged from 0.29 ha in Jordan to 9.25 ha in Syria. The relatively small average size of inherited/divided complete land rights in Jordan is a direct result of land policies which did not favor granting complete rights for agriculture in LRAs, and of inheritance. As such, we found that very few complete rights were acquired through inheritance. However, the increasing value of complete rights, because of a booming land market for construction, is pushing more people to purchase land. In Morocco, the average household holding of complete rights was 2.55 ha for purchased and 4.47 ha for inherited-divided (Table 6).

For incomplete land rights, the average household size with purchased lands was 7 ha in Jordan, 0.21 ha in Morocco, and zero in Syria. In the previous sections we noted that incomplete land rights in Morocco are not easily marketable because they cannot be sold outside the tribe (Nassif et al. 1997). In Syria the state will not allow holders of land reform lands to sell them. The average areas of inherited incomplete rights are higher in Jordan (6.66 ha) and in Morocco (6.93 ha) than in Syria where the average household holding of such lands was 0.045 ha (Table 6). The gender of the household head was included as a discrete variable with 1 for female and 0 for male household heads.

The average age of household heads was similar in the three countries with 56 for Jordan and Syria and 55 for Morocco. Fifty-Five percent of the households in Jordan were educated from primary level to secondary level compared to 12 percent in Morocco. In Syria, this question was not addressed.

The other discrete variables were irrigation and ownership of a tractor (Table 6). Irrigation is an important strategy for agricultural production to mitigate rainfall variability or diversify agricultural production (Table 6). In Morocco, for example, most of the irrigation is used to produce vegetables and fruits, whereas in Syria it is used for supplementation in wheat and legume production. In addition, in zones 3 and 4 in Syria, some of the farmers are involved in cotton production and use full irrigation. Ownership of tractors has increased in recent years for watering animals and transporting feed, as well as for cropping. In our sample, the percentages of households that own a tractor are Jordan - 29 percent, Morocco - 23 percent, and Syria – 28 percent.

RESULTS AND DISCUSSION

LAND RIGHTS AND LAND IMPROVEMENTS

Equation (1) specifying the relationship between land rights and land improvements was estimated for each country using the Stata Software (release 5, 1997) with 180 observations from Jordan, 562 observations from Morocco, and 341 observations from Syria. Probit analysis was used to estimate the coefficients and hypothesis tests. Marginal effects were estimated using the probit procedure in Stata. The results confirmed the importance of property rights variables in association with farmers' behavior in making long term improvements (Table 5).

Complete ownership rights are found to positively and significantly affect the propensity to make long term land improvements in LRAs Jordan and Morocco. Inherited-divided complete ownership rights, which exhibit significant positive coefficients in Jordan and Morocco, induce more investments than rented lands. The marginal effects on the probability of making long term investments were 0.91 for Jordan and 0.32 for Morocco (Figure 1). In both countries, the coefficients for purchased complete rights were positive and significant and the marginal effects on the probability of making long term investments more than on rented lands were 0.84 for Jordan and 0.40 for Morocco (Figure 1). The importance of complete rights was also corroborated by the negative sign and significance of coefficient of the two villages in Morocco (Oulad Radi and Oulad Njima) that have mainly incomplete land rights

compared to Oulad Achi that has only complete land rights. The results from Syria, however, were not significant for all the different modes of acquisition of complete rights. However, the coefficient for purchased complete rights was negative while those for inherited divided and undivided were positive.

Incomplete ownership rights, where holders own the use of the resource, were positive and significant for all the modes of acquisition in Jordan (*meeri* rights) and for inherited-divided in Morocco (collective rights) and Syria (agrarian reform). The propensity to invest in long term land improvements was much higher in Jordan where the marginal effects on the probability of making investments were 0.84 for inherited-undivided, 0.77 for purchased and 0.64 for inherited-divided (Figure 1). The results from inherited-undivided were not expected but shows that co-ownership, when compared to rented or state appropriated lands, is more desirable and does not prevent co-owners from investing in their lands as long as they, jointly, reap the benefits of their investments. In Morocco, the coefficients were positive but only the coefficients for inherited-divided and appropriated land rights were significant. The marginal effects on the probability of making investments for inherited-divided and appropriated land rights, were respectively 0.51 and 0.65 (Figure 1). In Syria, the marginal effects on the probability of making investments were 0.48. In addition, the results for appropriated collective lands in Morocco and state rented lands in Syria are positive and significant. The Marginal effects were 0.65 and 0.54 respectively. This may arise from the expectations of these farmers to secure ownership rights over these lands. However, the ban of cultivation in low rainfall lands in Syria, which has prevented farmers from benefiting from their investments, shows clearly the uncertainty of tenure on state rented property.

These results suggest that incomplete land rights, where farmers own the resource use, do not prevent farmers from investing in land improvements because they can recoup the full benefits of their investments. However, complete land rights have more production options as well as the possibility to sell their lands at higher prices and invest in non-farm production activities. Providing complete rights to farmers does not necessarily mean that they will stay in the agricultural sector but rather that they have wider options on how to use their resources.

LAND RIGHTS AND INCOME SHARES

Equation (2) specifying the relationship between land rights and income shares was estimated for each country using the Stata Software (release 5, 1997) and data collected from 66 households from Jordan, 69 households from Morocco, and 99 households from Syria. A generalized Tobit analysis was used to estimate the coefficients, goodness of fit measures, and hypothesis tests. Crop-share, livestock-share and off-farm-share equations were estimated for each country.

Shares of Crop Income. The results of crop income shares for Jordan, Morocco, and Syria are presented in Table 7. All the different modes of acquisition of complete ownership rights (*Mulk*) are positively related to shares of crop income except for purchased lands in Syria. The positive and significant coefficients for purchased and inherited-divided in Jordan and Syria support the hypothesis that having complete rights increases the share of income from agriculture. The negative and significant sign of the purchased complete rights suggests that household heads with purchased lands tend to have less income derived from cropping. In Morocco, the coefficients were positive but not significant even though the average share of income from cropping was 62 percent. The positive and significant coefficients for inherited divided and undivided in Syria were expected because holders of such rights derive their major source of income from cropping.

For incomplete rights, where the holders own the use of the resource, the coefficients are positive in Jordan for all modes of land acquisition, and for inherited-divided and rented lands in Morocco. The coefficients for purchased and appropriated collective lands in Morocco and inherited-divided and appropriated ag-reform lands in Syria were negative, and only the coefficient for inherited-divided ag-reform was significant. The negative signs were not expected because it assumed that the beneficiaries of these lands are farmers whose main source of income would be from cropping and that they received these lands through agrarian reform because they were previously landless.

The sign of the second type of incomplete rights, contracted or appropriated state lands, was negative and significant for rented *Meeri*, appropriated state lands in Jordan, and appropriated state lands in Syria. The results for appropriated state lands were expected because in general, farmers do not encroach on state lands. The negative sign of rented state lands is due to the loss of crop income following the ban of cultivation in the rangelands of Syria where such land rights prevail. Generally, we expected the relationships between rented fields and crop income shares to be positive and significant because renting land is an option that is

widely used by landless and landshort farmers to complement their land holding and satisfy their family needs. However, while the coefficient for rented collective lands in Morocco was positive and significant it was negative and significant in Jordan.

Among other variables the age of household heads gave mixed results and was not significant. Household size had a negative sign and was significant for Jordan and Morocco suggesting that the larger the family the less likely their income would come mainly from cropping. This was contrary to our general reasoning because it was expected that large families, which are well labor endowed, will be more likely to receive most of their income from cropping. However, a positive sign might result if, due to the reduction of costs associated with hiring labor, net income was considered instead of gross income. The negative and significant variable 'education suggests that educated people do not depend as heavily on cropping as their major source of income. This finding is contrary to the general belief that educated farmers tend to be more productive because they are more likely to adopt new technologies that will enhance their production systems. It also implies that educated farmers are more likely to seek additional sources of income to crops, such as livestock and off-farm earnings.

Negative signs for ownership of small ruminants were expected for Jordan and Syria; in Syria they are significantly negative reflecting the ban on cultivation of the rangelands where most of the flocks are located. In Morocco the sign of small ruminants was positive but that for ownership of cattle was negative and significant.

Irrigation is shown to have a positive effect on the share of income from cropping in all the three countries, and this was significantly so in both Morocco and Syria, reflecting the increasing use of full and supplemental irrigation for crop production.

The share of livestock income. The results of the equations of livestock income shares are presented in Table 8. As expected, the coefficients for small ruminants are significant and positively related to livestock income in Jordan and Syria. However, the negative and significant sign of the small ruminants in the case of Morocco was not expected. This may result from the increasing shift towards dairy cows there. During the rapid rural appraisal in Morocco, some livestock breeders stated that they are now shifting to dairy cows because this generates more income than sheep and if they have water and fields to cultivate hay, it is more profitable. Education is positively related to income shares from livestock and is significant for Morocco suggesting

that educated farmers are involved in livestock production, contrary to the situation of crop shares.

The sign of the dummy variable, ownership of a tractor, is positive for Jordan and Syria but not significant. The positive sign was expected because sheep breeders rely heavily on tractors to transport supplementary feed, water their animals, and plow large areas of pasture lands to grow barley (Oram 1995; Blench, 1995; Nesheiwat 1997; Ngaido 1997). The negative and significant signs for number of plots in Jordan and Syria confirmed, as expected, that livestock herders do not hold many plots.

In general, we expected a negative relationship between ownership of complete rights and the share of livestock income. In LRAs, farmers are more likely to own *mulk* lands and livestock breeders to have incomplete rights because they tended in the past to favor transhumance and nomadic production systems. This is confirmed by the negative coefficients for all inherited lands in Jordan, and for inherited and undivided *mulk* in Syria. Only the coefficient for purchased *mulk* in Syria was positive and significant. Contrary to our expectations, the coefficient for inherited lands in Morocco was positive and significant for the livestock share equation; this reflects the situation of Oulad Achi where all the land holdings were *mulk*.

In addition, because of the drive for tenure security in these countries in recent years, we expected livestock breeders to invest their revenues in land purchases. Two factors may be fostering such purchases: the need to secure lands for producing feeds because of the scarcity and degradation of pastures, and to invest in more stable assets. Increasingly, herders in LRAs of these countries are producing forage crops, mainly barley and some alfalfa in Morocco, to feed their animals. As such, owning land is not just a profitable investment but a way to reduce feeding costs. This is why the ban on barley cultivation in rangelands has adversely affected many livestock breeders who have long relied on barley production to provide supplementary feed (Oram and de Haan, 1995; Nordblom et al. 1995; Blench, 1995). The significant and positive sign of the coefficients for purchased complete rights in Syria and for purchased incomplete rights in Morocco confirms this trend. In Jordan, the negative sign was not expected and may be due essentially to the lack of *mulk* lands and even if such lands exist, it would not be profitable to use them solely for growing forages.

The generally positive and significant signs for incomplete ownership rights were expected because most of the livestock breeders, who were nomads, settled in recent years transforming their tribal

common property regime into individual land rights. As discussed in previous sections the outcomes of these tenure transformations varied from country to country. However, we did not expect the negative and significant sign for purchased *Meeri* and state appropriated lands because most of the trespasses recorded in the rangelands in Jordan were done by the breeders who plowed large areas of rangelands with barley (IFAD, 1995; Nesheiwat, 1996).

Off-farm income shares. The contribution of off-farm to total income in LRAs of the three countries is considerable, ranging from 23 percent in Syria to 28 percent in Jordan, and 33 percent in Morocco (Table 6). Many household heads or members migrate to urban areas or to other countries to generate income and send part of their savings to support their families. The results of the off-farm share analysis are presented in Table 9.

We made the following assumptions concerning the off-farm shares:

- Landless or landshort farmers and poor herders are likely to resort to off-farm income as their major source of revenues
- Conversely, farmers who are well endowed with complete or incomplete land rights, where they own the use-rights, are not so likely to rely heavily on off-farm earnings or remittances.
- Households with large herds are also less likely to rely on off-farm income as their major source of income.
- The relationship between rented land and shares of off-farm income will be positive. Thus, we expect a negative relationship between off-farm income shares, household small ruminants, and complete and the first type of incomplete (ownership of use) land rights. The results are as follows:
  i) Generally the signs of the different modes of acquisition in the three countries confirm the expected negative relationship between land rights and share of off-farm income, except for purchased complete rights in Jordan and in Syria, purchased incomplete rights in Jordan and complete inherited-divided rights in Syria. All signs are negative for Morocco.
  ii) The significant positive coefficient for purchased *mulk* in Jordan suggests that heads of household with off-farm income are purchasing lands. An advantage of complete land rights is that they allow the landowner to build a house on his plot; which is not permitted on *Meeri* lands. Hence many businessmen and migrant workers in Jordan are acquiring *mulk*.

iii) In Jordan and Syria the coefficients for small ruminants were negative and significant, confirming the hypothesis that households with large herds do not rely heavily on off-farm income. However, the positive significant coefficient of small ruminants in Morocco was not expected; one explanation might be that farmers receiving substantial off-farm income are using some of it to purchase livestock.

iv) The positive signs for rented *Meeri* lands in Jordan and for the state rented lands in Syria confirm that landless and landshort farmers are likely to try and complement their revenues through remittances and off-farm activities. In Syria this is due to the reliance on off-farm income by all the farmers who lost access to their cropland following the ban on cultivation. During our visit to the village of Mahmoudi, we found that all the women of the village went to pick cotton in the irrigation schemes.

The negative and significant sign of rented collective lands in Morocco was not expected. However, the positive and significant signs of household size, and small ruminants suggest that large households tend to rely more on off-farm income. This finding is important in the case of Morocco because most of the off-farm income comes from remittances sent by family members working in Europe or other in Arab countries.

Other results of the analysis included in Table 9 are:

a) Education: the negative and significant sign of this variable indicates that educated heads of households are less likely to rely on off-farm income.

b) Irrigation: this was positive and significant for Jordan and positive for Morocco, suggesting that some farmers in those countries may be intensifying their production systems. The main focus of irrigation in Syria is outside of the area studied in this project.

c) Fragmentation: The positive coefficients for the numbers of people per household in Morocco and Syria (significant) confirm the general reasoning that land fragmentation drives farmers to seek other income sources. Fragmentation, indicated by plot numbers, also appears to have negative impacts on crop incomes in Jordan and Morocco, and livestock incomes in Jordan and Syria.

REFERENCES

Al-Ahmed Hassan and Ali Khneifis. 1996. Property Rights in Syria. Paper prepared for the ICARDA/IFPRI/GTZ workshop on Property Rights, Amman November 9-13, 1996.

Baalbaki, Ahmed. 1996. Property Rights Issues in Low Rainfall Areas of Lebanon. Draft paper prepared for the ICARDA/IFPRI/GTZ workshop on Property Rights, Amman November 9-13, 1996.

Bachta M. and Marouane Abassi. 1996. La sitation fonciere dans les zones arides et semi-arides de la Tunisia. Draft paper prepared for the ICARDA/IFPRI/GTZ workshop on Property Rights, Amman November 9-13, 1996.

Barghouti, S. and J. Hayward. 1992. Land and Water Resources in the Middle East and North Africa: Issues and Challenges. Paper presented at EDI/WB/ICARDA/AOAD Seminar on Natural Resources and Environmental Management in Dry Areas, Aleppo, Syria, 16-27 February, 1992.

Besley Timothy. 1995. Property Rights and Investment Incentives: Theory and Evidence from Ghana. *Journal of Political Economy* 103 (5): 903-937.

Blarel, Benoit. 1994. Tenure Security and Agricultural production under Land Scarcity: The case of Rwanda. In *Searching for Land Tenure Security in Africa*, ed. John Bruce and Shem E. Mighot Adholla, pp. 71-94. Dubuque, Ia: Kendall/Hunt Publishing Company.

Blench, Roger. 1995. The Hashemite Kingdom of Jordan: National Program for Range Rehabilitation and Development. Baseline Survey of Socio-Economic and Animal Production Data. IFAD, Rome.

Borrows, Richard and Michael Roth. 1990. Land Tenure and Investment in African Agriculture: Theory and Evidence. *Journal of Modern African Studies* 28: 260-297.

Bromley, Daniel W. 1991. Environment and Economy: Property Rights and Public Policy. Oxford, U.K.; Cambridge, USA : Blackwell.

Bromley, Daniel W. 1989. Property relations and economic development : the other land reform. In *World Development* 17 (6) (June): 867 877.

Bruce, J. 1988. Is Indigenous Tenure a Development Constraint? Land Tenure Center, University of Wisconsin (mimeo).

Caidat of Beni Meskine Gharbia. Rapport sur les terres collectives de Beni Meskine Ghrabia. Document in Arabic.

Carter M. and P. Olinto. 1996. Getting Institutions Right for Whom? The Wealth-Differentiated Impact of Property Rights Reforms on Investment and Income in Rural Paraguay (mimeo).

Chiche Jeanne. 1997. A la recherche d'une definition des status foncier au Maroc. *Options Mediterraneennes* Serie A No. 32: 15-30.

Decroux, Paul. 1977. *Droit Foncier Marocain.* Editions La Porte. Rabat.

Demsetz, H. 1967. Towards a Theory of Property Rights. *American Economic Review* 57 (2): 347-359.

Dorner, P. 1972. *Land Reform and Economic Development.* Kingsport: Kingsport Press.

El Ghonemy Riad. 1993. Land, Food and Rural Development in North Africa. London: Intermediate Technology Publications.

El Ghonemy Riad. 1990. *The Political Economy of Rural Poverty.* London: Routledge.

Ellis, James E. and David Swift. 1988. Stability of Pastoral Ecosystems: Alternate Paradigms and Implication for Development.

Feder, Gershon and Raymond Noronha. 1987. Land Rights Systems and Agricultural Development in Sub Saharan Africa. *World Bank Research Observer* 2 (2) (July).

Feder, G. and T. Ochan. 1987. Land Ownership Security and Farm Investment in Thailand. *American Journal of Agricultural Economics* 69: 311-320.

Feder, G., T. Ochan, Y. Chalamwong, and C. Hongladaron. 1998. Land Policies and Farm Productivity in Thailand. Baltimore, Md.: The John Hopkins University Press.

Gavian S. and M. Fafchamps. 1996. Land Tenure and Allocative Efficiency in Niger. *American Journal of Agricultural Economics* 78 (May): 460-471.

Hassan, A. and Ali Khenefis. 1996. Property Rights Issues in Low Rainfall Areas of Syria. Draft paper prepared for the ICARDA/IFPRI/GTZ workshop on Property Rights, Amman November 9-13, 1996.

Ibn Hajar Al-Asqalani, Al Hafiz. 1996. *Bulugh Al Maram.* Riyadh, Saudi Arabia: Dar-us-Salam Publications.

IFAD. 1995. National Programme for Rangeland Rehabilitation in Jordan. May.

IFAD. 1997. National Programme for Rangeland Rehabilitation in Jordan. May.

Lawry, Steven W. 1990. Tenure Policy Toward Common Property Natural Resources in sub Saharan Africa. *Natural Resources Journal* 30 (Spring): [403] 422. University of New Mexico School of Law.

Leybourne Marina. 1996. The Extension of Barley Cultivation in the Arid Zones of Northern Syria. Pasture Forage and Livestock Program Annual Report 1994. ICARDA, Aleppo.

Maghribi, Mahmoud Abdel Majid. 1987. Wealth and Property in Islamic Charia.

Mahdi Mohamed. 1997. Le statut collectif des parcours entre le consensus de la collectivite et l'action individualisee. *Options Mediterraneennes*. Serie A No. 32: 31-38.

Malki M. and Redjel. 1996. Property Rights Issues in Low Rainfall Areas of Algeria. Draft paper prepared for the ICARDA/IFPRI/GTZ workshop on Property Rights, Amman November 9-13, 1996.

Mares, Hamdi. 1996. Froncier et gestion des ressources naturelles en Afrique du nord bilan Tunisien. Report. Mars.

Masri, A. 1991. The Tradition of Hema as a Land Tenure Institution in Arid Land Management: The Syrian Arab Republic. 1995, 61: 1-8.

Nassif F., M. Boughlala, and T. Ngaido. 1997. Farmers and Communities in Low Rainfall areas of Morocco: Their Decision Making Environment. Paper prepared for the Property Rights component of the Mashreq and Maghreb project. May 1997.

Neisheiwat, Karim. 1996. Property Rights in Low Rainfall Areas of Jordan. Draft paper prepared for the ICARDA/IFPRI/GTZ workshop on Property Rights, Amman November 9-13, 1996.

Nesheiwat, Karim. 1991. Socio-Economic Aspects of the Traditional Hema System of Arid Land Management in Jordan. FAO, Rome.

Ngaido T., T. Nordblom, G. Gintzburger, and A. Osman. 1998. A Policy Shift toward Sustainable Resource Development in the Mashreq and Maghreb Countries. In *Drylands: Sustainable Use into the Twenty-first Century*, ed. V.R. Squires and A.E. Sidahmed. Rome: International Fund for Agricultural Development. 1998

Ngaido Tidiane. 1997. Property Rights Institutions and Rangeland Development in Jordan. Evaluation report for the Rangeland Development Program in Jordan. Appraisals report on property rights prepared for IFAD. July.

Nordblom T.L., A.V. Goodchild, and F. Shomo. 1995. Livestock Feeds and Mixed Farming Systems in West Asia and North Africa. In *Livestock Development Strategies for Low Income Countries*, ed. R.T. Wilson, S. Ehui, and S. Mack, pp. 101-123. Proceedings of the joint FAO/ILRI Roundtable held at ILRI, Addis Ababa, Ethiopia, 27 Feb.-02 March 1995. Food and Agricultural

Organization/International Livestock Research Institute, Nairobi, Kenya.

Nordblom, Thomas and Farouk Shomo. 1995. Food and Feed Prospects to 2020 in the West Asia/North Africa Region. ICARDA Social Science Papers No. 2. ICARDA, Aleppo.

Office Regional de la Mise en Valeur Agricole du Gharb (ORMVA). 1991. Code Agraire Marocain. Sous la direction de N. Bouderbala et R. Filali-Meknassi.

Oram, Peter and John Hayward. 1992. Research and Extension Services for Land and Water Resources in the Near East and North Africa. Presented at the regional seminar organized by ICARDA/EDI on Land and Water Resources Management in Dry Areas. 16-29 February 1992, Aleppo Syria.

Oram, Peter and Cees de Hahn. 1995. Technologies for Rainfed Agriculture in Mediterranean Climates. World Bank Technical Paper Number 300. Washington, D.C.

Oram, Peter. 1995. Issues for Research on the Role of Agriculture Policy and property Rights in Sustainable Development of Low Rainfall Areas of West Asia and North Africa: A Position Paper. Paper prepared for the ICARDA/IFPRI Policy Workshop in Tunis 8-10 October.

Pascon, Paul. 1980. Idees et Enquetes sur la Campagne Marocaine. Societe Marocaine des Editeurs Reunis. Rabat.

Pender, J. and J. M. Kerr . 1997. The Effects of Non-Marketable Land Rights: Evidence from South India (mimeo).

Place, F., M. Roth, and P. Hazell. 1994. Land Tenure Security and Agricultural performance in Africa: Overview of Research Methodology. In *Searching for Land Tenure Security in Africa*ed. John Bruce and Shem E. Mighot Adholla, pp. 15-39. Dubuque Ia.: Kendall/Hunt Publishing Company.

Place, Frank and Peter Hazell. 1993. Productivity Effects of Indigenous Land Tenure Systems in Sub-Saharan Africa. *American Journal of Agricultural Economics* 75 (1): 10-19.

Rae, Jonathan, et al. 1996. Custom, Pragmatism, and Opportunity in Steppe Administration: An Analysis of Formal and Informal Institutions and Organizations on the Syrian Steppe. Ph.D. dissertation, Department of Geography, Oxford University, Oxford England.

Redjel Noureddine. 1995. Property Rights and Institutions in Algerian Steppe Rangeland. Paper prepared for the ICARDA/IFPRI Policy Workshop in Tunis 8-10 October, 1995.

Seve J., Bruce A. Ross-Sheriff, Peter C. Impara, and Diana de Treville. 1990. World Bank Drylands Management Study: Lessons of Experience. World Bank Environment Department.

Shideed, Kamil H. 1995. Crop/Livestock Integration, technology Adoption, Agricultural policies and property Rights under Rainfed Conditions in Iraq. Paper prepared for the ICARDA/IFPRI Policy Workshop in Tunis 8-10 October, 1995

Sidahmed, Ahmed E. 1992. Sustainable Rangelands in the Near East and North Africa. In *Rangelands* 14 (4) (August).

Sidahmed, Ahmed E. 1993. Towards Strengthening the Range/Livestock Research and Extension Capabilities of the National Institutions in the Near East and North Africa. Staff Working Paper No. 11. April 1993. IFAD, Rome.

Somel, Kutlu. 1991. Agricultural Diversification in the Middle East and North Africa. Paper presented at the EDI/WB/ICARDA/AOAD Seminar on Natural Resources and Environmental Management in the Dry Areas, Aleppo, Syria, 16-27 February 1992.

Stata. Statistical Software. User's Guide. Release 5. Stata Press. College Station Texas. 1997

Wachholtz, R. 1996. Socio-Economics of Bedouin Farming Systems in Dry Areas of Northern Syria. In *Farming Systems and Resource*

Economics in the Tropics, ed. W. Doppler. Vol. 24. Wissenschaftsverlag Vauk, Kiel.

World Bank. 1995. Rangeland Development in Arid and Semi Arid Areas. Strategies and Policies. Main report for North Africa and Iran. November 9, 1995.

Table 1: Land rights in Mashreq and Maghreb countries

	Ownership of the resource (*mulk ayni*)	**Ownership of the use of the (*mulk manfaa*) resource**	**Prescriptive acquisition (1)**	**Transfer and transaction possibilities**	**M&M Countries**
Complete ownership (*mulk taam*)					
Mulk, Melk	Owner (s)	Owner (s)	Already acquired	Yes	all
Mulk, Melk	Tribe	Tribal members	Ownership requires policy change	Restricted to the tribe	Morocco, Tunisia
Incomplete ownership (*mulk naqqis*)					
Ownership of use (*mulk al manfaa*)					
Waqf (Habous)	Private Ownership	Holder(s) or institutions	No	Inheritance	all
Perpetual use-rights	Tribal , State	Individual(s), household(s), cooperatives	Policy change	Sales are restricted to tribal members	Morocco, Tunisia, Algeria
Meeri	State	Holder(s)	Policy change	Yes	Jordan, Lebanon
Agrarian reform	State, cooperative(s) holder(s)	Holder(s)	Policy change	Inheritance	Morocco, Tunisia, Algeria, Syria
Rented or appropriated use-rights					
Renting or sharecropping	Owner, State	Contracted for limited time and under specific terms	No	No	all
Appropriated state lands	State	Appropriated for private use	Policy change	No	Jordan, Syria, Lebanon

1 Prescriptive acquisition: appropriated land which eventually can lead to ownership.

Table 2: Land rights in Jordan, Morocco, Syria and Tunisia (Arable lands), 1996

Mode of acquisition	Jordan (n= 180 plots)	Morocco (n= 562 plots)	Syria (n=341 plots)	Tunisia (=293 plots)
Complete ownership rights (*mulk taam*)				
Purchased	3%	10%	9%	14%
Inherited-divided	5%	30%	40%	82%
Inherited-undivided			9%	
Inherited-bought				2%
Granted by village council				1%
Subtotal	8%	40%	58%	99%
Incomplete ownership rights (*mulk naqqis*)				
Ownership of use	*Meeri*	Perpetual use-rights	Agrarian reform	
Purchased	15%	2%		
Inherited-divided	50%	44%	2%	
Inherited-undivided	4%			
Appropriated		3%	2%	
Contracted or appropriated use-rights				
Rented	17%	11%	4%	1%
Rented state lands			27%	
Appropriated state lands	6%		7%	
Subtotal	92%	60%	42%	1%
TOTAL	100%	100%	100%	100%

Table 3: Distribution of land improvements made on the plot since acquisition, 1996

Type of land improvement	Jordan (n=180 plots)	Morocco n=562 plots	Syria N=341
De-stoning and fencing	21%	19%	19%
Water harvesting			2%
Terraces	1%		
Trees	2%	3%	9%
Well	3%	5%	16%
All improved plots	27%	27%	46%

Table 4: Summary table of land improvement variables, 1996

		Jordan		Morocco		Syria	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Improved plots	(0,1)	0.26	0.44	0.27	0.45	0.46	0.50
Distance	Km	4.27	7.74	2.38	3.26	3.22	2.91
Area	Ha	9.97	19.50	2.13	2.42	7.24	10.40
Highlands	(0,1)			0.30	0.46	0.03	0.18
High-slope	(0,1)	0.01	0.07	0.04	0.19	0.06	0.24
Medium-slope	(0,1)	0.26	0.44	0.25	0.43	0.38	0.49
Low-slope	(0,1)	0.25	0.43	0.37	0.48	0.06	0.23
Plain	(0,1)	0.49	0.50	0.04	0.20	0.25	0.44
Salinity	(0,1)	0.04	0.19			0.09	0.28
High fertility	(0,1)	0.19	0.39	0.20	0.40	0.38	0.49
Medium fertility	(0,1)	0.57	0.50	0.20	0.40	0.56	0.50
Low fertility	(0,1)	0.24	0.43	0.26	0.44	0.06	0.24
Rocky	(0,1)			0.33	0.47		
Year of acquisition	Year	1965	20.47			1968	21.16
Village oulad radi	(0,1)			0.32	0.47		
Village oulad njima	(0,1)			0.44	0.50		
Village oulad achi	(0,1)			0.24	0.43		
Complete ownership rights (*mulk/melk taam*)							
Purchased	(0,1)	0.03	0.18	0.10	0.29	0.09	0.28
Inherited and divided	(0,1)	0.05	0.22	0.30	0.46	0.41	0.49
Inherited and undivided	(0,1)					0.09	0.29
Incomplete ownership rights (*mulk naqqis*)							
Ownership of use	(0,1)	*Meeri*		Collective		Ag-reform	
Purchased	(0,1)	0.14	0.35	0.02	0.14		
Inherited-divided	(0,1)	0.50	0.50	0.45	0.50	0.02	0.13
Inherited-undivided	(0,1)	0.04	0.19				
Appropriated	(0,1)			0.03	0.16	0.02	0.15
Contracted and state lands							
Rented lands	(0,1)	0.17	0.38	0.11	0.31	0.04	0.20
State leases	(0,1)					0.27	0.44
Appropriated state lands	(0,1)	0.06	0.24			0.07	0.25

Table 5: Results of the probit analysis for land improvements

Variables	Jordan	Morocco	Syria
Distance	-0.018 (0.022)	-0.060* (0.030)	0.04 (0.031)
Area	0.074* (0.021)	0.163* (0.042)	0.004 (0.009)
Highlands		-0.159 (0.353)	0.391 (0.600)
High-slope		-0.153 (0.477)	-0.508 (0.403
Medium-slope	1.077* (0.306)	0.182 (0.359)	-0.495* (0.233)
Low-slope	0.078 (0.475)	0.148 (0.345)	-0.015 (0.364)
High fertility	1.250* (0.400)	-0.034 (0.212)	-0.260 (0.505)
Medium fertility	0.873* (0.336)	0.303 (0.232)	0.294 (0.430)
Rocky		0.172 (0.179)	
Salinity	0.606 (0.554)		-0.005 (0.325)
Year of acquisition	0.020* (0.008)		-0.001 (0.005)
Village Oulad Radi		-0.889* (0.269)	
Village Oulad Njima		-0.700* (0.225)	
Complete ownership rights (*mulk/melk taam*)			
Purchased	2.852* (0.985)	1.100* (0.485)	-0.011 (0.553)
Inherited-divided	4.299* (0.819)	0.961* (0.378)	0.690 (0.511)
Inherited-undivided			0.404 (0.539)

Table 5 (continued)

Variables	Jordan	Morocco	Syria
Incomplete ownership rights *(mulk naqqis)*			
Ownership of use	*Meeri*	Collective	Ag-reform
Purchased	2.503* (0.736)	0.546 (0.443)	
Inherited-divided	3.077* (0.631)	1.700* (0.391)	1.513* (0.517)
Inherited-undivided	2.800* (0.708)		
Appropriated		1.886* (0.531)	-0.370 (0.746)
Rented state lands			1.618* (0.571)
Appropriated state lands			0.537 (0.603)
Constant	-44.864* (16.653)	-1.737* (0.552)	1.865 (10.369)

* denotes significance test at the 5% level, in a 2-tailed "t" test and () standard errors

Table 6: Summary of household variables for household income shares, 1996

	Variables	Jordan N=65	Morocco N=69	Syria N=99
Share of crop revenues	proportion	0.114 (0.254)	0.619 (0.288)	0.628 (0.330)
Share of livestock revenues	proportion	0.602 (0.370)	0.055 (0.112)	0.145 (0.216)
Share of off-farm revenues	proportion	0.284 (0.338)	0.327 (0.288)	0.227 (0.298)
Age of head of household	Years	56 (13.593)	54.826 (15.508)	55.806 (12.841)
Women head of household	(0,1)			0.051 (0.220)
Education of household head	(0,1)	0.554 (0.501)	1.478 (0.779)	
Experience in agriculture	Years	27.169 (15.101)		
Household size	members	10.323 (4.880)	8.551 (3.744)	9.687 (5.907)
Number of plots	Plots	2.615 (0.963)	7.449 (3.146	2.869 (1.620)
Adult Sheep and Goats	animals	177.215 (184.904)	164.493 (402.466	19.475 (30.031)

Table 6 (continued)

	Variables	Jordan N=65	Morocco N=69	Syria N=99
Cows	Cows		1.172 (2.480	
Irrigation	(0,1)	0.292 (0.458)	0.232 (0.425	0.283 (0.453)
Ownership of a Tractor	(0,1)	0.323 (0.471)	0.290 (0.457	0.253 (0.437)
Complete ownership rights (*mulk/melk taam*)				
Purchased	ha	3.754 (26.373)	2.553 (7.482	1.493 (5.298)
Inherited-divided	ha	0.286 (1.034)	4.466 (9.322	9.252 (14.001)
Inherited-undivided	ha			1.485 (5.392)
Incomplete ownership rights (*mulk naqqis*)				
Ownership of use		*Meeri*	Collective	Ag-reform
Purchased	ha	7.02 (25.935)	0.210 (0.956)	
Inherited-divided	ha	6.66 (10.172)	6.933 (7.846)	0.045 (0.262)
Inherited-undivided	ha	1.032 (6.709)		
Appropriated	ha		0.639 (2.790)	0.282 (1.415)
Contracted or appropriated				
Rented (*mulk, meeri,* Collective)	ha	4.754 (10.878)	0.752 (3.172)	0.393 (1.766)
State appropriated	ha	3.746 (16.781)		0.833 (2.523)
State rented	ha			5.663 (12.843)

* denotes significance test at the 5% level, in a 2-tailed "t" test and () standard errors

Table 7: Tobit regression of shares of crop income

Cropshare	Jordan	Morocco	Syria
Age of household head	-0.0054 (0.0053)	0.0007 (0.0020)	0.0015 (0.0017)
Women heads of household			0.0761* (0.0109)
Household size	-0.0403* (0.0072)	-0.0062* (0.0033)	-0.0012 (0.0009)
Education	-0.3710* (0.0985)	-0.0745* (0.0250)	
Experience in farming	-0.0012 (0.0023)		
Number of plots	-0.0190 (0.0481)	-0.0236* (0.0135)	0.0347* (0.0120)
Small ruminants (sheep and goats)	-0.0003 (0.0005)	0.0002 (0.0002)	-0.0011* (0.0003)
Cows		-0.0619* (0.0189)	
Owning a tractor	0.1000* (0.0336)	-0.0495 (0.0551)	-0.0479* (0.0061)
Irrigation	0.0092 (0.1322)	0.0679* (0.0339)	0.1564* (0.0184)
Complete ownership rights (*mulk/melk taam*)			
Purchased	0.1897* (0.0452)	0.0057 (0.0059)	-0.0143* (0.0010)
Inherited-divided	0.0168* (0.0088)	0.0031 (0.0066)	0.0020* (0.0006)
Inherited-undivided			0.0035* (0.0012)
Incomplete ownership rights (*mulk naqqis*)			
Ownership of use	*Meeri*	Collective	Ag-reform
Purchased	0.0156 (0.0030)	-0.0758 (0.0466	
Inherited-divided	0.0056* (0.0030)	0.0078 (0.0072)	-0.1456* (0.0203)
Inherited-undivided	0.0118* (0.0046)		
Appropriated		-0.0022 (0.0098)	-0.0148 (0.0122)
Contracted or appropriated			
Rented *mulk*		0.0051 (0.0131)	-0.0013 (0.0044)
Rented *meeri* or collective	-0.0077* (0.0032)	0.0098* (0.0019)	

Table 7 (continued)

Cropshare	Jordan	Morocco	Syria
State rented			-0.0016 (0.0029)
State appropriated	-0.0043* (0.0014)		-0.0006* (0.0003)
Constant	1.4654* (0.2581)	0.8893* (0.1881)	0.5431* (0.0363)

* denotes significance test at the 5% level, in a 2-tailed "t" test
() standard errors

Table 8: Tobit regression of shares of livestock income

Liveshare	Jordan	Morocco	Syria
Age of household head	0.0003 (0.0010)	-0.0002 (0.0009)	0.0011* (0.0002)
Women heads of household			-0.0366 (0.0328)
Household size	0.0017 (0.0130)	-0.0071 (0.0066)	-0.0004 (0.0035)
Education	0.0514 (0.0776)	0.0190* (0.0033)	
Experience in farming	0.0016 (0.0031)		
Number of plots	-0.1104* (0.0134)	0.0041 (0.0133)	-0.0351* (0.0029)
Small ruminants (sheep and goats)	0.0009* (0.0002)	-0.0002* (0.0001)	0.0018* (0.0007)
Cows		0.0133* (0.0030)	
Owning a tractor	0.0215 (0.1410)	-0.0467 (0.0468)	0.0636 (0.0586)
Irrigation	-0.1680 (0.1269)	0.0677 (0.0662)	-0.1074* (0.0152)
Complete ownership rights (*mulk/melk taam*)			
Purchased	-0.0037* (0.0011)	0.0001 (0.0007)	0.0110* (0.0020)
Inherited-divided	-0.0339 (0.0210)	0.0027* (0.0004)	-0.0017* (0.0009)
Inherited-undivided			-0.0019 (0.0024)

Table 8 (continued)

Incomplete ownership rights (*mulk naqqis*)			
Liveshare	**Jordan**	**Morocco**	**Syria**
Ownership of use	*Meeri*	Collective	Ag-reform
Purchased	-0.0001 (0.0005)	0.0193* (0.0018)	
Inherited-divided	0.0016 (0.0044)	-0.0015 (0.0025)	0.0938* (0.0120)
Inherited-undivided	0.0071 (0.0046)		
Appropriated		0.0029 (0.0031)	0.0048 (0.0096)
Contracted or appropriated			
Rented *mulk*		0.0038 (0.0065)	0.0170* (0.0010)
Rented *meeri* or Collective	0.0015 (0.0024)	0.1049* (0.0058)	
State rented			0.0025* (0.0011)
State appropriated	-0.0027* (0.0003)		-0.0010 (0.0035)
Constant	0.7604* (0.1102)	0.2051* (0.0327)	0.2370* (0.0577)

* denotes significance test at the 5% level, in a 2-tailed "t" test
() standard errors

Table 9: Tobit regression of shares of off-farm income

Variables	**Jordan**	**Morocco**	**Syria**
Age of household head	-0.0013 (0.0035)	-0.0013 (0.0033)	0.0005 (0.0041)
Women heads of household			-0.2363* (0.0792)
Household size	0.0015 (0.0106)	0.0082* (0.0025)	-0.0028 (0.0031)
Education	-0.1285* (0.0402)	0.1083 (0.0759)	
Experience in farming	0.0026 (0.0024)		
Number of plots	-0.0013 (0.0645)	0.0197 (0.0140)	0.0178* (0.0080)

Table 9 (continued)

Variables	Jordan	Morocco	Syria
Small ruminants (sheep and goats)	-0.0014* (0.0002)	0.0006* (0.0001)	-0.0020* (0.0008)
Cows		-0.0521* (0.0245)	
Owning a tractor	-0.0803 (0.1073)	-0.1019* (0.0116)	-0.0595 (0.0463)
Irrigation	0.1007* (0.0579)	0.0082 (0.0001)	-0.0993 (0.0757)
Complete ownership rights (*mulk/melk taam*)			
Purchased	0.0042* (0.0009)	-0.0022 (0.0095)	0.0016 (0.0043)
Inherited-divided	-0.0183 (0.0131)	-0.0044 (0.0041)	-0.0028 (0.0031)
Inherited-undivided			0.0062* (0.0023)
Incomplete ownership rights (*mulk naqqis*)			
Ownership of use	*Meeri*	Collective	Ag-reform
Purchased	0.0006 (0.0008)	-0.0086 (0.0264)	
Inherited-divided	-0.0035 (0.0026)	-0.0137* (0.0068)	-0.1196 (0.0748)
Inherited-undivided	-0.0049 (0.0047)		
Appropriated		-0.0070 (0.0060)	-0.0394* (0.0160)
Contracted or appropriated state lands			
Rented *Mulk*		-0.0319* (0.0046)	-0.0216* (0.0041)
Rented *Meeri* or Collective	0.0054* (0.0021)	-0.0690* (0.0355)	
State rented			0.0065* (0.0026)
State appropriated	0.0001 (0.0004)		-0.0162* (0.0061)
Constant	0.7703* (0.3277)	0.3268 (0.3174)	0.4517* (0.1714)

* denotes significance test at the 5% level, in a 2-tailed "t" test

() standard errors

THE EXPERIENCE WITH DROUGHT MANAGEMENT POLICIES IN WANA

Mohammed El-Mourid and Mohammed Moussaoui[13]

ABSTRACT

The WANA region is characterized by highly erratic and deficient rainfall, creating severe water shortages. This is aggravated by the variability of soil and farming systems. Human pressure on land and water has led to vulnerable and fragile agroecosystems. Droughts are of high frequency and human activities have worsened their impact on crops, livestock, and people. The WANA region is facing serious food and feed deficits at the beginning of the 21st century.

Drought is one of man's worst natural enemies; four types are described; meteorological, agricultural, hydrologic and socioeconomic. In the last 20 years most countries of WANA have implemented drought management policies and instruments, mainly in favor of emergency relief programs. These programs usually consist of purchase and distribution of concentrate feed for livestock, import of food and feed grains, development of livestock watering points, improvement of rural drinking water supply, and credit debt relief. These actions are often responses to drought through crisis management and do not provide the basis for long term strategic planning for future droughts in a risk management framework. Cases of policies developed in the WANA region are reviewed and their impacts are assessed. Finally suggestions are made for developing long-term action plans.

THE REGIONAL SETTING

The region of West Asia and North Africa (WANA), where ICARDA's mandate covers 25 countries stretching between the Atlantic ocean and the Indian ocean, has a total area of about 17 million km^2 (Van Schoonhoven, 1991).

Most of this region has a Mediterranean climate characterized by cool to cold winters and hot to extremely hot summers; many locations

[13]Mohammed El-Mourid is Directeur de Recherche and Chef de Centre Aridoculture Settat of the Institut National de la Recherche Agronomique (INRA), Morocco. Mohammed Moussaoui is Senior Scientist, INRI, Meknes.

suffer extremes of both. Rainfall is highly erratic in space and time. It ranges from 50 mm to 1200 mm, with variation in the duration of the growing season ranging from zero to 200 days. Only 128 million ha, about 8 percent of the region's area is thought to be arable, 22 percent is steppe; the area under perennial crops and forest is small, so that the bulk of the remaining 70 percent is desert. Irrigated land totals 35 million ha (2 percent of WANA's total area, but constitutes 27 percent of its arable land) (Van Schoonhoven, 1991).

Much of the land has steep slopes and/or shallow, rocky, or saline soils that are unsuitable for cultivation without extensive, expensive reclamation. The region's soils are generally calcareous and low in phosphorous, nitrogen and organic matter. In many areas, shallow soils limit the amount of water that can be stored in the soil profile during rainy season, thus shortening the effective growing season.

Land use in WANA is dominated by dryland farming and pastoralism, where rainfed cropping systems are integrated to livestock production. Farming throughout much of the region remains a hazardous venture. Avoiding the risk of crop failure is often more important to farmers than maximizing their yields in good years.

WANA is characterized by high population growth, expected to more than double by 2020. If nothing is done now food deficits will excalate, and WANA will have to import about 86 million mt of grain at an estimated cost of $9 billion a year by 2020 (El Beltagy, 1997; Nordblom and Shomo, 1995).

In response to the region's rising demand for food, and especially for livestock products, there is an increasing tendency to abolish fallow, to cultivate marginal land, and to overgraze natural pastures and steppe. The whole WANA region is drought prone and each year every country experiences drought and water deficit at some levels, which complicates decisionmaking at the farm level, as well as for policy makers. Consequently, in an attempt to solve water deficit problems and mitigate drought consequences most countries of WANA have implemented emergency drought management programs.

WHAT IS DROUGHT?

Definitions of drought are almost as numerous as the number of publications dealing with the subject. It is a complex phenomenon.

A distinction should be made between aridity and drought. Aridity defines the set of climatic factors characterizing a region (temperature, precipitation, humidity of the air, etc.). Arid and semi-arid regions are characterized by an erratic rainfall, high evaporation and precarious

water resources. Such zones are often vulnerable to erosion. Over-exploitation of these naturally fragile ecosystems, causes irreversible changes and the degradation of production potential. Drought is an accidental phenomenon of variable duration and frequency and marked by an acute shortage of water. Whereas drought may occur in any geographical zone, in arid and semi-arid zones the disturbance that it causes to the functions of ecosystems, and to farming systems in the broad sense, can reach alarming proportions.

Drought is undoubtedly one of man's worst natural enemies. Not only does it affect the social and economic life of millions of people every year, but from time to time the existence of whole nations is endangered.

A most important factor in understanding drought is often overlooked in the various definitions: it is a "supply and demand" phenomenon (Gibbs, 1975). A definition that does not include reference to water requirements or "demand" must therefore be regarded as inadequate.

If the " demand" factor is included in the definition it follows that delineation of drought occurrence depends on the nature of water need. Conditions which a farmer growing a crop may regard as drought, may at the same time cause little or no concern to a farmer rearing livestock. In other words, drought occurrence depends on the density and distribution of plants, animals and human population; their life style and their use of natural resources, as much as on rainfall deficiency (Gibbs, 1975).

Thus the definition of drought should not be formulated in a narrow sense, but rather must incorporate both physical and social measures that have a local or regional significance (Wilhite and Glantz, 1987; Mainguet, 1995).

Wilhite and Glantz (1987) reviewed more than 150 published definitions of drought and clustered them into four types: meteorological, agricultural, hydrologic, and socio-economic.

Meteorological drought. Meteorological definitions of drought are the most prevalent. They often define drought solely on the basis of the degree of dryness and the duration of the period. They are also often site-specific, but the thresholds used to distinguish drought from nondrought periods are seldom spelled out. For example in various countries, meteorological droughts have been defined as follows:

USA - Less than 2.5 mm of rainfall in 48 hours (Blumenstock, 1992 in Wilhite and Glantz, 1987).

Libya - When annual rainfall is less than 180 mm (Hudson, 1964 in Wilhite and Glantz, 1987).

India - Actual seasonal rainfall is deficient by more than deviation (Randas, 1960 in Wilhite and Glantz, 1987).

Agricultural drought. Agricultural drought definitions link various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages, departures from normal, evapotranspiration (ET), etc.

An operational definition should account for the variable susceptibility of crops at different stages of crop development and availability of soil moisture at different stages. The crop moisture index (CMI), developed in the USA, defines drought in terms of the magnitude of computed abnormal ET deficits. It has been adopted by the U.S. Department of Agriculture and is published in its Weekly Weather and Crop Bulletin as an indicator of the availability of moisture to meet short-term crop needs.

Hydrologic drought. Definitions of hydrologic drought are concerned with the effects of dry spells on surface or subsurface hydrology. It might be considered as a "period during which streamflows are inadequate to supply established users under a given water management system."

Hydrologic droughts are often out of phase with both meteorological and agricultural drought. In Colorado USA, a surface water supply Index (SWSI) was developed in 1981 to complete the Palmer drought stress index (PDSI) and to implement Colorado's Drought assessment plan (Denver, Colo., Division of Disaster: Emergency Services, 1981).

Socio-economic drought. Definitions that express features of the socio-economic effects of drought can also incorporate features of meteorological, agricultural, and hydrological drought. They are usually associated with the supply and demand of some economic good.

In many instances, land use practices might create a drought situation or make an existing one worse. The dust bowl years on the USA's Great Plains in the 1930s and the Sahelian drought in West Africa in the 1970s are examples of the relations between drought and human activities.

DROUGHTS IN THE WANA REGION

A major characteristic of the environments in WANA is their variability, particularly of weather conditions in space and time. These environments often face severe water deficits. In many areas adjacent to the Mediterranean, rainfall exceeds 1,000 mm/year, but the amount

declines steeply with distance from the coast; beyond 100-200 km annual mean rainfall is often 200 mm or less. Drought with a high risk of occurrence over years is a structural feature of the region. All countries of this region face the risk of droughts of variable severity and duration, from a few months to several years.

In Morocco for example, studies on drought over 1,000 years show that the country has experienced 116 episodes of drought of which 84 percent were less than two years in duration; however, extremes of seven years have been observed.

In the last 50 years, Morocco has experienced four cycles of drought; the most drastic in duration was from 1980 to 1985 and the driest was in 1994-95. Rainfall deficits, or departures from normal rainfall, varied from 20 percent to 51 percent depending on the years and regions, with extremes of 85 percent in the 1982-83 and 1983-84 cropping seasons.

Since mid-1970, Morocco has undergone a dry spell, with a decrease of 50 to 100 mm from the average rainfall over 60 years of observations.

In Tunisia, a recent study has shown that the climate has not changed in the last 2,000 years (Sakiss et al., 1994), thus Tunisia has long been an arid and semi-arid country. Droughts are of high occurrence in Tunisia.

Bortoli (cited by Ben Dhia and Messaoudi, 1996) showed that at Manouba Station, Tunisia, over 90 years, there have been seven years of consecutive drought (1941-1947); four series of two-year drought and 12 years of one-year droughts. Drought years amounted to 33 of the 90 years, i.e., 34 percent. Over the last 20 years, 35 percent were droughty (1977-78; 1982-83; 1985-86; 1987-88; 1988-89; 1993-94; 1994-95). Similar examples from Syria or Jordan can be cited.

The climate has probably not changed in the region, but human activities putting pressure on marginal land, rangeland and forests have degraded natural resources and substantially modified the fragile agroecosystems, increasing drought occurrence and aggravating the impacts of drought. These effects are endangering the sustainable development of the whole region.

DROUGHT MANAGEMENT INSTRUMENTS DEVELOPED IN WANA

All governments of the WANA region have implemented measures in attempts to limit the social and economic damage from drought. While these vary in scope and emphasis many of the instruments developed are similar; in general they comprise emergency drought relief programs, including:

- Purchase of concentrate feed and distribution to livestock owners;
- Import of barley, corn, sorghum, dry alfalfa and other feedstuffs;
- Veterinary prophylaxis measures (distributions of vaccine doses);
- Development of livestock watering and water points;
- Improvement of rural drinking water;
- Digging and deepening of wells; and
- Access to credit and debt relief.

However, in many countries long-term actions have also been implemented, such as increasing over-year storage capacity of water (dams: Morocco), or rangeland and sylvopastoral improvement projects (planting shrubs and forest trees: Algeria, Jordan, Libya, Morocco, Syria, and Tunisia).

A Case Study: The Drought of 1994-95 in Morocco

Most sites in Morocco have highly variable rainfall from year to year and from season to season. Rainfall records from recent times, and those extending back for several centuries, indicate that the Moroccan territory has always suffered from episodes of drought followed by good rainfall years. While the probability of drought in a given year in at least one of the country's major regions is quite high, in the range of 30-40 percent, the probability of drought nationwide is much lower, in the range of 10-15 percent (Roggers, 1995).

Since the mid 1970s a sequence of nationwide droughts of varying severity has occurred. Following a bumper crop of 9.6 million mt in 1994 (Figure 1), the 1994-95 drought was perhaps the worst single year drought in the last century with the lowest cereal production ever reached, 1.7 million mt.

Faced with these swings in the economy, the Government of Morocco has instituted a series of emergency measures, including importing large quantities of food and feed, expanding well-drilling programs, transporting water by truck and ship, and creating jobs in the rural areas. These emergency measures, costing more than US$565 million in 1994-95, were deemed essential to protect the population from the consequences of drought but do not provide the basis of a long term strategic plan for managing future droughts.

In response to the drought of 1994-95, the Government of Morocco borrowed $100 million in the form of an emergency drought relief loan from the World Bank. Forty-four million dollars (DH 371 million) was

allocated for rural drinking water procurement, $30 million (DH 250 million) for small and medium irrigation systems, $12 million (DH 100 million) for livestock watering and pastures, and $15 million (DH 132 million) for urban drinking water.

This does not include a separate item of $14 million (DH 120 million) to cover the $6 million spent for the emergency pipeline and pumping station in Tangier nor the $125,000 per day operating cost for water tankers.

In addition to the protection of employment provided by livestock watering and irrigation programs, the rural and urban potable water programs generated 500,000 days of employment each.

At the credit level, there was a debt relief component of the 1995 drought mitigation programs amounting to 1,650 million DH ($200 million) (Oram, 1997).

In addition to drought program costs, Morocco imported additional food and feed grains amounting to 1.5 million mt of wheat, 150,000 mt of maize and 40,000 mt of animal feed stuffs costing $450 million beyond normal imports (Roggers, 1995). Moreover, 8 million doses of vaccine were distributed to protect livestock from epidemic diseases. Furthermore, the government monitored distribution of barley on the "Guichet ouvert" (open market) where 4.8 million mt sold as custom-free importation of feedstuff were allocated to the private sector; in additon around 527,000 tons of bran, dry alfalfa, and sugar beet pulp were imported.

For previous droughts of the early 1980s and 1991/92, 1992/93 the most popular drought-relief program was the "sauvegarde du cheptel (Livestock relief program) "intended to protect the livestock by decreasing the slaughtering and selling of animals that was observed in the droughts of the early 80s. The total cost of these programs from 1981 to 1995 reached about 1,334 million DH ($157 million) including subsidies and costs of transportation; around 2 million mt of feed were distributed (Laamari et al., 1997). These programs concerned the low rainfall areas (LRAs) of Morocco which have large livestock herds, and the rangeland areas.

Examples from Other WANA Countries

Oram (1997) reviewed drought mitigation policies and programs of Syria, Jordan, Tunisia and Morocco. The programs have many common features though they vary in detail. Purchase and distribution of concentrate feed (mainly barley, sorghum, maize, and bran) to livestock owners, under government control, is the key element in these programs.

In Jordan: The quantities of feed sold at subsidized prices through emergency programs were as follows: the annual average rose from 96,000 mt of barley, 95,000 mt of bran and 65,000 mt of corn/sorghum for the 1982-90 period to an average of 552,000 mt of barley, 167,000 mt of bran and 35,000 mt of corn/sorghum for 1993-1995 period. Indeed for the period 1991-96 the cumulative subsidy cost totaled about US$116 million (Oram, 1997).

In Syria: Consumption of concentrates rose from 6 percent to 25 percent of total feed supply and the contribution of rangelands fell from 65 perent to 33 percent, as sheep numbers increased by 7.8 million, doubling between 1975 and 1983 (Oram, 1997).

In Tunisia: Concentrates, which averaged under 10 percent of total feed requirements up to the mid-80s, have risen subsequently to 30 percent in normal years and 50 percent in drought years.

In the 1993-95 drought period, 991,000 mt of barley and 704,000 mt of bran were distributed to farmers and sold to the feed industry. Imports of feed barley averaged about 500,000 mt in 1994 and 1995 compared to 256,000 mt in 1993 and only 55,000 mt in 1996. Moreover there were considerable imports of bran, sorghum, oats and alfalfa in 1994 and 1995, while none were recorded for 1993 or 1996 (Boughanmi, 1997).

WHAT HAVE BEEN THE IMPACTS OF THESE POLICY INSTRUMENTS IN LRAS?

During drought periods, spatially marginal environments, economically marginal activities, and socially marginal groups are the most vulnerable. None of these marginal areas or groups is strongly buffered against changes of the environment. Even though they may not coincide, it is reasonable to suggest that each is likely to be particularly sensitive to variation in weather (Figure 2) (Parry, 1991).

A fully integrated impact assessment assumes that a study is made not only of interactions between different orders, but also of interactions within the same order, i.e., within individual sectors. The impacts can be measured at nationwide, community or farm levels.

In the region, comprehensive and serious studies of impacts of drought policies are generally lacking. It is difficult to quantify the exact impacts because there are many interactions at all levels. However, there are indications from various reports, for example:

- In Jordan, Stroebel (1996) describes the drought policy as a subsidy for overgrazing and destruction of the environment. Oram (1997) reported that these policies led to increasing

numbers of animals in marginal lands and that wealthier farmers have clearly benefitted most.

- In Syria, numbers of sheep in LRAs increased by 7.6 million between 1975 and 1983.
- In Tunisia, the impact of the "livestock relief program" has been evaluated (Boughanmi, 1996). It is concluded that the overall impact of the "Livestock Relief Program" is positive in stabilizing inventories and supply. During the1994-95 drought, both animal numbers and red meat production increased respectively by 2 percent and 3 percent. A remarkable increase in national milk production was also noticed during drought years; showing that the milk subsector took advantage of subsidized feed distribution.
- In Morocco, Laamari et al. (1997) and Sekkat (1996) analyzed the impact of the "Livestock Relief Program" in 1994-95. They reported that prices of animals, feed and food remained stable and the number of animals did not decrease as in 1992-93, when a 10 percent decrease in livestock numbers was observed, or in 1982-83 when livestock inventories dropped by 25 percent to 30 percent (Oram, 1997).

Moreover, Laamari et al. (1997) conducted a farm survey in Khouribga Province (central Morocco), the M&M Project target zone, in order to evaluate the impact of the livestock relief programs during the 1992-93 and 1994-95 droughts. One hundred twenty farmers were surveyed in three "Communes Rurales."

These farmers complained that concentrate feed, distributed by DPA (Provincial Directorate of Agriculture) in the three communities, covered only 1-1.6 percent of their livestock needs, which amount to 200 kg of barley/head/year. Moreover, the distribution procedures did not suit those farmers who have to pick up small quantities of feed from 10 to 25 km away. Large farmers who own trucks benefitted most. The authors conclude that at least in the low rainfall region of Khouribga, the livestock relief program could not reach its objectives and satisfy farmers expectations (Table 1).

Farmers in arid and semi-arid areas of Morocco have developed strategies, and tactics to cope with drought. Four adjustments to drought have been described by Herzenni (1992), Boughlala and Laamari (1992), and Nassif and Moussaoui (1992).

(a) Appropriate management of stocks and decrease in consumption costs

(b) Selective reduction of herd size by getting rid of weak animals
(c) Diversification of activities off-farm (emigration, rehabilitation of Zaouias, Mosques)
(d) Re-negotiation of livestock contracts in which the owners of animals contribute to animal feeds, which is not the case in normal years

From these examples, it is inferred that in the countries studied emergency drought relief programs have a positive impact nationwide, and partially protect the population and livestock from negative effects of drought. The measures have contributed to the preservation of the national livestock base and enabled more rapid post-drought recovery.

However, they can have negative effects too. While rich farmers benefit most, and lobby to see these programs institutionalized, poor farmers are disfavored and will probably become poorer. Meanwhile large flock owners will keep more animals in the overgrazed marginal lands. In addition, as barley is subsidized during drought years, farmers are also given an incentive to grow more barley in marginal lands. Finally, governments have to support the burden of subsidization, tax breaks, etc., and often have to borrow money to finance these programs. This situation increases foreign debt pressure, and/or a transfer of resources from other investment sectors, delaying the development of the country.

IMPROVING DROUGHT MANAGEMENT AND POLICIES IN WANA: AN ACTION PLAN

Governments in the WANA region frequently respond to drought through crisis management where the time to act is perceived by decisionmakers to be short. This often results in the implementation of hastily prepared assessment and response procedures that lead to ineffective, poorly coordinated and untimely response. If drought planning was initiated between periods of drought, the opportunity would exist to develop an organized response that might effectively address issues and specific problem areas. Moreover the limited resources available to governments to mitigate the effects of drought would be allocated in a more beneficial manner (Roggers, 1995).

Therefore, it is recommended that each country formulates a national drought plan to provide assistance in a more timely, consistent and equitable way to drought-affected areas. According to Wilhite (1986) such a plan requires:

- Reliable and timely information on drought conditions and drought- related impacts. This information must be developed and properly assembled and disseminated.
- Improved impact assessment techniques. In the case of agriculture, the first economic sector to experience the hardships of drought, new types of analysis must be developed to provide decisionmakers at all levels with the information necessary to assess the severity of drought and its impacts, so that appropriate actions can be implemented in a timely manner.
- Designation procedures should be centralized under a single committee with complete authority to determine eligibility for all assistance programs. Criteria must be determined in advance of drought, well publicized when drought occurs and applied in a consistent manner.
- Assistance programs must be developed in advance of drought to avoid delays in program formulation.

A terrible drought can also be a great teacher; it shows the strengths and weaknesses of the present institutions, technological approaches, and planning capabilities (Roggers, 1995). Thus drought can act as a catalyst for change. The social crises arising during severe droughts often stimulate governments to reorganize their institutions and procedures so that the next drought will not catch them unprepared.

The most important issue in drought management is how to reduce the risk to society from the water shortages while at the same time encouraging the best and most economic use of the water resource.

Any strategic plan to deal with drought management should have at least three major components: supply augmentation, demand management, and institutional development (Roggers, 1995). This plan should be combined with tactical planning actions such as: drought insurance, pricing and tariff selling, and use of a drought preparedness support system. Finally, the strategic plan should look at all technology options concerning water, as well as rangeland and livestock production and management.

There is an urgent need for countries of WANA to treat drought as an integral component of the production function (Oram, 1997) as well as a structural feature of their climates.

To mitigate drought in a sustainable way, it is necessary to develop a rural development strategy that deals with drought as a major constraint of the LRAs, and that targets improvement of farm revenues and

alleviation of poverty. As Oram (1997) suggested the actions should be developed around five major themes:

- Create a permanent institutional base to manage drought, identify priorities, coordinate actions, improve early warning and drought monitoring. The experience of India is relevant, with its Drought Advisory Committee (DAC) (Walker, 1991).
- Improve public investment in the development of LRAs: including investment in rural public works (roads, digging wells, building earthworks and small dams) which has been successful in Sub-Saharan Africa (Walker, 1991); implementation and generalization of water harvesting and land reclamation techniques at farm level; building schools, health centers and public services. These programs will create employment and decrease rural migration while improving revenues from off-farm activities.
- Encourage the private sector to invest in rural agricultural development of LRAs, for example, by developing small businesses, ecological tourism, generalization of mechanization, fattening live animals, marketing of feed and livestock, etc., which will increase employment opportunities and improve the livelihood of the local population.
- Implement policies that protect the environment in LRAs: discourage cultivation of marginal lands, increase shrub fodder/ agroforestry plantations alone or in association with crops in alley-cropping systems, development of loans and insurance systems to help farmers incorporate appropriate levels of risk management in individual farms, encourage cost-sharing measures (Australian approach).
- Establish a strong and effective research system network that addresses the major issues of LRAs, so as to increase and sustain productivity and alleviate poverty while reducing damage to the environment. This would help develop baseline information systems on physical, biological, sociological and economic environments. Multidisciplinary teams mixing technical and social sciences are necessary to tackle the challenges posed by production in these fragile environments. The experience of the "Centre Aridoculture INRA Settat, Morocco" is relevant and deserves to be evaluated and disseminated throughout WANA.

In conclusion, an integrated plan of action is necessary in order to cope with devastating effects of drought. The 10 steps of a drought

planning process suggested by Wilhite (1991) in the USA might be used as a basis for effective drought planning in WANA (Table 2). Moreover, as indicated on page 14, farmers have learned to face droughts by their own means and have developed indigenous techniques and procedures that should be evaluated and incorporated in any drought planning strategy.

REFERENCES

Ben Dhia, M. and L. Messaoudi. 1996. Les Mesures d'Allégement des Effets de la Sécheresse. Draft report, pp 14. Office de l'Elevage et des Pâturages/ Ministère de l'Agriculture de Tunisie. Atelier Régional sur l'Amélioration des Parcours, Mai 23-25, 1996, INPFCA- Sidi Thabet, Tunisie.

Blumenstock. 1992. Wilhite & Glantz. 1987.

Boughlala, M and A. Laamari. 1992. Effets de Sécheresse Sur le Marché des Animaux et Produits Agricoles.p 27-29. In *Sécheresse 1991-92: Manifestations et Implications* ed. Derkaoui, Nassif and Benaouda. Report INRA/USAID. Centre Aridoculture. Settat, Morocco.

Boughanmi, H. 1996. Drought Management and Public Policy. Draft Report on Tunisia. M&M Project, INRA, Tunisia.

El Beltagy, A. 1997. West Asia and North Africa: A Regional Vision. ICARDA, brochure pp. 16. ICARDA, Aleppo Syria.

Gibbs, W. J. 1975. Drought, its Definition, Delineation and Effects, pp. 39. Special Environmental Report No. 5, Drought World Meteorological Organization. No. 403.

Herzenni, A. 1992. Village de la Haute Chaouia Face à la Menace d'une Année Sèche. p.30-32. In *Sécheresse 1991-92: Manifestations et implications*, ed. Derkaoui, Nassif and Benaouda. Report INRA/USAID. Centre Aridoculture. Settat, Morocco.

Hudson. 1964. Wilhite & Glantz. 1987.

Laamari, A., M. El Mourid, and N. M. Chaherli. 1997. Sécheresse et Interventions de l'État au Maroc. Draft report pp. 26. M&M Project INRA, Settat, Morocco.

Maingnet, M. 1995. La Pomme et la Sécheresse. Masson Géographe - Paris.

Nassif, F. and M. Moussaoui. 1992. Comportement Socio-économique des Agriculteurs en Situation de Sécheresse, pp. 33-37. In *Sècheresse 1991-92: Manifestations et Implications* ed. Derkaoui,

Nassif and Benaouda. Report INRA/USAID. Centre Aridoculture, Settat, Morocco.

Nordblom, T. L. and F. Shomo. 1995. Food and Feed Prospects to 2020 in the West Asia/ North Africa Region. ICARDA Social Science Paper No. 2, 56 pp. (ICARDA, Aleppo, Syria).

Oram, P. 1997. The Influence of Government Policies on Livestock Production and the Environment in West Asia and North Africa. Proceedings of the International Conference on Livestock and the Environment. Ede/Wageningen. June 1997.

Parry, M. L. 1991. Assessment of the Impact of Climatic Variability. In *Climate Risk in Crop Production Models and Management of the Semi-Arid Tropics and Subtropics*, ed. Muchow and Bellamy, pp. 19-35. Proceedings of the International Symposium, Brisbane, Australia, 2-6 July, 1990. CAB International.

Randas. 1960. Wilhite & Glantz. 1987.

Roggers, P. 1995. La Grande Sechéresse. Strategic Considerations, p. 19. Morocco Report to USAID Morocco.

Sakiss, N., N. Ennabli, M. S. Slimani and H. Baccour. 1994. La Pluviométrie en Tunisie a-t-elle Changé Depuis 2000 ans? Recherche de Tendances et de Cycles Dans les Séries Pluviométriques. Rapport Ministères du Transport, de l'Agriculture et de l'Environnment et de l'Aménagement du Territoire pp. 283. Imprimerie officielle, Tunisie.

Sekkat, M. R. 1996. Sauvegarde et Protection du Cheptel en Cas de Sécheresse. Cas du Maroc. Draft report pp. 18. Ministère de l'Agriculture et de la Mise en Valeur Agricole. Direction de l'Élevage. Présentation à l'Atelier Régional sur l'Amélioration des Parcours. Tunisie 23-25 Mai 1996.

Stroebel. 1996.

Van Schoonhoven, A. 1991. Soil and Crop Management for Improved Water Use Efficiency in Dry Areas: The Challenge. In *Soil and Crop Management for Improved Water Use Efficiency in Rainfed*

Areas, ed. Harris, Cooper and Pala, pp. 3-8.. Proceedings International Workshop. ICARDA, Ankara, Turkey, May 15-19, 1989.

Walker, T. S. 1991. Improved Technology in Relation to Other Options for Dealing with Climatic Risk to Crop Production in the Semi-Arid Tropics. In *Climatic Risk in Crop Production: Models and Management of the Semi-Arid Tropics and Subtropics*, ed. Muchow and Bellamy, pp. 511-525. Proceedings of the International Symposium. Brisbane, Australia, July 2-6, 1990, CAB International.

Wilhite, D. A. 1991. Drought Planning: A Process for State Government. *Water Resources Bulletin (USA)* 27 (1): 29-38.

Wilhite D. A. and M. H. Glantz. 1987. Understanding the Drought Phenomenon: The Role of Definitions. In *Planning for Drought: Toward a Reduction of Social Vulnerability*, ed. Wilhite and Easterling, p. 11-27. Boulder, Colo.: Westview Press.

Wilhite, D. A. 1986: Drought Policy in the U.S. and Australia: A Comparative Analysis *Water Resources Bulletin* 22 (3): 425-437.

Table 1: Distribution of animal-feed to farmers in three communities (communes rurales) of Khouribga Province during the 1991-93 drought (Laamari et al., 1997)

Statistical descriptors	Beni Ikhlef	Ouled Fennane	Foqra
	-Kg-		
Number of observations	989	727	641
Average distributed	142	74	144
Standard deviation	117	32	148
Median	100	65	100
Mode	100	65	65
Kurtosis	75	-0.57	12
Skewnesss	7	-0.59	3
Total kg	**140,448**	**50,890**	**92,304**
Average no. of sheep equivalent per farmer	47	41	59

Table 2: The ten-step drought planning process (Wilhite, 1991)

Step1:	Appointment of Task Force
Step2:	Statement of Drought Policy and Plan Objectives
Step3:	Avoiding and Resolving Conflicts between Environmental and Economic Sectors
Step 4:	Inventory of Natural, Biological, Human Resources, and Financial Legal Contraints.
Step 5:	Development of Drought Plan
Step 6:	Identification of Research Needs and Institutional Gaps
Step 7:	Synthesis of Scientific and Policy Issues
Step 8:	Implementation of Drought Plan
Step 9:	Developments of Multilevel Educational and Training Programs
Step 10:	Development of Drought Plan Evaluation Procedures

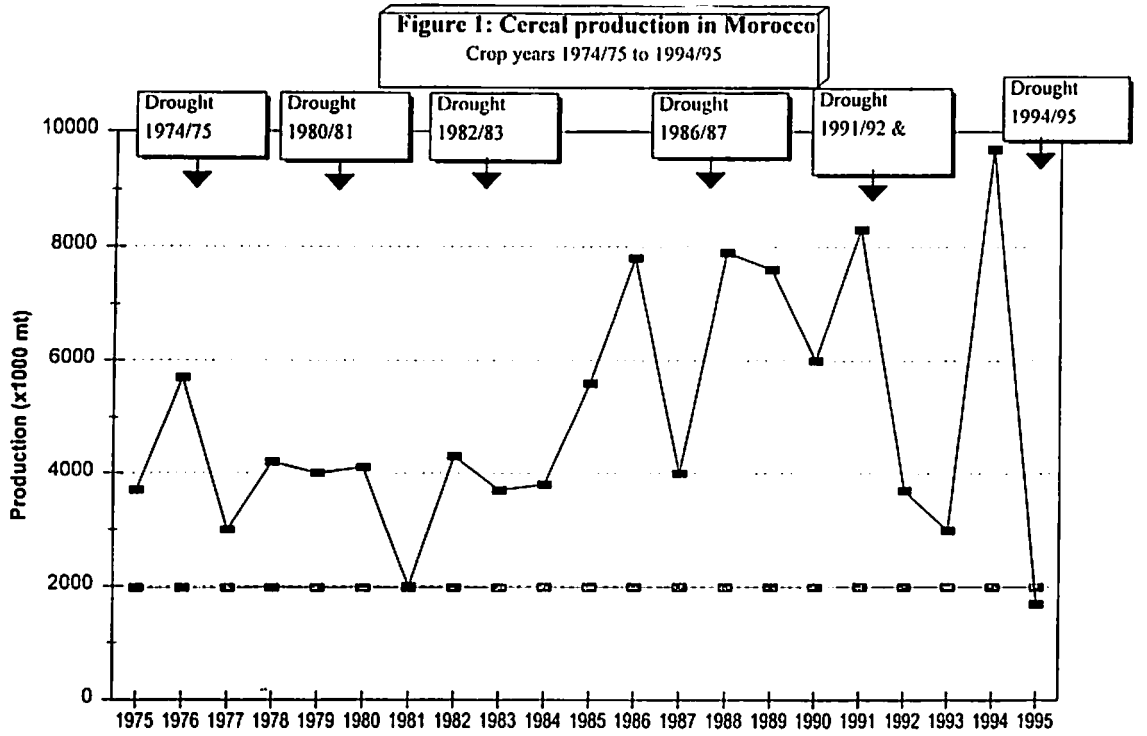
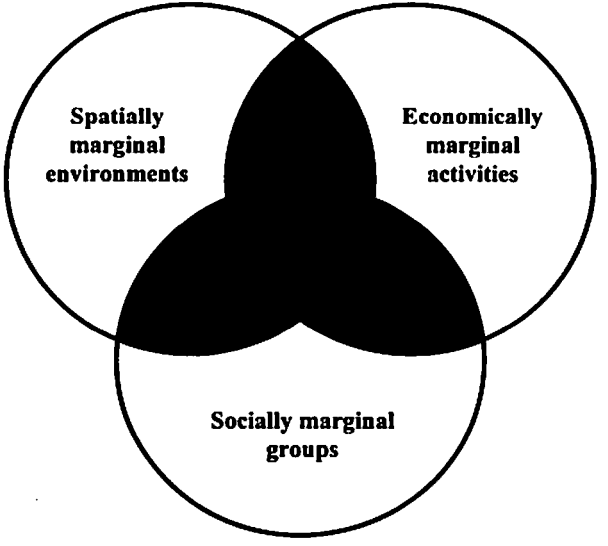


Figure 1: Cereal production in Morocco
Crop years 1974/75 to 1994/95
Drought 1974/75
Drought 1980/81
Drought 1982/83
Drought 1986/87
Drought 1991/92 &
Drought 1994/95
Production (x1000 mt)
10000
8000
6000
4000
2000
0
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995

Figure 2: Types of marginality (Parry 1991)



FACILITATING WIDER ADOPTION OF EXISTING AND PROMISING NEW TECHNOLOGIES IN THE LOW RAINFALL AREAS

Nasri Haddad[14]

ABSTRACT

Research activities addressing the problems associated with low rainfall areas (LRAs) in West Asia and North Africa countries have only started in recent years. These efforts were strengthened by the establishment of ICARDA in the region in 1977, more long-term, multi-disciplinary research work was initiated and promising results were achieved.

Several technologies have been identified to improve the productivity of barley-livestock based farming systems, which could both increase the yield and maintain the resources. Moreover, technologies for rangeland and marginal land rehabilitation seem to be promising but need more adaptative research for their verification and adoption.

The adoption rate of technologies in LRAs is in general low, and differs by technology, cropping system and target groups of land users. However, numerous technical and policy constraints limit their wider adoption. These include: i) common property issues in the rangelands and disputes on land ownership; ii) the need to lift feed subsidies and replace them by a government support program for farmers and herders in drought years; iii) the unavailability or insufficiency of improved seed; iv) unavailability of other inputs at a reasonable price; v) the need for credit; and, vi) weak extension systems, especially with respect to livestock.

On the technical side, the constraints include: i) the need to breed more drought tolerant varieties and species; ii) several impediments to diversification of cropping systems to include fruit trees; iii) poor water harvesting techniques; and, iv) limited crop-livestock integration.

The paper concludes with a summary of measures which could help to alleviate these technical, policy, and socio-economic constraints.

---

[14]Nasri Haddad is the Regional Coordinator, Nile Valley Regional Program, ICARDA, Cairo, Egypt. He was previously coordinator of the M&M Project, ICARDA, Amman, Jordan.

Governments and donors should invest more in research and development for the LRAs, and should consider the social and the environmental benefits as part of the return to their investment in these areas.

IMPEDIMENTS TO IMPROVING AGRICULTURAL PRODUCTIVITY IN THE LRAs

The West Asia and North Africa (WANA) region is characterized by high population growth rates, large and rapidly increasing food shortages, highly variable national and per capita income levels, and limited natural resources, particularly of arable land and water. The climatic features of the area, especially low and variable rainfall, limit the options available to farmers. Economic growth, increasing urbanization and the accompanying rising consumer demand have been forcing changes in production practices that threaten the natural resource base of the region (ICARDA, 1996).

The region has experienced a substantial increase in the number of animals over the last two decades. This has been particularly noticeable at the drier end of the arable farming spectrum where more native pasture lands are open to free grazing, resulting in overgrazing and rangeland degradation. As a result, the contribution of natural grazing as a proportion of total feed resources, in many countries has declined from around 70 percent in the 1950s to only 20 percent at present. Likewise, soil fertility in areas cultivated with barley is rapidly depleting, and pest and diseases have built up, due to the cultivation of previously uncultivated marginal land and the replacement of the annual fallow areas with continuous barley cropping (ICARDA, 1997).

While farmers in the higher rainfall areas have been able to benefit from intensification of production, diversification of cropping patterns and commercialization, the scope of such progress is more limited in the lower rainfall environments. Rural populations in these less favored areas are often forced to pursue production strategies which, while meeting short-term requirements, are in the long term destructive and unsustainable.

Inappropriate policies regarding land use, and the absence of secure property rights has exacerbated the problem. In most countries of the region, the traditional local institutions governing access to grazing lands have been disrupted, resulting in a system of "open access" with no corresponding regulatory mechanism to control the extent and intensity of grazing. In addition to its unfavorable environmental impact, there are

indications that the decline in the productivity of the rangelands is contributing to poverty and out-migration.

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

This paper will briefly review the technologies that have been developed for the improvement of productivity in the LRAs of WANA; identify promising technologies with potential in these areas; identify constraints that limit their use by farmers and herders, and indicate measures to facilitate their wider adoption.

DRYLAND AGRICULTURE AND THE LRAs

Dryland agriculture is, by definition, agriculture dependent upon the vagaries of weather, especially rainfall. Above all, dryland agricultural systems must emphasize the capture and efficient use of rainfall (Clarke, 1988). The FAO classification of drylands includes arid lands experiencing a crop growing period of up to 74 days; while semi-arid lands have a growing period of 75 to 119 days (FAO, 1987).

However, LRAs is a loose term which could refer to different situations and environments in different countries. Therefore, this paper will be confined to the LRAs as addressed by the Mashreq/Maghreb project. In this context they refer to the area primarily involved in the barley-based farming system, extending to steppes and rangelands, and where raising small ruminants is a dominant and integrated element of agricultural activities. The average annual rainfall ranges from 350 mm down to areas receiving 100 mm. The growing season for barley usually exceeds 74 days when it is located in the relatively high rainfall areas, but it can require less time when planted at the dry end of the zone. Therefore, and according to the FAO definition for dryland, the LRAs stretch into both the arid and semi arid-lands. However, in the steppe, the amount of rainfall does not mean much; instead, the available water, which can be harvested either naturally through flooding or artificially by proper conservation techniques, is more important. In these areas, valley basins (Marabs) which are flooded by water during a certain period of the season, are important areas for grazing and for future development.

INVESTMENT IN THE LRAs

Given the constraints to production in LRAs, investment there has been less attractive for governments and donors compared to higher potential areas. The classical government intervention in LRAs has come in the form of relief programs in response to drought, in order to help inhabitants of those regions to survive. By comparison investment in technology development has been even lower. This is due to several factors including: low economic returns to investment, the high risks involved, poor infrastructure and governmental attention to sustainable development in these areas and, finally, a diversity of problems and disputes among the inhabitants who claim ownership of the land (mainly rangeland) and between them and the government over the rights to common property.

However, although the issue of priorities for research investment in LRAs versus concentration of resources in regions of higher agricultural potential is still controversial, there is good evidence that returns on investment towards integrated development of LRAs would justify giving them greater priority. The joint work of multidisciplinary teams of biophysical and social scientists in the Mashreq/Maghreb project has led to the following consensus regarding the development of those areas (ICARDA/IFPRI, 1996):

- With appropriate policy and property rights reforms, and with sufficient and appropriate agricultural research, it is possible to increase productivity in the LRAs on sustainable basis; and
- It may be possible to design public investments in LRAs that are competitive with those in high rainfall regions, especially if social (poverty reduction) and environmental benefits are to be considered in addition to productivity gains.

This indicates clearly that calculating returns to investment in LRAs should not be based solely on economic criteria but should also take into consideration resource sustainability and alleviation of poverty of the inhabitants of those areas, issues which are reflected in the main themes of this conference as a triangle of growth, sustainable resource management and poverty alleviation.

TECHNOLOGIES DEVELOPED FOR THE LRAs

Research activities addressing the problems associated with LRAs in West Asia and North African countries have started only recently. Previously, governmental attention and investments were all oriented toward the higher rainfall and irrigated areas, which is not surprising in

view of the high returns to investment there. These areas are heavily populated and have more influence with government officials. However, recently, governments and international and regional organizations have started to focus attention on the development of technologies suited to LRAs, for the following reasons.

- The LRAs are inhabited by the poorest sector of the population, resulting in spontaneous migration to the highly populated areas in the cities.
- The natural resources of soil and vegetation are suffering from heavy degradation due to the mismanagement of these areas, and signs of desertification are evident.
- In some countries the LRAs are the only remaining resources where the potential for agricultural production exists, if proper and sustainable technologies could be developed and implemented.
- The socio-economic issues of poverty and malnutrition of the inhabitants of these areas are added factors that contribute to governments giving them more attention.

Developing technology for the LRAs in the WANA countries began with a modest effort addressing single factors and lacking the integration between bio-physical and socio-economical components. With the establishment of ICARDA in 1987, more long-term, multi-disciplinary research work started to address the problems of LRAs in the region.

The findings presented here are a synthesis of the outcome of research carried out by national programs, by ICARDA, and by other regional organizations in this region. Examples from the experience gained in the Mashreq project and the subsequent Mashreq/Maghreb project will be cited to demonstrate the technological potential and the constraints facing technology adoption and future impact.

Are the available technologies appropriate for the LRAs? What makes technology appropriate and widely adopted? These are important questions that need to be addressed, and on which the conference should arrive at a consensus. An appropriate technology needs to be:

- simple and easy to apply to users;
- stable over years and locations (wide adoption);
- low risk;
- socially acceptable;
- economically sound; and
- able to maintain and conserve the resource base

AGRICULTURAL PRODUCTION SYSTEMS IN LRAs

There is a need to distinguish between two groups of farmers and farming systems in the LRA:

(a) The barley-based farming system X 350-200 mm mean annual precipitation.

(b) The rangeland system < 200 mm mean annual precipitation.

Small ruminants (sheep and goats) are considered an integral part of both systems. Two topics that will be discussed in connection with these systems are: technology for livestock improvement, and water-capturing techniques, to emphasize their importance and the constraints that limit their adoption in the LRA.

In spite of the close connection between the two main systems, resource utilization, land users' interest, socio-economic aspects, and technologies for the development of these areas tend to differ. Moreover, policies and their interaction with the applied technologies and their output and adoption also differ.

Therefore in addition to discussing the available technologies for the LRAs under the two main systems; the paper will also examine the interaction and integration between the two systems.

THE BARLEY-BASED FARMING SYSTEM

Technologies developed for the barley-based farming system have focused on improving the productivity of barley crops, with emphasis on a crop-livestock production approach. The technological achievements and the progress that has been made, as well as how much of it has been hindered by some national policies and institutional arrangements in the WANA countries, will be discussed under two main headings:

Improving crop productivity: through crop genetic improvement and fertilizer application

Improving production system: through the introduction of legumes in rotation with barley and crop-livestock integration

Crop genetic improvement: development of new barley cultivars. Extensive work has been done in the WANA region on the development of new barley cultivars that have high yield and high adaptability to the LRAs. Joint efforts by ICARDA and the national programs have resulted in the release of several new cultivars. However, the adoption rate of these new high yielding cultivars have varied from one country to the other: whereas large scale adoption was reported for Rihan in Iraq, Tunisia and Lebanon (Mashreq/Maghreb project 1996) lower rates of

adoption were reported in other countries. The slow process of adoption was due both to policy-related and technical issues, including:

- Improved seed is not produced in adequate quantities and at competitive prices. Farmers in Syria, for example, indicated that the high price of improved seed sold by the government discouraged them from using improved cultivars. This is a government policy which needs to be modified.
- Another important issue limiting adoption of improved cultivars is the policy of some governments of subsidizing the cost of barley grain, making it available in the market at a lower price, thus discouraging farmers from investing in new technologies.
- From the technical point of view, the yield advantage of the improved cultivars in farmers' field conditions rarely exceeded 10 percent, which is considered to be low, especially in LRAs.
- Moreover, while some of the improved cultivars possess high grain yield potential not much attention has been paid to the quality of straw and grain as feed for small ruminants. This issue of quality is now being addressed by the ICARDA barley breeding program, and early consultation with farmers and herders, regarding the new cultivars, at the pre-released stage is being undertaken by ICARDA and by the Mashreq/Maghreb project.

Barley fertilization. The major feature of barley production in the LRAs is the great year to year variability in yield and response to fertilizer. However, as a result of the depletion of soil fertility due to continuous barley cultivation, the response of barley straw and grain yield to fertilizers has recently become more pronounced. Demonstrations on farmers fields, carried out by the project, indicate that fertilizer application to barley increases grain and straw yield, reduces risk, and increases the farmers' net return.

For example, in Jordan, the average increase in grain yield due to fertilization was around 43 percent and 36 percent for straw. In Syria, the increase in grain yield ranged from 13 percent to 79 percent, with an average increase in local barley yield of 67 percent. Maximum grain yield potential of the improved cultivar was realized when fertilizer was applied, with 50 percent higher yield than when unfertilized. Fertilizer application improved the grain yield of the local barley by 34 percent and its straw yield by 62 percent (Mashreq/Maghreb project's annual reports).

Until recently national policies in Syria and Iraq regarding the allocation of fertilizers to different agro-ecological zones did not permit its use for the barley crop, which is traditionally grown in the LRAs; instead the irrigated and high rainfall area crops, such as wheat, were favored.

Studies by Saade (1991) and El-Hajj and Saade (1992) (both cited by Nordblom and Shomo in 1995), who investigated the returns to both nitrogen and phosphate fertilizer allocations to different crop combinations and different zones, indicated that significant gains could be made by reducing the allocation to the higher rainfall crops and increasing it for dryland barley. It showed a potential upward shift of 4.2 percent in national agricultural domestic product by supplementing domestic fertilizer production with imports to satisfy farmers' demands.

As a result of these findings and related research, policy has been changed in Syria to allocate fertilizer to barley. Similar actions were recently taken by Iraq. This is a good example of how policy makers can change their policies when research can provide them with proof of the benefits at the national level.

Adoption of the barley fertilization technology has increased in the last few years but is still below expectations, in spite of the benefits farmers are getting. This is mainly due to the high cost of fertilizer, its unavailability at the proper time and place and, more important, to the policies of certain governments that subsidize barley grain prices, making grain available to farmers and herders at lower prices and discouraging farmers from investing in barley technology.

Barley systems, crop rotation, and crop-livestock integration. In the past, farmers grew barley in a fallow-barley rotation. However, recently a continuous barley system has become common practice in the LRAs, resulting in the depletion of soil fertility and the appearance of soil borne insects and diseases. The technical solution to this problem is to introduce forage legumes in rotation with barley, particularly medics (*Medicago spp.)* and/or Bekia (*Vicia sativa*). Long-term studies in ICARDA show that this barley-forage legume rotation is more profitable to farmers, and is considered a sustainable system since it fixes atmospheric nitrogen in the soil, improves the soil's physical properties and provides high quality fodder for the livestock, which encourages crop/livestock integration.

Yet this system is still not widely adopted due to technical and policy obstacles. From the technical point of view, more work is needed to identify legume genotypes and species that withstand drought and low winter temperatures, and are palatable to the animals. More work is also

needed regarding grazing management. Moreover, mechanized harvesting of these crops is still not fully resolved in the region, which slows down its adoption by farmers. On the policy side, the legume seed production system needs to be established, and this requires government support. Moreover, regulations in some countries, including Syria and Iraq, require all sheep flocks to move out of the arable area from mid-February through harvest time, the main period of crop growth, due to the fear of night-grazing of crops by the flocks. This conflicts directly with efforts to better integrate livestock and crop production by using sown pastures grown in rotation with barley. Revision of such policies will enhance adoption of these technologies.

RANGELANDS SYSTEMS

In this context we define rangeland as terrain adjacent to the barley production areas that usually receives less than 200 mm of annual rainfall. Some refer to it as native pasture or steppeland.

Technologies available for rangeland rehabilitation are limited and have not been adopted by land users. The technology solutions, or the single-practice solution, do not consider integration with livestock and have been developed in isolation from land users.

Adopting the technology needed for rangeland rehabilitation is most difficult in the LRAs. Its verification and adaptation to local conditions, which is an important step in technology transfer, face serious problems of property rights and ownership disputes, as rangeland is a common property in most WANA countries. As a result, technologies available for rangeland have mostly been tested and evaluated under controlled reserves or government stations, with little involvement of land users. However, exceptions can be found in some countries, such as Tunisia, where a large proportion of the rangeland is privately owned.

The development of sustainable, socially and environmentally acceptable rehabilitation and management measures for rangeland areas can only be achieved through integrated research, including ecological assessments and inventories of resources. Remote sensing and GIS application are relatively new techniques for determining the trends and severity of resource degradation for evaluating future resource hazards, identifying macro and micro-catchments for water harvesting, and for producing sustainable land-use maps. These techniques are now being used by some national and international institutions in the region, and hopefully they will facilitate efforts towards the sustainable and productive development of rangelands.

However, participation of inhabitants and land users in the early stages of research, at the diagnosis stage, and later in technology development and transfer, is essential for a successful effort as well as for future adoption of the recommended technologies.

The following section will briefly review some of the technologies that have been developed for the improvement of the rangeland and marginal areas, and assess the constraints that limit their wider adoption.

Seeding of shrubs for rangeland rehabilitation: This is the most common practice in many countries of the region. *Atriplex spp, Salsola spp* and *Acacia spp* have been planted and protected from grazing in several countries of WANA. In Syria, for example, around 0.1 million ha is planted with shrubs. However, the biggest challenge is how to manage these plantations in a sustainable way, with benefits both for the environment and for livestock production.

The economic benefit, when studied under controlled conditions, with government management, showed that milk production during the 15 weeks of lactation of sheep grazing shrub-seeded pastures was double that of sheep grazing on native unimproved pasture.

Barley-shrub alley cropping: Barley cultivation has encroached on the steppe in many countries of the region, resulting in destruction of the native vegetation and soil depletion. Research conducted in Syria (ICARDA, 1994) indicated that around one-third of the steppeland covered in the study was cultivated with barley.

Alley cropping of barley with shrubs appears a more attractive alternative for land users than continuous barley or shrubs alone; the barley crop gives them some short-term security, while in time they will also realize the benefit of the shrubs in the improvement of the land and additional feed for their animals.

Phosphorus application: Phosphorus application to marginal areas with annual rainfall above 250 mm is a promising practice, which has resulted in improving vegetation, enhancing the growth of legume species, and enriching the seed bank. However, the economics of such technologies need to be evaluated and land ownership issues must be resolved.

Marginal land rehabilitation: The rehabilitation of marginal land through seeding with legumes collected on native pasture and with phosphorous fertilization was also found to be successful. However, the success of this technology will depend on the management of the pasture by the owners. The main constraint is the ownership and control problem of the marginal lands with a traditionally open access to herders (ICARDA, 1993 and 1994).

Spineless cactus: Spineless cactus has a high biomass yield, evergreen habit, high palatability, and is drought and salinity tolerant. The plant can also be used for soil conservation. The experience of Tunisia show that cactus is adapted to low moisture, can be used successfully in alley cropping with barley or shrubs, and provides good feed for small ruminants when it is fed in combination with Acacia, Atriplex, or treated straw. More attention should be given to this crop in the development of LRAs (Nefzaoui and Ben Salem 1997).

Rangeland rehabilitation by shrub plantation should be coupled with water harvesting techniques to ensure success in reseeding, and economical biomass production. The idea of combining direct seeding with micro-water catchments to improve water availability to newly established shrubs after initial germination was developed by ICARDA scientists, using a simple pitting machine (ICARDA, 1994). The machine is cheap to build and easy to operate. It is now under test in Syria and Jordan.

The issue of rangeland property rights is the main policy constraint to rangeland development efforts in the region. This issue should be settled in consultation with the land users. The solution will differ from country to country: while private ownership is the best solution in one country, cooperative utilization could be the best system in another. However, no sustainable development can be achieved without the participation of land users in rehabilitation, utilization, and conservation of the rangeland. Also, finding alternative fuel sources for the inhabitants' use is important so as to reduce uprooting of shrubs as a source of fuel. Policies to regulate the number of small ruminants in a given area, to maintain a safe balance for resource conservation, are also needed.

On the technical side, many issues still need to be addressed, including direct seeding of shrubs vs. transplanting, selection of adapted native species for rangeland, and grazing management.

Livestock. Because of the importance of livestock as an integrated component of the production systems in the LRAs it will be discussed here as a separate section but closely interrelated to the other topics discussed earlier.

Major areas which require technology intervention in relation to livestock are: animal health, genetic improvement, reproductive physiology, nutrition and management.

In WANA the governments' major investment in animal health tends to be in the veterinary services, which in many countries appears greater than in some industrialized countries where livestock accounts for a

major share of the value of agricultural production (Nordblom and Shomo, 1995). However, not much research is carried out in the region regarding the diseases and pests of small ruminants, and their control. Most of the interventions follow the recommendation of the pharmaceutical manufacturing companies. There is need for investment in research in this area, to identify the prevailing diseases and improve the efficiency and effectiveness of their treatment.

Research on small ruminant genetic improvement is carried out in several national programs in the region with modest progress. ACSAD is assisting in this effort and has a station in Salamieh, Syria, for this purpose. Ongoing work in Morocco and Iraq also seems to be promising.

Research on reproductive physiology and in nutrition and management is receiving attention in many countries. Extensive work on-farmer flocks is being conducted through the ICARDA Mashreq-Maghreb project with very promising results. The areas that have been covered include:

- The use of sponge and PMSG hormone for ewe synchronization and increasing twinning rates, shows good results. Synchronization assists in having ewes give birth during a specific period, which facilitates flock management and orderly marketing of the lambs. Twinning rates showed a substantial increase over control due to the treatment.
- Early weaning of lambs has resulted in increased milk production and has attracted farmer attention due to its low cost.
- Injection with vitamin A during drought years (when there are no green roughages) has resulted in the improvement of ewe fertility.

In the area of nutrition, several on-flock owner research activities were conducted and resulted in substantial improvement. These activities included:

- The production and utilization of feed blocks from agricultural and industrial by-products. This has resulted in reduced costs of feed and improved productivity. This technology is now being adopted by many farmers in several countries of the region.
- Urea treatment of straw, which improves its digestibility and nutritive value. Here again, adoption of the system has slowly increased, but more effort is needed.

In brief, many technologies that could improve the production of small ruminants are available, more research work is needed in two important areas:

Low ewe fertility. This is a common problem in the region, which seriously affects the productivity of small ruminants. Some work is now being conducted which will help identify the cause of low fertility and recommend ways to address it.

Micro nutrient deficiency. A survey has indicated symptomatic evidence of widespread deficiency in sodium, zinc, and vitamin E in sheep in Jordan, Syria, and Turkey. The conclusion of this survey is that current feeding practices do not provide mineral and vitamin requirements, and diets are deficient in both macro- and micro nutrients (ICARDA, 1994).

In spite of the fact that several technologies have been developed to improve livestock production and have been verified and tested on farmers' sheep flocks, with their participation, wide adoption of these technologies has not yet been realized. Some of the reasons that can be cited are:

- Weak and low priority extension effort regarding livestock.
- Rapid and sudden policy changes in some countries that discourage owners from investing in technologies which could improve their animal's productivity; among these changes are: import-export policies, and restraints on movement of flocks across borders.
- Marketing problems, especially regarding milk produced in remote areas.
- Credit facilities are cited as a reason, in some countries, for limited investment in new technologies.
- Feed subsidies: the feed subsidy policy is a major factor in discouraging farmers and sheep owners from adopting research results since feed is available to them a price lower than the cost of its production. Consequently, farmers are not interested in investing more in barley production, since they do not get a good price selling it, as was indicated earlier and, at the same time, they can purchase it from the government at lower prices. Some farmers in Jordan used to sell their barley in the market and get their animal's needs from the subsidies on barley. Moreover, the availability of subsidized feed discourages sheep owners from adopting technology for producing cheap feed such as by-product feed blocks and treated straw. It has been observed in Jordan, that after the recent government decision

to lift the subsidies on barley and animal feed, farmers and sheep owners started to ask research and extension staff about feed blocks, urea-treated straw and forage grazing and showed more willingness to adopt those technologies.

On the other hand, removing feed subsidies increases the cost of feed and flock owners' strategies in raising sheep start to change. Before subsidy removal, owners tended to keep large numbers of animals, partly as a matter of pride since many of these animals were non-productive. Now they are more careful, keeping the most productive members of their flocks, and getting rid of all non-productive animals. Some farmers in Jordan have indicated that they reduced the size of their flocks by 20 percent to 25 percent. This should also reduce pressures on rangeland. This experience should be carefully evaluated, since important lessons may be learned from it.

Even though lifting subsidies appears to be a positive move, incentive programs to encourage and assist sheep owners in dry areas to maintain raising animals during drought years should be considered by governments. Past experience with drought emergency efforts in WANA, indicated that future programs should be carefully studied and prepared well ahead of their implementation.

WATER HARVESTING IN LRAS

Through the utilization of water harvesting techniques, a few millimeters of rainfall collected in a catchment basin can be equivalent to several hundred millimeters of rainfall when supplied to an individual cultivated field (Perrier, 1988). The technological possibilities for water harvesting will depend on several factors related to soil, adequate catchment areas, logical dam sites and storage areas. The collected runoff water can be stored in the soil, behind dams, or in *wadis*; and can be used for the artificial recharge of aquifers or for supplemental irrigation; or captured in-place on contour ridges, terraces or tied-ridged agricultural fields.

The application of water harvesting techniques is a necessary component to developing the LRAs. Under rangeland conditions, water harvesting, coupled with contour benching, is essential for the success of rangeland reseeding (Le Houe'rou, 1997). Captured water, when stored and used for supplemental irrigation, will assist in the development of integrated crop-livestock, agroforestry, and intercropping systems, which can provide more stable production in a fragile environment, and also create opportunities for crop diversification as shown in Jordan and Tunisia where fruit trees, such as olives and almonds, are being

successfully grown. Therefore, it must be given serious consideration and integrated with other technological options available for the development of the LRA. Transfer of these technologies must include a detailed cost-benefit analysis of increased crop yields and an assessment of the long-term benefits of controlling soil erosion and preserving the sustainability of agricultural production.

However, the techniques of water capturing schemes are still not very common and technology transfer efforts are weak and face many constraints; limits to its adoption are partly technical, partly of a socio-economic nature. They include:

- Problems of property rights in the catchment area and legal disputes on the utilization of water, especially in *wadis* which run through a long strip of land (head and tail land owners);
- Inadequate characterization of soil profiles and associated physical properties of soils;
- Limited applicability of the results because of their site-specific nature with regard to water capture and use of the research site; and
- A community approach to water collection and utilization which may require special policy and other arrangements by government institutions.

SUGGESTED MEANS TO ALLEVIATE CONSTRAINTS

This section presents ideas that may help alleviate the constraints facing wider adoption of the technology, which are of technical or of policy and socio-economic nature.

- Government policies have resulted in inadequate long-term investments in LRAs, including training professional staff for research and extension. Greater investment in research and extension is needed both for solving the problems of LRAs, and for wider adoption of the solutions.
- Governments, research institutions, and donor agencies should take into consideration the social and environmental benefits of the development of LRA and consider them as part of the return to investment in these areas.
- Government officials, policy makers, and donors should be aware that time horizons for progress in LRA are generally much longer than for high rainfall or irrigated agriculture.

- Government policies and programs should be linked to integrated production system technologies rather than to single dryland and resource conservation practices.
- Feed subsidies should be lifted and replaced with a farmer support program, to be implemented when needed.
- Low rainfall, high rainfall, and irrigated agricultural production programs should be planned and implemented as integrated, complementary systems.
- Alternative and compatible crops for the low rainfall system are limited and so is the adoption of a more productive cropping system. Lack of market alternatives for crops produced in the LRAs further limit the options, therefore more work is needed in this direction.
- Diversification of crops and cropping systems is needed for LRAs. Tree plantations with the use of water harvesting and supplemental irrigation techniques should, wherever possible, be introduced to the LRAs. This will reduce risk and give more production and income stability to land users.
- Biotechnology should play an important role in the LRA through the development of drought tolerant plant species and varieties, and for the improvement of livestock productivity.
- Technology transfer for rangeland improvement needs to be refined and new approaches should be initiated. However, without solving property rights issues in the rangelands, technical solutions may not be adopted and overuse of the resources by their inhabitants will continue.
- Farmers' and land users' participation in the development and transfer of technology of LRAs is minimal and needs to be strengthened.
- To facilitate the development, adaptation, and adoption of low rainfall farming technology, a network of national and international organizations is essential.

REFERENCES

Clarke, N.P. 1988. Welcome and Overview. In *Challenges in Dryland Agriculture. A Global Perspective*, ed. P. Unger, T. Sneed, W. Jordan, and R. Jensen, pp. 3-5. Texas Agricultural Experimental Station. U.S.A.

El-Hajj, K. and M. Saade. 1992. An Economic Analysis of Fertilizer Allocation Strategies in the Syrian Arab Republic. In *Fertilizer Use Efficiency Under Rainfed Agriculture in West Asia and North Africa: Proceedings of the Fourth Regional Workshop*, ed. J. Rayan, A. Matar, pp 227-245. May 5-10, 1991, Aghadir, Morocco.

FAO. 1987. Improving Productivity of Dryland Areas. Committee on Agriculture. Ninth session. Food and Agriculture Organization of the United Nations. Rome, Italy.

ICARDA. 1993. Pasture, Forage and Livestock Program. Annual Report. International Center for Agricultural Research in the Dry Areas, Aleppo, Syria.

ICARDA. 1994. Pasture, Forage and Livestock Program. Annual Report. International Center for Agricultural Research in the Dry Areas, Aleppo, Syria.

ICARDA. 1996a. Medium-Term Plan. 1998-2000. ICARDA.

ICARDA. 1996b. Mashreq/Maghreb Project Document. ICARDA.

ICARDA. 1997. Mashreq/Maghreb Project Document. Phase II. ICARDA.

ICARDA/IFPRI. 1996. The Role of Social Science in the Work of the Mashreq/Maghreb Project. ICARDA, Aleppo, Syria/IFPRI, Washington, D.C., U.S.A.

Le Houe'rou, H. N. 1997. Germplasm for Arid land Rehabilitation in Jordan. Consultants report. ICARDA.

Mashreq/Maghreb Project. 1996. Annual Report for the 1995/1996 Growing Season in Iraq. IPA Agricultural Research Center,

Baghdad, Iraq.

Nefzaoui, A. and H. Ben Salem. 1997. Spineless Cactus: A strategic Fodder in Arid Zones. Mashreq/Maghreb Project Newsletter. ICARDA, West Asia Regional Program. Amman, Jordan.

Nordblom, T., and F. Shomo. 1995. Food and Feed Prospects to 2020 in the West Asia/North Africa region. ICARDA Social Science Paper No. 2 vi + 56 pp. ICARDA, Aleppo, Syria.

Perrier, E. R. 1988. *Water Capture Schemes for Dryland Farming. In Challenges in dryland agriculture: A global perspective*, ed. P. Unger, T. Sneed, W. Jordan, and R. Jensen, pp. 235-238. Texas Agricultural Experimental Station. U.S.A.

Saade, Maurice. 1991. An Economic Analysis of Fertilizer Allocation and Import Policies in Syria. Ph.D. dissertation. Department of Agricultural Economics, Michigan State University, East Lansing, Mich., U.S.A.

PART III. POSTER SESSION PAPERS

A. MODELING

AGRICULTURAL POLICY REFORMS AND MARKET LIBERALIZATION EFFECTS ON THE ECONOMY OF LOW RAINFALL AREAS IN MOROCCO

Mohamed Moussaoui, ENA, Meknes, Morocco
Rachid Doukkali, IAV-Hassan II Rabat, Morocco
Nabil Chaherli, ICARDA /IFPRI, Aleppo, Syria
Mohamed Bendaoud, INRA, Settat, Morocco

THE PROBLEM

Low rainfall areas (LRAs) in Morocco comprise about 87 percent of the total arable land, involve more than 40 percent of total population and are the source of about 50 percent of grain and livestock products. Changes in market prices, supply and demand of major agricultural products and inputs are underway as a result of policy reforms, consisting of adjustment programs (since 1985), the GATT-1994, and the European Union-Morocco Association Agreement (1996).

Given the importance of LRAs in Morocco's agricultural sector and the strong relationships between crop and livestock production, any policy reform targeted to the corresponding markets may have significant effects on the LRAs' economy.

The purpose of this study is to identify the nature of key policy measures related to the grain and livestock sub-sectors in Morocco, and to assess the impact of these measures on LRAs with the aid of an appropriate model.

METHODOLOGY

The identification of key policy measures was achieved through a review of the literature related to the pre- and post-reform situations and to future scenarios of market liberalization under the GATT and

European Union-Morocco Association Agreements. Special attention was paid to the collection of information relative to the description and analysis of the different phases of market liberalization and their specific effects on grain and livestock production in the LRAs of Morocco.

Identified key policy measures were, then, empirically assessed using a multi-market equilibrium model with a breakdown of agro-ecological zones. The model prototype considers four areas: Irrigated, favorable rainfed, less favorable rainfed and urban; LRAs are located in the less favorable area. Eight products (durum wheat, soft wheat, barley, forage, straw, lamb, beef and milk) and five inputs (seeds, fertilizers, barley, forage, and straw) were selected. Impacts on market supply and demand, revenues and the balance of trade were simulated by introducing changes in agricultural world prices, tariff equivalent rates, exogenous revenues and input prices.

RESULTS AND DISCUSSION

POLICY REFORMS

The literature review showed that market liberalization reforms initiated since 1985 under agricultural sector adjustment programs resulted in free prices and marketing procedures for most of the common agricultural products, inputs and services during the period 1987-1994. Prices of the remaining strategic products, such as bread wheat, oil seeds, sugar beet and sugar cane, were liberalized in the summer of 1996.

Tariff equivalent rates introduced in 1992 for most of the strategic domestic agricultural products, have been reinforced under the agricultural component of GATT-1994 version.

Assessment of policy reforms that have been under implementation during the last ten years, and of future scenarios under GATT, shows that the production of the overall agricultural sector as well as that of the grain and livestock sub-sectors rose after policy reforms as compared to the pre-reform situation. Furthermore, protection of specific grain products will even increase through implementation of the GATT measures (Tables 1 and 2).

Greater protection of the grain and livestock sub-sectors will induce more barley and wheat encroachment on rangeland and will put more pressure on already degraded arable and rangelands. Therefore, it is recommended that the effects of ongoing policy reforms be assessed with regard to the sustainability of LRAs' agricultural resource base.

Combined variations in tariff equivalent rates and world prices (Tables 3 and 4), while keeping input prices and exogenous revenues unchanged, have been simulated to assess their impact on Morocco's partial balance of trade, incomes in the LRAs, and wheat and lamb supplies. This article focuses on the results for the case with no exchange rate devaluation and constant world prices (Table 5). Moving from low tariffs to high tariffs improves the partial balance of trade, income in the LRAs and the supply of durum wheat.

However, some paradoxical trends are noticed with respect to soft wheat and lamb supplies. Soft wheat supply seems to be more responsive to low and high tariff equivalent rates as opposed to medium rates, while lamb supply is more responsive under medium tariff equivalent rates. This is due to the substitution patterns between the different commodities occurring as a result of the changes in relative prices between soft wheat, durum wheat and lamb production. The low tariff level reflects a situation where Morocco has to effectively reduce protection on the crop and livestock sector; a situation that will have a negative impact on income generated in the LRAs (-34.8 percent). LRAs tend to lose more than the HRAs (-30.1 percent) from the reduction in protection. With higher protection levels embodied in medium and high tariffs, LRAs tend to benefit slightly more from the protection schemes.

The high tariff level captures a situation where Morocco could invoke the clause in the GATT agreement allowing protection of sensitive agricultural sectors. With higher protection levels for the livestock sector (medium and high tariffs), income in the LRAs grows at as high a rate as obtained in the HRAs.

CONCLUSION

Policy reforms implemented over the last ten years and those expected in the near future appear to offer adequate protection to Morocco's agricultural sector against changes in world market prices. As a result, grain and livestock production will generally continue to increase, as well as pressure on the already degraded marginal arable and rangelands.

Trade policies, in conjunction with world price variation, may induce opposite effects on grain and livestock products, depending on the policy under implementation.

Table 1: A comparative analysis of aggregate producer subsidy equivalents (PSE in percent)

Sector	Pre-reform (1980-1983)	Post-reform (1991-1993)
Cereal products	4	8
Livestock products	28	44
Agricultural Sector	10	15

Note: PSE = [(Pd - Pr + Sp - Tp)/Pd] * 100 Where: Pd is the domestic price, Pr the reference price, Sp the producer subsidy and Tp the producer taxation. If PSE < 0 then the product is taxed and if PSE > 0 then the product is subsidized.

Source: L. ESSLIMI, 1996, Reformes economiques et leur impact sur le secteur céréalier au Maroc. In proceedings of the Interconférence IAAE/AMAECO Symposium, Rabat, June 24-26, 1996.

Table 2: Producer subsidy equivalents (PSE) for selected cereal products (in percent)

Products	Pre-reform	Post-reform	Under GATT
Wheat	7	12	29
Barley	-1	0	13
Corn	8	9	15
Average	4	8	23

Note: PSE = [(Pd - Pr + Sp - Tp)/Pd] * 100 Where: Pd is the domestic price, Pr the reference price, Sp the producer subsidy and Tp the producer taxation. If PSE < 0 then the product is taxed and if PSE > 0 then the product is subsidized.

Source: L. ESSLIMI, 1996, Reformes economiques et leur impact sur le secteur céréalier au Maroc. In proceedings of the Interconférence IAAE/AMAECO Symposium, Rabat, June 24-26, 1996.

Table 3: Changes in tariff equivalent rates (TER)

Products	*TER levels* *			
	1	2 (Low)	3 (Medium)	4 (High)
Soft wheat	0	0.75	0.95	1.81
Hard wheat	0	1.40	1.42	2.13
Barley	0	1.13	1.41	1.50
Lamb	0	2.30	3.00	3.15
Beef	0	2.30	3.60	3.80

* TER's range from zero (no tariffs) to the maximum allowed tariff after two years of GATT measures implementation (all maximum tariff equivalent rates reduced by 4.8 %).

Table 4: Changes in world prices (in percent)

Products	Drop	Stagnation	Increase
Soft wheat	50	0	10
Hard wheat	50	0	10
Barley	50	0	10
Lamb	50	0	10
Beef	50	0	10

Table 5: Impact of tariff changes on selected aggregates in Morocco (in percent)

Type of aggregate	Level of tariffs		
	Low	Medium	High
LRA Income (% change relative to baseline)	-34.8	7.6	12.3
HRA Income (% change relative to baseline)	-30.1	3.0	12.0
Durum Wheat Supply (% change relative to baseline)	-7.5	-0.6	5.6
Soft Wheat Supply (% change relative to baseline)	19.3	-8.6	7.8
Lamb Supply (% change relative to baseline)	-17.6	16.3	3.5
Balance of Trade (change in M DH)	-62,000	9,620	37,411

A COMMUNITY MODEL FOR EVALUATING THE IMPACT OF POLICY, TECHNOLOGY AND PROPERTY RIGHTS CHANGES IN THE LOW RAINFALL AREAS OF MOROCCO

Mohamed Bendaoud, INRA Settat, Morocco
Mohamed Boughlala, INRA Settat, Morocco
Nabil Chaherli, ICARDA/IFPRI, Aleppo Syria
Mohamed Moussaoui, ENA Meknes, Morocco
BouchaibBoulanouar, INRA Settat, Morocco
El Houcine El Mzouri, INRA Settat, Morocco

THE PROBLEM

Attempting to improve resource management in the low rainfall areas (LRAs) of the WANA region primarily through technological change is often impeded by non-technical problems related to farmers' risk behavior, insecure property rights, and an inadequate policy context. Thus a broader and more innovative approach is needed to ensure sustainable resource management and social welfare in the low rainfall areas, by integrating research on policy, institutional and property rights issues at the community level with technology research.

The purpose of this study is to report on a community model constructed to evaluate new technologies, analyze key policy reforms and simulate institutional and property rights changes.

METHODOLOGY

The community model prototype used has features that are similar to the features commonly used for watershed modeling. It was designed for and fed with data from the Ait Ammar community (low rainfall area in Khouribga province, Morocco). Farm survey data were collected and used to cluster farms into five types. Specific features in community behavior were also identified. Private and common resource endowments are considered, in addition to technical, market and institutional constraints. Furthermore, the model is designed to allow for crop-livestock integration and the analysis of equity and growth objectives.

The community model was used to assess the impact of tariff rate changes for major crop products, and to analyze the effects of new technology adoption and output price variations. Changes in tariff rates

were combined with variations in world prices and exchange rates (Tables 1 and 2). The new technology consists of dual-purpose barley varieties. Six levels of cereal prices are examined with respect to their impact on arable land degradation.

RESULTS

Impacts of Changes in Tariff Rates

Results show that liberalization leads to production losses for both the livestock and cereal sub-sectors. When considering individual crops, the supply of wheat was highly depressed under more liberal conditions, and unchanged under other situations. Results also show that equity and efficiency are strongly linked (Figure 1). There are no lose-lose options but very few win-win situations. Market liberalization options favor equity, while protectionist policies are more advantageous to income growth. Therefore, it appears that more adequate policies are required, leading to win-win situations.

New Technology Adoption Effects

The availability of new dual-purpose barley varieties resulted in increased land allocation to barley, and consequently to increased barley production, and greater feed supply availability for livestock (Figure 2). However, the adoption of these new varieties does not seem to alter the prevailing income distribution among the different farm types (insignificant changes in the Gini coefficient).

Environmental Concerns

Policy reforms also have important environmental implications. Output price variations tend to affect the degree of erosion of arable land. Figure 3 shows that:

- Increased output prices are an incentive to the development of agricultural practices that worsen arable land erosion.
- Small to medium farms are more responsive to increased output prices than medium or large farms.
- Large farms use agricultural practices that are more harmful to the land resource base.

CONCLUSION

The prototype community model proved to be a powerful tool for evaluating the integrated impacts of changes in policy and technology on

cereal and livestock supplies, community income, land use and soil conservation. Simulations based on changes in prices received by farmers and cost of inputs show that there are some trade-offs between income growth and equity. The introduction of a new barley variety has important implications in terms of changes in land allocation but tends to be neutral with respect to equity. Results obtained from the changes in output prices also show that small and poor farmers do not necessarily have a higher propensity than large farmers to adopt more erosive practices as a response to more favorable prices.

Table 1: Changes in tariff rates (in percent)

Products	Tariff rate levels				
	Ceiling	**Current**	**2000**	**2005**	**Liberal**
Wheat	90	50	52	44	0
Barley	49	30	30	22	0
Feed	65	25	25	24	0
Livestock	200	100	100	80	0

Table 2: Changes in world prices and exchange rates

World price		**Exchange rate**	
Increase	+ 10%	Unchanged	0%
Stagnation	0%	Mild	+ 10%
Drop	- 10%	Strong	+ 20%

Figure 1: Income growth and income distribution trade-off with policy reforms in Ait Ammar (Morocco)

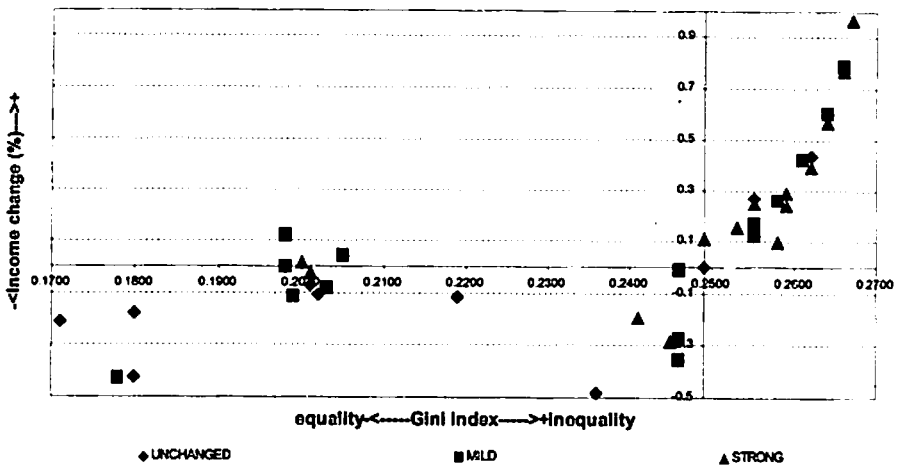


Figure 2: Impact of new technology introduction on land allocation in Ait Ammar (Morocco)

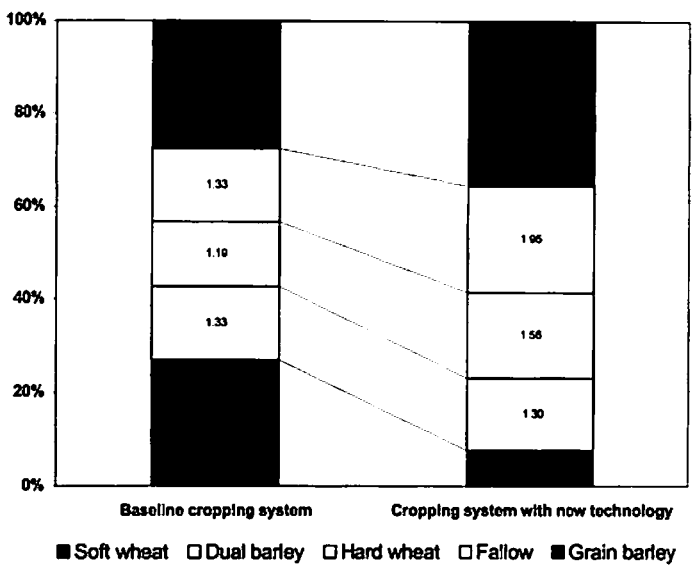
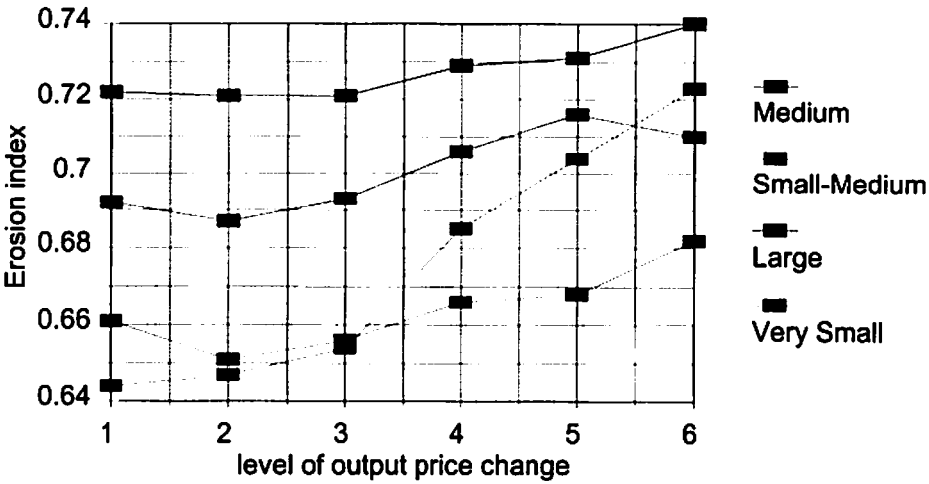


Figure 3: Impact of output price changes on erosion by farm type



COMMUNITY MODELING IN TUNISIA

Mohamed Salah Bachta, INAT, Tunis, Tunisia
Boubaker Thabet, INAT, Tunis, Tunisia

THE PROBLEM

In recent years important changes have occurred in rural areas of Tunisia as a result of regional and national socio-economic development policies and public investments in basic infrastructure, training, production capacities and supporting institutions. Relatively self-contained rural communities have become more closely integrated with the rest of the country and there have been dramatic effects on farming systems. For example, pastoral nomads in low rainfall central Tunisia have become settled farmers practicing relatively intensive tree crop and irrigated agriculture.

These significant changes in existing production systems have been accompanied by the mobilization of almost the totality of the available natural resources (water and soil), and also by a further effort by the government to support these regions, mainly in the form of additional productive investments. This has resulted in a significant increase and diversification of agricultural production. However, questions are now being raised about the viability of production systems of the transformed societies, in the new economic context characterized by trade liberalization and the reduction or elimination of direct public support. Furthermore while the existing cereal-livestock production systems have had some success with the respect to resource conservation, the new systems exert a heavy demand on water and land resources, threatening their long-term sustainability.

The objective of this paper is to simulate the effects of a variety of policy scenarios in relation to ongoing market liberalization policies, on farmers in the low rainfall areas (LRAs) of Tunisia. The analysis focuses on the quantification of the expected effects in terms of efficiency and equity.

CONCEPTUAL FRAMEWORK

The first step was to identify important farm types in the selected community of Nouayel (Sidi Bouzid Governorate). Five farm types characterizing the main productive activities were identified, using

principal component analysis of the survey data. The second step involved development of linear programming models for each farm type, and then linking these models into a single community model for the purpose of analyzing the welfare implications of alternative policy options.

SIMULATION AND RESULTS

Seven alternative scenarios to be evaluated with the model are defined in Table 1. In some scenarios (1 to 3), the resource endowments of the different farm types are added together to treat the community as a single profit-making farm. This essentially assumes that key fiscal resources (land, labor, machines) are perfectly mobile across farms. In other scenarios the farms are linked but resources are assumed to be less mobile because of transaction costs. High transaction costs for these factors are considered to reflect market imperfections.

Overall, the results obtained in Table 2 conform to observed production patterns. The areas of rangeland, fallow and barley are given in the optimal solutions for the simulation experiments performed. Wheat and irrigated vegetables are more important than the other crops but are constrained by water availability. Sheep production is shown to be dependent on feed subsidies. The other production choices, however, are little affected by the changes in price policy. On the contrary, the internal functioning of the community, particularly in the case where mobility of resources across farms is permitted, constitute important determinants of resource allocation and technical possibilities among the different crops.

As a result of the production choices, the highest profit levels are obtained when the transaction costs are reduced. The highest profit level corresponds to the situation where resources are perfectly mobile at zero cost; that is, when all available resources are used as if they belong to a single production unit. We note also that when a fixed minimum profit per farm is imposed, the global revenue is reduced by approximately 10 percent. This suggests a need for care in analyzing the relationships that may exist between the level of global revenue (efficiency) and its allocation among the five representative farms (equity) (Table 3).

The Gini coefficient is a device to capture the equity aspect, and is calculated for each scenario considered. The coefficient has the highest value, indicating the worst equity level, when the global profit is greatest (Table 4).

CONCLUSION

The results obtained indicate that the existing production choices in the project area will probably not change materially in the future. Indeed, trade liberalization and the gradual elimination of the constraints related to factor mobility tend to disfavor traditional crops (sheep production and barley). These changes, dictated by the search for maximum efficiency, favor beef production and irrigated vegetable crops.

Important technical changes are required if the traditional crops are to be competitive. The necessary productivity gains are estimated to be 30 percent for barley and 20 percent for sheep. Although the possibility of obtaining these increases may be questioned, the results obtained from the technology transfer activities of the Mashreq & Maghreb Project seem to support their feasibility.

Nevertheless, care is needed in interpreting the results of these simulation exercises. First, they do not take account of climatic risk on the production of different crops. Second, the effects of the various production systems on the environment are not considered in the model. For example, the rangeland activity may be the most beneficial form of land use with respect to soil conservation. On the other hand, annual crops, mainly cereals, may have a negative effect on the long-term sustainability of the resource.

Table 1: Description of policy experiments

Number	Description
1	Community profit maximization with current output prices and without feed subsidies
2	Community profit maximization with current output prices and with feed subsidies
3	Community profit maximization with a decrease in current output prices and with feed subsidies
4	Optimal solution with high transaction costs of resource transfer
5	Private profit maximization with high transaction costs and a decrease of output price and feed subsidies
6[a]	Private profit maximization with high transaction costs, a decrease of output price and feed subsidies, and with minimum income bound (TD 5000)
6[b]	Private profit maximization with high transaction costs, a decrease of output price, and feed subsidies, and with minimum income bound (TD 3800)

Table 2: Optimal land use (in ha)

Experiment Activity	1	2	3	4	5	6a	6b
Durum	612.47	612.47	612.47	610.47	603.20	603.20	603.20
Barley	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tomatoes	0.00	0.00	0.00	7.40	0.00	0.00	0.00
Water melon	61.52	61.52	61.52	54.00	68.59	68.59	68.59
Olive	221.20	221.20	221.20	221.20	221.20	221.20	221.20
Range	0	0	0	0	0	0	0
Sheep	0	298	0	1,394	1,411	1,332	1,410
Beef	74	0	74	53	20	33	18

Note: Beef and sheep are expressed in bovine and ovine zootechnical unit respectively.

Table 3: Optimal farm profit (in thousand TD)

Experiment farm type	1	2	3	4	5	6a	6b
1	6,349	6,349	6,349	83,512	64,191	100,000	76,000
2	13,300	13,300	13,300	156,568	114,823	111,598	114,823
3	265,553	323,830	265,553	43,228	129,573	65,000	113,752
4	412,686	331,481	412,686	104,000	72,943	80,000	72,943
5	3,476	3,476	3,476	120,665	85,905	90,000	85,905
Total	**701,364**	**678,436**	**701,364**	**507,973**	**467,435**	**446,598**	**463,423**

Table 4: Levels of profit and income distribution by experiment

Experiment	1	2	3	4	5	6a	6b
Profit (in thousand TD)	701,364	678,436	701,364	504,974	467,438	446,598	463,425
Coef. Gini (%)	64.00	60.50	64.00	17.50	20.00	6.35	14.00

MULTI-MARKET MODELING ANALYSIS OF AGRICULTURAL POLICIES IN TUNISIA

Lassaad Lachaal, INRAT, Tunis, Tunisia
Boubaker Thabet, INAT, Tunis, Tunisia
Laiech Mahfoudhi, INAT, Tunis, Tunisia

THE PROBLEM

Tunisia is undergoing major policy reforms that call in most cases for market and trade liberalization (adjustment programs, GATT, a free trade area with the EU). Despite this generally liberal policy orientation, the government continues to intervene in several markets, using price fixing instruments for basic commodities and subsidies for animal feed. These interventions are justified by the need to correct for market and institutional imperfections (e.g., risks associated with world price variability); and to alleviate the effects of some unfavorable circumstances (e.g., droughts) on small farmers, particularly in the low potential areas.

The extensive and systematic use of these instruments could however affect the incentive structure and lead to unsustainable land use patterns. For example high levels of protection for grain have favored barley-livestock systems at the expense of forage production and pasture, threatening the future productivity of the resource base. Untargeted drought subsidies could also weaken market institutions designed to deal with production risk and uncertainty (insurance) and lessen farmers' motivation to adopt drought-management technologies.

The objective of this paper is to develop a multi-market model to analyze the effects of market liberalization and other policy instruments on the agricultural sector. The need for a multi-market framework is justified by the fact that all markets are linked by substitution possibilities in production and consumption, and market interventions in one market may have spillover effects in other markets. The model will permit to trace the important effects of policy changes at both national and regional levels, including the low potential areas. The analysis will focus on the grain and livestock production systems to reflect the main agricultural activities in low potential regions.

THE TUNISIAN MULTI-MARKET MODEL SPECIFICATION

The model divides the country into different ecological zones or areas. The choice of these areas was primarily based on the project objectives; namely the need to analyze the impact and the role of government policies on crop and livestock production in the country's low rainfall area (LRA). With this in mind, the country is divided into three different ecological zones: the low rainfall area, the high rainfall area, and the rest of the country.

The LRA (also referred to as the project area) is defined by the following criteria: (i) a region that receives less than 350 mm of rain per year, (ii) an advanced level of land degradation, and (iii) the main agricultural activities observed in the region are barley, lamb and grazing pasture. This area includes the governorates of Siliana, le Kef, Kairouan, Sidi Bouzid, and Kasserine.

Markets included in the model are those which appear most relevant to the LRA. Criteria for this selection are: (a) the importance of the products to the region's welfare, and (b) substitution effects with other regions' products.

To capture substitution effects within and across regions, the following products were included: wheat, barley, sheep meat, beef, olive oil, forage, pasture, and lamb. Each of these markets has its specific characteristics and some of the products (barley, forage, pasture and lamb) are used as inputs to the production of other products.

All products, except forage, pasture and lamb, are traded internationally at world prices. Therefore, markets are assumed to clear via changes in net exports. Forage, pasture and lamb are not traded internationally; hence, these markets clear through domestic prices moving to equate supply and demand. Adjustments of these types of markets will be expected to impact on Tunisia's foreign exchange requirements as well as the cost of living effects of proposed policy changes.

On the factor side, only three inputs are included in the model. These are ammonium fertilizer, labor, and machinery. All factor markets are assumed to clear through domestic price adjustments; no trade is assumed.

The baseline data needed to run the Tunisian multi-market model are gathered from different government and non-government sources.

On the supply side, data represent an average year from a long time-series. Quantities produced were computed as the 1995 cultivated areas times the average yields observed within the period 1980-1995.[15]

On the demand side, quantities consumed were computed as per capita consumption per year times the 1995 estimated number of inhabitants.[16] Prices used within this baseline are those of 1996.

Given the above, the Tunisian multi-market model includes a subsystem of regional output supplies and regional factor demand equations. However, factor supply is assumed to be national. For intermediate products (i.e., barley, forage, pasture and lamb) supply and demand functions are specified on a regional base. Further, the specification of regional output supply and national final demand includes some exogenous shifters that will be used to simulate policy scenarios.

The resulting model is a system of 65 equations in the same number of unknowns. To solve this model, all the equations are log-linearized to yield a system of equations that are linear in the rates of change in both endogenous and exogenous variables with the coefficients transformed into elasticities. Once solved, the model can be used for simulation of the effects of price, institutional and technological policies.

The set of elasticities used in the Tunisian multi-market model includes the supply and derived demand elasticities as well as the final demand and income elasticities of the different products retained in the model. This very large set of information was partially collected from research work undertaken both inside and outside the country. Unavailable elasticities were estimated. Given, however, the incompleteness of the system, only the relevant theoretical restrictions implied by production and consumption theory were imposed.

SIMULATIONS OF THE EFFECTS OF POLICY, TECHNOLOGY, INSTITUTIONS AND DROUGHT

This section describes a variety of policy, technological, institutional and drought scenarios that were analyzed using the multi-market model. We give particular attention to the impact on the low rainfall areas.

The first policy scenario analyzed is a GATT scenario in which domestic prices for tradables are set equal to border prices. This means

[15]See, AEnquAte de structures≅, 1994/1995.

[16]See, EnquAte nationale sur le budget et la consummation des m9nages, 1990; and Annuaire statistique de l=INS, 1996.

that producer and consumer prices for all tradable commodities included in the model are reduced (by 13 percent) except for olive oil (which increases by 15 percent and 4 percent, respectively at the producer and consumer levels).

The consequences of this scenario on the supply and demand structure of the commodities are as expected: the supply of wheat, barley and sheep meat declined in the three regions whereas that of beef and olive oil increased. On the demand side, final demand increased slightly for all commodities except olive oil.

This change in the structure of demand and supply affected trade with world markets. The import bill of wheat and sheep meat worsened whereas that of beef and barley improved. Export revenue from olive oil increased (23 percent) due to a larger supply response to higher domestic prices. Overall, the balance of trade improved by 23 percent.

Despite this improvement the government budget was negatively affected by the market liberalization policy. Producer and consumer subsidies declined but also producer and consumer taxes, the net effect being a 32 percent decrease in government revenues.

For non-tradables, there was a sharp decline in the price of pasture and lamb (20 percent and 12 percent, respectively), which depressed regional supply and demand for these commodities, and had a negative effect on agricultural incomes in the LRA. We note that this scenario did not affect the regional linkages with respect to transfers of livestock resources. The regional affects on forage production are not clear, but its price appears to rise slightly. The low rainfall region exports lamb and barley to the other regions and has a small deficit in pasture. Forage is still in excess supply in the high potential region whereas it is in excess demand in the other two regions.

The second scenario analyzed is where only the price of wheat is set equal to its border price. In this scenario, since producer and consumer taxes are not eliminated and producer subsidies are drastically reduced, Government revenue increased by 48 percent. The heavy wheat import bill due to an important reduction in domestic wheat supply and the slight increase in olive oil exports worsened the balance of trade. It is also interesting to note that because of the substitution effects in production, the reduction in the price of wheat increased the supply of the other commodities reducing significantly their import bills.

Technological change is assumed in the third and fourth scenarios, where more productive technologies (improved seed varieties and better management) are adopted in the production of barley and pasture, increasing supply of both commodities in the low rainfall area by 15

percent. The technical change in barley had little effect on supply and demand of other commodities due to a weak substitution effect. The larger supply of barley was positively reflected in the balance of trade but had a negative effect on government revenues (a 4-percent reduction) because production subsidies increased.

Technological change in pasture had similar effects on both the government budget and the trade balance but also had strong indirect effects on other production systems. We note here the change occurring in the inter-regional linkage with respect to the transfer of feed resources with the low rainfall area becoming a net "exporter" of pasture and the "other" region a net "importer".

Drought management policy and drought effects are simulated respectively in the sixth and the seventh scenarios. Tunisia has implemented several drought relief programs that included a strong feed subsidy component with a high budgetary cost. The simulation exercise showed that a 15 percent decrease in the user price of barley resulted in a 23 percent decline in government revenues but surprisingly no major impact on the balance of trade. The derived demand of livestock feed was not affected.

The drought effect is simulated in a seventh scenario assuming a 15 percent decline in the production of all products in the LRA except for olive oil and beef whose production declined by only 5 percent. The simulation is performed by making changes in the level of supply that are typically observed for a drought year. The main results indicated that drought had a negative impact on the balance of trade (a 40-percent decrease) and a positive one on the government budget. This can be explained by the reduced subsidy expenditures following the shortfall in production. The drought also had its expected effect on the price of forage, pasture and lamb, which increased by 7 percent, 37 percent and 30 percent, respectively.

CONCLUSION

The results obtained show how a policy intervention or a technical change in one market creates complex second round effects in other markets which is not predictable on a partial equilibrium basis. The GATT scenario showed an improvement of the trade balance and a decrease in the resources of the government budget. According to these results, liberalization would also have downward effects on the price of lamb and pasture, with a negative effect on income in the low rainfall area because of the importance of these products as a source of income in that region. Technical change in barley production had a negative

effect on the government budget and no noticeable effect on agricultural revenue. Results of the drought scenarios show predictable negative effects on the balance of trade.

THE IMPACT OF SUPPORT PRICE POLICIES ON CEREAL PRODUCTION IN IRAQ

Kamil H. Shideed
IPA Agricultural Research Center, Baghdad, Iraq

GOVERNMENT POLICIES IN SUPPORT OF AGRICULTURE

Iraq is classified as a deficit country in food and feed production. Domestic production of food and feed grains is far below the total demand for these crops. As a result there has been a widening food and feed gap due to a decrease in local production and to population growth, as well as growth in per capita income. The main source of the decrease in local production is low yields. For example, yield levels for wheat and barley mostly ranged between 400-800 kg/ha during the period 1967-1990.

Unlike the period before 1987 when most agricultural activities were under government control and operation, the present policy is to vitalize the private sector and encourage investment in agriculture. Though a privatization of the agricultural sector has been initiated, the public sector is still handling services such as research, plant and animal protection, financing, provision of some inputs, land reform, and natural resource management practices like land reclamation, drainage and irrigation. Pricing policies are also administered by government and used as a tool to enhance domestic food production. Support prices have been high for the major crops: wheat, barley, paddy, corn, cotton, and sunflower. Meanwhile, agricultural inputs, such as fertilizers, seeds, chemicals, machinery and spare parts are subsidized and distributed by government agencies.

THE IMPACT OF SUPPORT PRICE POLICIES

To study the impact of support price policies and to measure the comparative advantage of farmers in producing cereal crops, the Policy Analysis Matrix (PAM) approach was used. Estimated Nominal Protection Coefficients (NPC) on wheat, barley and paddy outputs were 0.72, 0.58, 0.90, respectively, which are less than 1.0 indicating that substantial output taxes are implicitly applied. Estimated NPCs on tradable inputs of 0.47, 0.46, 0.28, 0.62 for wheat, barley, paddy, and corn, respectively are less than 1.0, indicating a substantial subsidy on inputs.

Estimated Effective Protection Coefficients (EPC) of 1.29 and 1.77 for paddy and corn, respectively, are greater than 1.0, indicating that the overall effect of agricultural policies is to increase net returns to farmers. Support price policies have made paddy and corn producers better off; however, these distortions have also made barley producers worse off. The estimated EPC of 0.84 for barley is less than 1.0, indicating that despite the subsidy on inputs, the overall effect of the policy-induced distortions in output and input prices is to reduce net returns to barley farmers to below what they would have been had there been no interventions. In the case of wheat, the estimated EPC is 1.0, suggesting that wheat producers earn net returns equal to what they would have been had there been no interventions.

Measures of comparative advantage, as captured by the Domestic Resource Cost (DRC), for wheat and paddy of 0.97 and 0.71, respectively, are less than 1.0, implying that positive social profits are earned from production of these two crops. Therefore, an expansion of wheat and paddy production would improve agricultural efficiency from the national viewpoint. The DRCs for barley and corn of 2.59 and 1.49, respectively, suggest that social losses are incurred on the margin from production of these commodities.

THE EFFECTIVENESS OF PRICE SUPPORT POLICIES IN INCREASING CEREAL CROP PRODUCTION

In order to evaluate the effectiveness of price support policies in increasing crop production, price elasticities of produced and marketed quantities of major crops must be estimated. These were derived from the estimation of supply response equations of wheat, barley, paddy, and corn using 1970-1993 time series data. The supply responses for these crops are inelastic, indicating that increasing support prices by a certain percentage would increase their production by a smaller percentage. The price elasticity of wheat is the lowest, suggesting a weak response of this crop to price changes. Its numerical value of 0.295 implies that increasing the wheat price by 10 percent would increase the planted area by no more than 3 percent. A similar conclusion applies to the response of the planted area of barley to price changes, as its estimated price elasticity is 0.342.

The price elasticities of paddy and corn indicate that pricing policy is likely to be more effective in increasing the production of those crops compared to wheat and barley. Meanwhile, the cross price elasticities reflect the negative impact of the support price of a particular crop on the planted area of the competing crop as a result of their competition on the

limited land resource. These cross price elasticities have important policy implications in that the competitive relationships among crops must be taken into consideration in determining support price levels. Ignoring the competitive nature among crops will reduce the effectiveness of support price policies in achieving appropriate cropping patterns.

The four crops are under mandatory marketing orders, which require farmers to market all produced quantities through official marketing channels. But, in practice, part of the production is used for home consumption and another part is marketed through unofficial channels. Therefore, it is important to know the effectiveness of support prices in increasing marketed quantities through official channels. This was done by estimating price elasticities for marketed quantities. These estimates indicated that pricing policy is more likely to be affective in increasing marketed quantities of barley, corn and paddy than of wheat.

MULTIMARKET ANALYSIS OF AGRICULTURAL POLICY IN IRAQ

Kamil Shideed, IPA, Baghdad, Iraq
Nabil Chaherli, ICARDA-IFPRI, Aleppo, Syria

Government intervention in Iraq agriculture takes the form of supporting output prices and subsidizing input prices for producers. At the same time consumer prices are far below domestic prices of producers and world markets. While the Government is trying to liberalize agricultural markets because of the heavy budgetary costs associated with price support, Iraq is facing an embargo situation that calls for particular steps towards increasing food self-sufficiency and food security.

To analyze the impact of alternative policy scenarios on the markets of related commodities, a multi-market model was constructed to analyze the impacts of the two paths mentioned above (market liberalization versus food self-sufficiency). The model focuses on the production system of five commodities (barley, wheat, sheep and goats, lentil and chickpea) in two main regions (irrigated and rainfed). However, the rainfed area is divided into three sub-regions (high-, moderate- and low- rainfall areas referred to as HRA, MRA and LRA). Wheat is produced in the three rainfall zones as well as under irrigation. Barley is mainly produced in moderate- and low - rainfall areas as well as under irrigation. Chickpea is only produced in high rainfall area. Lentil is mainly produced in the moderate rainfall area. Sheep are raised almost every where in the country. The structure of the model is summarized in Table 1.

Several changes in output and input price policy were investigated. These pricing policy changes are summarized in Table 2. The impact of these specific changes in price policy instruments are summarized below.

IMPACT ON AGRICULTURAL INCOME

A reduction in the feed subsidy by 10 percent (S2) would reduce farm income in all ecological zones but by different percentages (Table 3). The reduction in farm income is highest (12.9 percent) for the irrigated area, whereas the percentage decreases in farm incomes for rainfed zones are lower. The drop in farm incomes of high-, moderate-,

and low-rainfall areas is 7.3 percent, 3.1 percent and 6.8 percent, respectively.

Increasing producer support price levels of wheat, barley, lentil and chickpea (S4) would increase farm income in rainfed zones by up to 7.3 percent and reduce farm income in the irrigated area by 1.8 percent. The increase in farm income of the LRA is the least, 2.3 percent. Similarly, the effect of increasing the fertilizer price by 10 percent (S3) would increase farm income in all zones. The combined impact of increasing support price levels of crops and reducing the subsidy on fertilizers is to increase farm income in all zones (S5). The highest increase of 9.3 percent is in the moderate rainfall area, whereas the lowest increase of 7.1 percent is in the irrigated area.

However, the combined effect of increasing support price levels of crops and reducing feed and fertilizer subsidies (S6) would decrease farm income in the irrigated area and increase it in the HRA, MRA and LRA. A similar type of impact is expected under (S7), which is a mixture of increasing crop support price levels to producers while reducing the wheat price subsidy for consumers, and the feed subsidy to sheep owners and producers.

Market liberalization policies in the form of reducing output support prices and input subsidies (S8) will increase farm income in all zones expect the MRA which is expected to experience a reduction in its farm income of 5.3 percent. The highest increase in farm income is expected in the irrigated area (10.7 percent). In general, however, the chances of reducing farm income as a result of alternative pricing policies are more apparent in irrigated than rainfed areas.

IMPACT ON TRADE

The wheat subsidy reduction (S1) reduces wheat imports by 17.1 percent (Table 3). Meanwhile, reducing the fertilizer subsidy for producers would increase imports of wheat, lentil and chickpea by 46.1 percent, 2.6 percent and 1 percent, respectively. On the other hand, a reduction of 12.6 percent in wheat imports is expected under the scenario of increasing its output price support. The combined impact of a fertilizer subsidy reduction and an output support increase is to increase the imports of wheat by 33.5 percent. The increase in wheat imports would drop to 7.8 percent if the subsidy for wheat consumers were reduced as well (S7). The highest increase in wheat imports, 58.7 percent, arises with the full market liberalization policy (S8) in output and input markets.

IMPACT ON COMMODITY SUPPLY

Reduction of fertilizer subsidy decreases the supply of wheat, barley, lentil and chickpea in all zones (Table 4). Wheat is expected to experience the largest reduction in its production, 6.4 percent, while barley production decreases by 4.6 percent. Meanwhile, raising output support prices would increase supply by up to 3.1 percent for wheat and barley. Relatively small increases in lentil and chickpea production are associated with increasing their support prices. These results have important policy implications in that subsidizing input prices would have a greater impact on crop supplies than supporting output prices.

Market liberalization policies in the form of reducing output support and input subsidies (S8) will reduce crop production by higher percentages. Irrigated wheat production would decrease the most, by 10 percent, while the LRA would experience the lowest reduction of 8 percent in wheat supply, with barley production in that area decreasing by 6.4 percent. In general the impact of market liberalization on wheat supply is greater than that of barley in all zones. However, its impact on the LRA is generally lower than in other areas.

IMPACT ON DERIVED DEMAND FOR BARLEY AND FERTILIZER

The reduction of feed subsidy alone reduces the derived demand for barley in the LRA by 4.6 percent while the reduction of fertilizer subsidy decreases that for fertilizers by 9.9 percent (Table 5). On the other hand, an increase in output support would increase the derived demand for fertilizers considerably. This would increase the most in the high- and moderate-rainfall areas. The combined impact of increasing output support and decreasing input subsidy (S5) is to increase the demand for fertilizers by 2.8 percent in the LRA and IRA, and by 5.2 percent in the MRA and HRA. However, the combined effect of output support reduction and input subsidy removal (S8) is to reduce the demand for fertilizers by 22.5 percent, with the biggest reductions in the HRA and MRA.

IMPACT ON FINAL DEMANDS FOR CROPS

Changes in final demand are reported in Table 6. Reduction of consumer subsidy alone (S1), decreases the demand for wheat by 2.5 percent, while the combined impact of all policy instruments (S7) is to decrease demand for wheat by 2.8 percent. Market liberalization, on the

other hand, increases the demand for wheat by less than 1 percent. Demand for lentil increases by 1.2 percent.

CONCLUSION

Simulations based on multi-market modeling of alternative pricing policies in Iraq show the important implications of removing or consolidating producer support and input subsidies from crop and livestock products. An important result drawn from the simulations is that market liberalization does not necessarily yield a decrease in income for the LRA. On the contrary, the LRAs tend to gain more than the HRA or MRA from less government support for crops as a result of substitutions between crops and livestock activities at the regional and sector level.

Table 1: Structure of the multi-market model for Iraq

Region / commodity	Irrigated	Rainfed			Commodity trade status	
		HRA	MRA	LRA		
Production side						
Whea	*	*	*	*	T	imports
Barley	*		*	*	NT	
Sheep	*	*	*	*	T	exports
Lentil		*	*		T	imports
Chickpea		*			T	imports
Consumption side						
Whea	*	*	*	*	T	imports
Barley	*	*	*	*	NT	
Meat	*	*	*	*	T	imports
Milk	*	*	*	*	NT	
Lentil	*	*	*	*	T	imports
Chickpea	*	*	*	*	T	imports

Note: T = tradable; NT = non-tradable
HRA = High rainfall zone
MRA = Moderate rainfall zone
LRA = Low rainfall zone

Table 2: Simulated price policy scenarios for Iraq (percentage change in price level)

Commodity	Level of price intervention	S1	S2	S3	S4	S5	S6	S7	S8
Wheat	Producer				10	10	10	10	-10
Barley	Producer				10	10	10	10	-10
Lentil	Producer				10	10	10	10	-10
Chickpea	Producer				10	10	10	10	-10
Wheat	Consumer	10						10	
Barley	User		10				10	10	
Fertilizer	Producer			10		10	10	10	10

Table 3: Impact of alternative pricing policies on agricultural income and trade for Iraq

Economic variables	*Baseline*	Impact of pricing policies (in percent)							
		S1	S2	S3	S4	S5	S6	S7	S8
Agricultural income (hundreds of ID)									
IRA	19,392,770	0.0	-12.9	8.9	-1.8	7.1	-5.8	-5.8	10.7
HRA	1,756,083	0.0	-7.3	5.0	3.3	8.3	1.0	1.0	1.7
MRA	4,829,724	0.0	-3.1	2.0	7.3	9.3	6.2	6.2	-5.3
LRA	7,250,156	0.0	-6.8	5.2	2.3	7.5	0.7	0.7	3.0
Imports (tons)									
Wheat	253,574	-17.1	-8.6	46.1	-12.6	33.5	24.9	7.8	58.7
Lentil	4230	0.0	-2.8	2.65	0.0	2.6	-0.2	-0.2	2.6
Chickpea	12,800	0.0	0.0	1.0	0.0	1.0	1.0	1.0	1.0
Meat	6,116	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 4: Impact of alternative pricing policies on commodity supply in Iraq

Commodity and area	Baseline (tons)	Impact of pricing policies (in percent)							
		S1	S2	S3	S4	S5	S6	S7	S8
Wheat.IRA	597,500	0.0	0.0	-6.9	3.1	-3.7	-3.7	-3.7	-10.0
Wheat.HRA	123,046	0.0	0.0	-6.9	2.8	-4.0	-4.0	-4.0	-9.7
Wheat.MRA	448,239	0.0	0.0	-6.9	1.7	-5.2	-5.2	-5.2	-8.6
Wheat.LRA	307,615	0.0	0.0	-6.9	1.1	-5.7	-5.7	-5.7	-8.0
Barley.IRA	359,200	0.0	0.0	-4.6	2.9	-1.7	-1.7	-1.7	-7.5
Barley.MRA	110,484	0.0	0.0	-4.6	3.1	-1.4	-1.4	-1.4	-7.7
Barley.LRA	298,716	0.0	0.0	-4.6	1.8	-2.8	-2.8	-2.8	-6.4
Lentil.HRA	800	0.0	0.0	-1.3	0.0	-1.3	-1.3	-1.3	-1.3
Lentil.MRA	1,200	0.0	0.0	-1.3	0.6	-0.7	-0.7	-0.7	-1.9
Chickpea.HRA	5,000	0.0	0.0	-2.6	0.0	-2.6	-2.6	-2.6	-2.5

Table 5: Impact of alternative pricing policies on derived demands for barley and fertilizer for Iraq

Commodity	Baseline (tons)	Impact of pricing policies (in percent)							
		S1	S2	S3	S4	S5	S6	S7	S8
Barley.IRA	583,680	0.0	0.0	-4.6	2.5	-2.1	-2.1	-2.1	-7.1
Barley.HRA	28,570	0.0	0.0	-4.6	2.5	-2.1	-2.1	-2.1	-7.1
Barley.MRA	32,440	0.0	0.0	-4.6	2.5	-2.1	-2.1	-2.1	-7.1
Barley.LRA	12,331	0.0	0.0	-4.6	2.5	-2.1	-2.1	-2.1	-7.1
Fert.IRA	295,180	0.0	0.0	-9.9	12.7	2.8	2.8	2.8	-22.5
Fert.HRA	17,711	0.0	0.0	-9.9	15.1	5.2	5.2	5.2	-24.9
Fert.MRA	64,518	0.0	0.0	-9.9	15.1	5.2	5.2	5.2	-24.9
Fert.LRA	44,277	0.0	0.0	-9.9	12.7	2.8	2.8	8.5	22.5

Table 6: Impact of alternative pricing policies on final demand and price of non-tradable goods

Commodity	Baseline (tons)	Impact of pricing policies (in percent)							
		S1	S2	S3	S4	S5	S6	S7	S8
Final demand									
Wheat	1,729,574	-2.5	-1.3	0.9	0.1	1.0	-0.3	-2.8	0.8
Lentil	6,230	0.0	-1.9	1.3	0.1	1.5	-0.5	-0.5	1.2
Chickpea	17,800	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Meat	23,081	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Milk	102,800	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prices of non tradable goods	**Baseline (I.D/ton)**								
Barley	500	0.0	0.0	0.0	10.0	10.0	10.0	10.0	-10.0
Milk	1,005	0.0	7.7	0.0	0.0	0.0	7.7	7.7	0.0

ASSESSING MAJOR AGRICULTURAL POLICIES IN THE LOW RAINFALL AREAS OF JORDAN: "A MULTI-MARKET MODELING APPROACH"

Amer S. Jabarin, University of Jordan, Amman, Jordan
Nabil Chaherli, ICARDA/IFPRI, Aleppo, Syria

INTRODUCTION

Though Jordan has a relatively market based economy, the Government of Jordan is still involved in setting prices for many food and agricultural products as well as owning infrastructure such as storage silos, grading facilities, processing plants, wholesale markets, etc.

Since 1968, the government has implemented several policies to influence basic food supplies and to achieve certain other objectives. Stated goals of its intervention in this sector were to:

- Increase the production of food commodities;
- Improve the efficiency of utilization of scarce resources in the production of food;
- Reduce the disparity in income distribution between agricultural producers and producers in other sectors.

Policies which have affected the low rainfall areas (LRAs) either directly or indirectly, include:

- Subsidization of retail prices
- Subsidization of producer prices
- High tariffs on imported commodities
- Subsidized credit
- Measures in the Agricultural Sector Adjustment Program (ASAL).

According to the Department of Statistics, 22 percent of Jordan's population was living in the rural areas in 1994. It is estimated that one-half of those people are located in the LRAs. Despite government intervention to achieve the above objectives, the LRAs are facing serious problems that can be summarized as follows:

- Subsidization of producer prices has encouraged producers to cultivate wheat and barley on natural rangeland leading to soil erosion and the loss of indigenous seed banks;
- Unsustainable farming practices in these fragile lands have led to loss of soil fertility and a serious reduction in farm incomes;

- The subsidization of livestock feed increased livestock densities and in turn led to overgrazing and deterioration of rangelands.

PURPOSE OF THE RESEARCH

The objectives of this research are to:

- Determine the impact of market liberalization policies on welfare in the LRAs;
- Analyze the relative efficiency of those policies between low rainfalls and high rainfall areas (HRA) and how this might change in response to alternative policy scenarios for market liberalization.

The analysis tries to quantify the impacts of changes in government price policies on welfare, production, and consumption of major commodities produced and consumed in the LRAs such as wheat, barley, milk (white cheese) and sheep and goat meat.

METHODS AND DATA

A multi-market level model was built to capture the simultaneous interaction of supply and demand of the four selected commodities (wheat, barley, sheep and goat milk (cheese), and sheep and goat meat). Different scenarios were run for different policy options. In this paper, the results of the market liberalization scenario are presented.

Time series data was obtained from official sources such as the Department of Statistics, Ministry of Agriculture, Ministry of Supply, and ICARDA. Some missing estimates and technical coefficients were borrowed from available data in neighboring countries. 1994 was chosen as the base year to compare the pre- and post- liberalization impacts.

RESULTS

The impact of market liberalization on income in the LRAs and on supply and demand of the commodities selected is shown in Figures 1-6. Simulations tend to support the view that LRAs are hit disproportionately by the process of market liberalization. Farm income in LRA and HRA is reduced by JD 22,348,126 (-21%) and JD 1,534,680 (-1 %) respectively (Figure 1). Market liberalization will also significantly affect the balance of trade. Imports of wheat and barley are reduced by 25,453 tons and 117,746 tons, respectively while mutton imports go up by 9,781 tons (Figure 2). The large decline in LRA income is from a reduction in the supply of wheat, barley, mutton, and cheese by 118 tons,

230 tons, 4,313 tons, and 2,041 tons, respectively (Figure 3). For the HRA, supply of wheat and barley is reduced by 1,322 tons and 563 tons, respectively (Figure 4). On the demand side, the reduction in wheat subsidies reduces total demand for wheat by 126,893 tons (Figure 5). Given the changes in relative prices between the different consumer goods, it is expected that total demand for mutton will increase by 5,468 tons (Figure 6). However, total demand of cheese declines by 2,041 tons (Figure 6).

Market liberalization has important budgetary implications. It is expected that the government will save a sum of JD 56,775,067 through the following:

- Saved subsidies paid to wheat consumers (JD 34,097,310);
- Saved subsidies paid to barley users (JD 5,120,310);
- Saved subsidies paid to wheat producers (JD 1,230,147);
- Saved subsidies paid to barley producers (JD 693,120); and
- Tariffs charged on increased imported mutton (JD 15,634,000).

CONCLUSIONS

- The impact of market liberalization seems to be positive with respect to its main objective, which is improving the efficiency of government spending and resource allocation.
- The reduction in cultivated areas of barley and in mutton and milk production, as a result of less government intervention, will decrease the pressure on rangeland which in turn will reduce the environmental hazards of soil erosion, overgrazing and range deterioration.
- The expected loss in incomes of farmers in LRA due to the program, which is expected to be about 22,348,126, can be covered from the expected government savings that exceed the losses by two fold. Compensation to farmers in the LRA can be made through indirect payments

Figure 1: Impact of market liberalization on farm income in Jordan

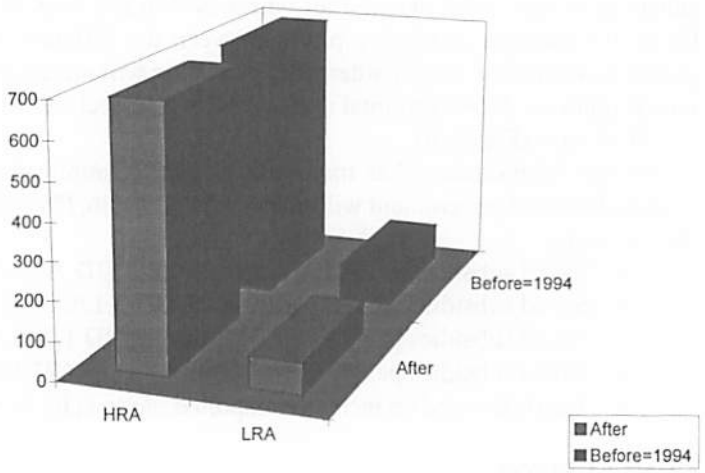


Figure 2: Impact of market liberalization on imports of selected commodities in Jordan

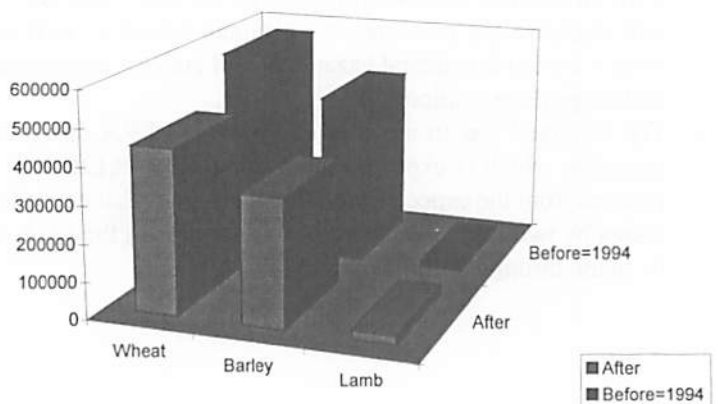


Figure 3: Impact of market liberalization on supply in the low rainfall areas of Jordan

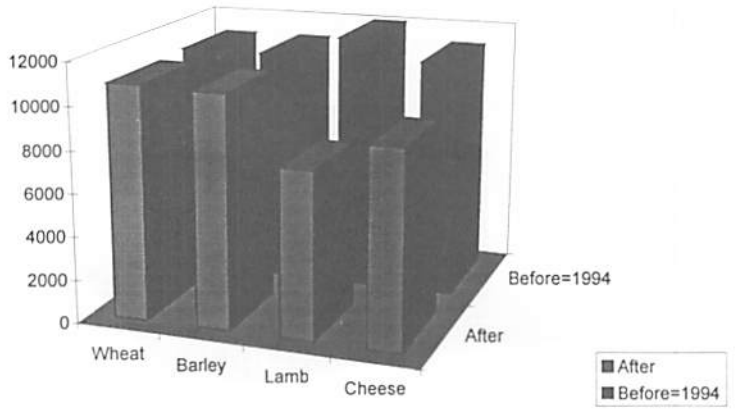


Figure 4: Impact of market liberalization on supply of selected commofities produced in the high rainfall areas of Jordan

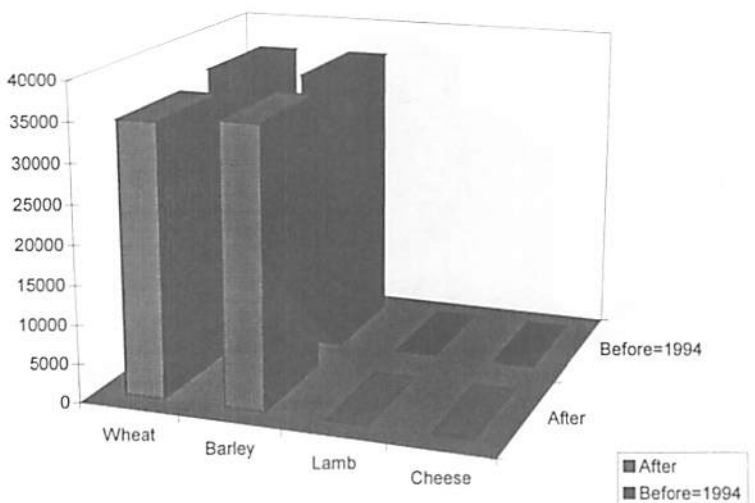


Figure 5: Impact of market liberalization on total demand of wheat in Jordan

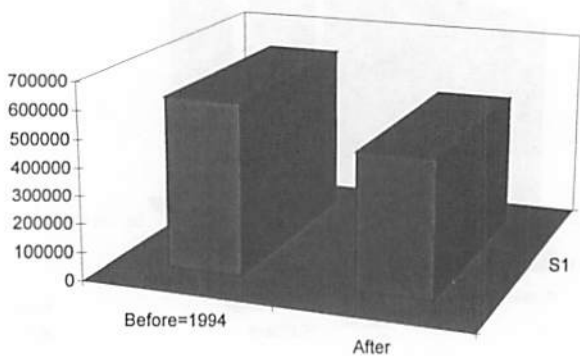
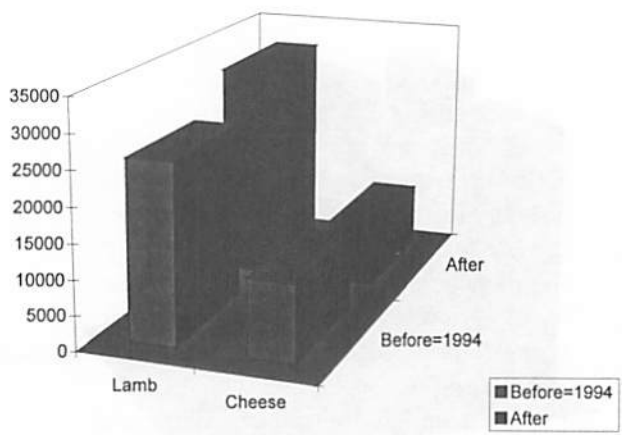


Figure 6: Impact of market liberalization on total demand of livestock products in Jordan



PART III. POSTER SESSION PAPERS

B. PROPERTY RIGHTS

PROPERTY RIGHTS AND INVESTMENT IN THE LOW RAINFALL AREAS OF TUNISIA, SIDI BOUZID GOVERNORATE

Mohamed S. Bachta, Institut National Agronomique de Tunisie, Tunis, Tunisia
Marouane El-Abassi, Institut des Etudes Commerciales, Tunis, Tunisia

INTRODUCTION

Feder (1982) developed a theoretical framework for the analysis of the impact of changes in land property rights on farm economic behavior and, in particular, on investment, credit demand and productivity gains. This framework allows empirical analysis in different socio-economic situations (Feder and Ochan, 1987, Place and Hazell 1993). The underlying hypothesis being that farmers with tenure security have more incentive to invest in improving land due to lower risk of losing the benefits from that investment and better access to institutional credit. However, customary institutions, which prevail in developing countries and are responsible for the management of natural resources like land, are often believed to be outdated and to lack the ability to enable the modernization of agricultural production. Consequently, land tenure polices are being re-oriented in several countries to provide greater security to farmers.

Tunisia has not been left out of this evolution. While land under collective tribal and *Habous* (granted use-rights for religious reasons) rights accounted for more than 80 percent of agricultural land at the eve of Independence, their importance has been reduced to around 15 percent today. The M&M project zone and, in particular the Sidi Bouzid region, is an excellent illustration of this trend. All land tenure systems prevailing in the country are represented. While the dominant status is

still collective ownership (60 percent of arable land) it has been in the process of privatization since 1971, when a law was promulgated allowing management councils (conseils de gestion) to lease collective land, but not rangeland, to eligible farmers. Those who benefited from this land reform were given an "attribution certificate" which has the same value as an ownership title. The objective of this paper is to analyze the linkages existing in the Sidi Bouzid region between property rights, investment and productivity.

The major hypothesis that will be tested is that land tenure reform, which provides title or another legally recognized tenure status, will increase investment by reducing the probability of dispossession and increasing credit supply. Moreover, land tenure reform, which provides titles, will increase the supply of credit by enhancing the collateral value of the land and relax capital constraints for production and investment.

EMPIRICAL ANALYSIS

Fourteen counties of the Sidy Bouzid Governorate were selected to evaluate the effects of property rights following the land reform process. A community was selected in each county for Rapid Rural Appraisal (RRA). The RRA analysis identified three distinct groups of communities:

1. Land titling is completed, conflicts seem to have been well controlled, and public and private investments have allowed production choices to be geared toward more efficient uses; the Ouled Ayouni community exemplifies this trend.
2. Unequal distribution of land resources between community members and low progress in land titling. The Ouled Abdallah community typifies this situation.
3. Important public investments, which have generated substantial productivity gains (e.g., irrigation), were made. The community of Nouael, which is characterized by a high level of social cohesion, exemplifies this situation.

Following the RRAs, these three communities were selected for in-depth household studies. A survey was conducted in 1997 amongst 110 households (20 households in Ouled Ayouni, 30 households in Ouled Abdallah, and 60 households in Nouael). The questionnaire included household characteristics (age, education, occupation of all members, number of regular workers, nonfarm income, wealth, and credit use.); farm characteristics (size, number of parcels) and parcel characteristics (mode of acquisition, type of document held, soil fertility, topography,

distance from house, size, land improvement, crop grown, input use and output).

RESULTS AND DISCUSSION

Nine (OLS) regressions were estimated to evaluate the effects of property rights on (1) land purchases, (2) total investment by community and for the three communities, (3) productive investments (equipment and land improvement) for each community and for the three communities (Table 1). The property rights variable was defined as the ratio of owned lands over the total land holding of each household, until a higher ratio corresponding to greater owership and hence greater tenure security.

Land purchases were significant only in the community of Ouled Ayouni, where dynamic land transaction activities were observed, and in this case the higher the ownership index, the lower the investment in land purchases. In the Ouled Ayouni community the ownership index was negatively related to both total investment and productive investment. However, this conclusion was not supported by the results from the Ouled Abdallah community. In general, these results suggest that the ownership index was an inconsistent explanatory variable of farmers' behavior with respect to investment.

Credit and yield variables were positive and significant for the all–communities' equation. Credit availability is positively related to investment and all the coefficients in the Ouled Abdallah and Nouael communities are significant. For the Ouled Ayouni community the results were not significant. This situation may result from the difficulty farmers in this village confront in seeking formal credit because of their existing insolvency. Survey results showed that in this community many credit contracts were made in the past but were not repaid. Presently, farmers invest using their own funds either by selling part of the assets.

The productivity variable (yield) had the expected positive sign, but it was not significant in any of the three communities.

CONCLUSION

Our analysis shows that credit is a significant determinant of investment in land improvements, in most cases, but that property rights as portrayed by a land ownership index have little impact.

REFERENCES

Feder, Gershon. 1982. Adoption of Interrelated Agricultural Innovations: Complementarity and the Impacts of Risk, Scale, and Credit. *American Journal of Agricultural Economics* 64 (1) (February).

Feder, G. and T. Ochan. 1987. Land Ownership Security and Farm Investment in Thailand. *American Journal of Agricultural Economics* 69: 311-320.

Place, Frank and Peter Hazell. 1993. Productivity Effects of Indigenous Land Tenure Systems in Sub-Saharan Africa. *American Journal of Agricultural Economics* 75 (1): 10-19.

Table 1: Results of the regressions amongst 107 households in the Sidy Bouzid Governorate, Tunisia, 1996

Equation	Land purchases	Total investment				Productive investment			
	Ouled Ayouni	Ouled Ayouni	Ouled Abdallah	Nouael	All	Ouled Ayouni	Ouled Abdallah	Nouael	All
Constant	8.26 (2.74)	9.05 (2.64)	-0.26 (-0.15)	986.6 (2.34)	4243.7 (2.7)	8.9 (2.47)	341.22 (1.4)	3.031 (1.31)	4731.9 (2.66)
Ownership index	-1.52 (-2.25)	-1.21 (-1.57)	0.947 (1.4)		-32.35 (-1.93)	-1.1 (-1.4)	-1.26 (-0.3)	-0.34 (-0.56)	
Education level	-1.98 (-1.98)	-0.85 (-0.7)	1.67 (1.77)			-1.31 (-1.09)		0.024 (0.031)	1.29 (1.69)
Credit		0.27 (1.4)	0.27 (1.19)	1.19 (11.99)	1.18 (6.99)		0.86 (4.06)	0.84 (6.29)	1.18 (6.99)
Yield (kg/ha)	0.06 (0.26)	0.87 (3.21)	0.13 (0.55)	0.27 (0.48)	1.29 (1.67)			0.052 (0.27)	1.29 (1.69)
Number of observations	20	20	14	65	107	20	16	63	107
R^2	0.27	0.43	0.63	0.69	0.41	0.42	0.48	0.39	0.41

Note: The figures in parenthesis are t- test statistics.

LAND POLICIES, PROPERTY RIGHTS AND LONG-TERM LAND IMPROVEMENTS IN THE LOW RAINFALL AREAS OF MOROCCO (EL BROUJ DISTRICT, PROVINCE OF SETTAT)

F. Nassif, INRA, Centre Aridoculture Settat, Morocco
M. Boughlala, INRA, Centre Aridoculture Settat, Morocco
T. Ngaido, ICARDA/IFPRI, Aleppo, Syria

INTRODUCTION

For the past 70 years, land policies in Morocco have tried to address equity, efficiency and sustainability issues in the low rainfall areas (LRAs). The major result of such policies has been the official maintenance of the tribal system, which has recognized and titled ownership of tribal territories, and the allocation of perpetual use rights to tribal members. In recent years, however, changing demographic, socioeconomic and environmental conditions are negatively affecting land tenure systems in the LRAs. These negative effects, which are being worsened by market liberalization policies, are fostering disputes and environmental degradation. Consequently, the future of tribal collective lands is an important issue for the Moroccan government, which organized a national workshop to discuss these problems in December 1995.

LAND POLICIES AND THE CRITICAL TRIANGLE

EQUITY

The November 1, 1912 and April 27, 1919 decrees recognized collective ownership rights to tribes on their territories and the February 18, 1924 decree provided the legal framework for delimiting and titling tribal territories in the name of the tribe. Land was distributed to tribal household heads according to the size of their families. This equitable land distribution concerned mainly resident tribal members. Tribal members who had out-migrated did not receive land. However, a provision was made by the November 13, 1957 decree to grant them plots to cultivate from the unallocated part of the arable collective lands.

In addition, the November 13, 1957 decree (No. 2977) regulated distribution of collective lands by recognizing the rights of widows with at least one child from a community right holder to have the same

privilege as a married man. Moreover, this decree required the constitution of a land reserve (one-fifth of the total arable lands) for landshort household heads and returnees from migration. Nevertheless, these different measures are proving difficult to implement due to population growth and the lack of a reserve of arable land. As a result, many tribal members are encroaching on their common pastures.

EFFICIENCY

Land policies in the LRAs addressed efficiency issues by empowering tribal institutions in the management and control of their resources and the allocation of individual use-rights on arable lands. Each head of household has perpetual use-rights on tribal arable lands and access rights to tribal common pastures. To promote the development of arable lands, the April 14, 1945 Decision distinguished between valorized and non-valorized collective lands and allowed right holders, who invested in a piece of collective land, to receive an act from the Trusteeship Council recognizing their perpetual use-right on this plot.

The July 25, 1969 decree was the first attempt of the government to transform perpetual-use-rights in irrigated areas into private property. The government believed that to use water resources efficiently and promote agricultural production it was necessary to change the tenure status of irrigated collective lands. Beneficiaries, who were allowed to title these plots under their name, could carry out all the transactions that are possible on private lands. However, to limit land fragmentation, the decree stipulates that only one family member can inherit the land left by their father, provided that beneficiary compensates the other right holders.

In addition, the Ministries of Agriculture and Agrarian Reform, Justice, Interior, and Finance conjointly drafted a decision (December 18, 1985 circular No. 24) to reduce titling fees and promote the generalization of titling in rural areas. This policy, which aimed at improving the tenure security of farmers and facilitating better access to land and credit markets, contributed to the drive for titling. For example, the Land Registration Office in Settat now receives on average 716 titling requests per year, of which 90 percent concern the titling of farmlands.

SUSTAINABILITY

The use of local institutions and rules for the use of the resource has been an important means of sustaining crop and livestock production systems in the LRAs, with the focus on tribes and tribal institutions, that were allowed to register their lands in the name of the tribe. However, its success depends very much on the strength of the local community to enforce the rules over resource use and access and the capacity of these institutions to oversee the production strategies of their members. Population growth and environmental variability have constrained the capacity of local communities to grant land to their members and led to the breakdown of the redistribution mechanism that maintained the traditional tenure system.

PROPERTY RIGHTS RESEARCH IN THE LRAs OF MOROCCO

The property rights research in Morocco was divided into two components: (1) analysis of the legal and land policies, the land titling process, and the effectiveness with which land disputes and tenure related issues are adjudicated; and (2) community and in-depth household surveys. The study was designed to test two hypotheses: that demographic and socioeconomic pressures in the LRAs are affecting the efficiency of local institutions in the management of their common resources, and that insecure property rights prevent farmers from making long-term land improvements.

The study area, which covers the El-Brouj district (193,400 ha) is located in the southern part of Settat province and includes the sub-districts of Beni Meskine Charquia and Beni-Meskine Gharbia and the municipality of El Brouj. The El-Brouj district, which is characterized by low and highly variable rainfall with an average of less than 300 mm, represents the driest end of a decreasing north-south climatic gradient in Settat province. Rapid Rural appraisals were conducted in 10 villages of the El-Brouj district among which three (Oulad Achi, Oulad Njima and Oulad Radi) were selected for in-depth household and plot surveys.

PRESSURES AND INEFFICIENCIES ON TRIBAL COLLECTIVE LANDS

The analysis of conflict reporting and resolution on collective lands is an adequate tool for evaluating the strength of local institutions, because according to custom and to the April 27, 1919 decree, all the collective lands are under the management and control of chosen local land managers (naibs). As such, it can be expected that all the conflicts

occurring in collective lands would be reported by these land managers and any other reporting of infractions on these lands at the level of the sub-district could be considered as overriding the authority of the land managers.

The analysis of 345 officially reported disputes in the sub-districts of Beni Meskine Charquia and Beni Meskine Gharbia shows that transgressions on collective lands accounted for 93 percent of all the cases (Table 1). Cropping was the major source of dispute (60 percent) of which 58 percent of the cases were on collective lands. Customarily, cropping is the common means of asserting ownership rights over a piece of land. This process of individual appropriation has a negative effect on the management of collective lands and on social cohesion between right holders. Furthermore, powerful community members are using live fences of barley in collective tribal pastures to prevent other right holders from grazing in that area. This type of dispute accounted for 22 percent of the cases.

The growing numbers and nature of the disputes in the LRAs is an important indication of the types of inefficiencies that are affecting the performance of local institutions. Moreover, it reflects the behavior of local community members when traditional systems can no longer respond to their growing demands and needs.

Land Distribution in the LRAs of El Brouj District

Rangelands account for 36 percent of the total district; croplands for 55 percent; and the remaining 9 percent are forests and uncultivable lands. The dominant tenure regime in the district is tribal collective ownership (60.4 percent) followed by private property or Melk (30.8 percent). The average number of plots held by each household is 6.48 for Oulad Achi, 6.79 for Oulad Njima and 8.96 for Oulad Radi and the respective average total household land holdings are 12.94 ha, 15.22 ha and 11.92 ha. Amongst the 73 households that were interviewed, 62 percent of the households cultivated their own lands and 38 percent had additional lands on a rental or sharecropping basis.

Property Rights and Long Term Land Improvements

A Probit model was used to estimate the effects of property rights on long-term land improvements. Tenure variables were discrete and rented privately owned fields were used as a base in defining dummy variables for property rights. In our selected sample, farmers conducted three types of land improvements: de-stoning (19 percent), well digging

(5 percent) and fruit trees (3 percent). The coefficients for inherited-divided and appropriated collective rights, and inherited-divided and purchased private property (*Melk/Mulk*) are significant and positive (Table 3). However, the marginal effect of appropriated collective rights was the highest (Figure 1). These results suggest that holders of tribal collective and *Mulk* rights to make long-term investments because both land rights guarantee to their holders the possibility to reap the full benefits of their investments.

CONCLUSION

Much inefficiency occurs because the flexibility of land holdings that was the major sustainability mechanism of tribal tenure systems in the past is now virtually lost. People have long-term security over their lands that they can bequest to their children. However, the breakdown of the flexibility of land redistribution pushes landless and landshort community members to encroach on the common pastures.

The results of the Probit analysis suggest that there are no big differences between collective lands and *Mulk* lands when it comes to long term land improvements. Land policies as well as farmers' expectations to upgrade collective lands to private property constitute an important incentive for making long term land improvements. In the case of the LRAs in Morocco, it does not appear that farmers are prevented from making long-term investments because of insecure property rights.

Table 1: Distribution of land disputes in the sub-district of Beni Meskine Charquia and Beni Meskine Gharbia, El-Brouj (1986-1996)

Types of disputes	Collective arable lands (%)	Collective pasture lands (%)	Private lands (%)	Total (%)
Cropping	14	44	2	60
Fencing	3	15	4	22
Threshing area	0	7	0	7
Harvesting	3	0	1	4
Building a house	1	0	0	1
Others	1	5	0	6
Total	22	71	7	100
Number of disputes	77	245	23	345

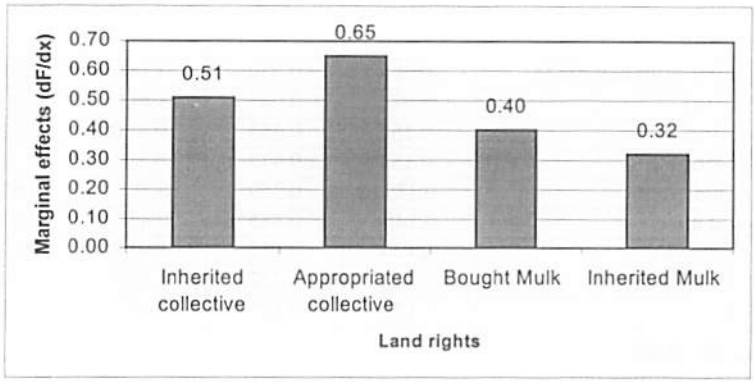
Table 2: Land distribution for 562 plots in the villages of Oulad Achi, Oulad Njima and Oulad Radi, El Brouj, 1996

	Plots (percent)	Oulad Achi			Oulad Njima			Oulad Radi		
		Number of plots	Mean Size (ha)	Standard error	Number of plots	Mean	Standard error	Number of plots	Mean	Standard error
Mulk										
Inherited	30.07	103	1.99	2.132	66	2.05	3.230	0		
Bought	9.61	20	3.26	2.870	34	3.87	5.143	0		
Rented	3.73	13	1.25	0.659	8	4.25	4.080	0		
Collective										
Inherited	44.84	0			111	1.55	1.307	141	1.83	1.319
Bought	1.96	0			10	1.80	1.085	1	7	
Rented	7.12	0			16	3.17	3.315	24	2.46	1.503
Appropriated	2.67	0			1	8.5		14	2.47	1.424
Village		136	2.11	2.216	246	2.24	3.040	180	1.99	1.416

Table 3: Results from the probit analysis of land improvements on 531 Plots, Morocco, 1996

Variables	Coefficients	Standard error	z|	P>|z
Plot variables				
Distance from household	-0.060	0.030	-1.960	0.050
Area (ha)	0.163	0.043	3.817	0.000
Highland	-0.159	0.353	-0.450	0.652
High slope	-0.153	0.477	-0.321	0.748
Medium slope	0.183	0.359	0.508	0.611
Low slope	0.148	0.345	0.430	0.667
High fertility	-0.034	0.213	-0.158	0.874
Medium fertility	0.303	0.232	1.309	0.191
Rocky	0.172	0.179	0.961	0.337
Tenure variables				
Bought collective	0.546	0.443	1.233	0.218
Inherited-divided Collective	1.696	0.391	4.335	0.000
Appropriated Collective	1.886	0.531	3.553	0.000
Bought *Mulk*	1.101	0.485	2.270	0.023
Inherited-divided *Mulk*	0.961	0.378	2.541	0.011
Villages				
Oulad Radi	-0.889	0.269	-3.302	0.001
Oulad Ndjima	-0.700	0.225	-3.104	0.002
Constant	-1.737	0.552	-3.145	0.002

Figure 1: Marginal effects of property rights on long-term land improvements



PROPERTY RIGHTS AND LAND IMPROVEMENTS IN THE LOW RAINFALL AREAS OF JORDAN

Karim Neshiewat, Ministry of Agriculture, Amman, Jordan
Tidiane Ngaido, ICARDA/IFPRI, Aleppo Syria
Qassem Mamdoh, National Center for Agricultural Research and Technology Transfer (NCARTT), Baqaa, Jordan
Nasri Haddad, ICARDA, Amman Jordan
Yasser Mohawesh, National Center for Agricultural Research and Technology Transfer, (NCARTT), Baqaa, Jordan
Eman Kurishat, National Center for Agricultural Research and Technology Transfer, (NCARTT), Baqaa, Jordan

INTRODUCTION

Jordan covers 91,860 sq. km of which 92 percent are considered as rangelands and receive less than 300-mm annual rainfall. These low rainfall areas (LRAs) are undergoing rapid changes as a result of agricultural policies, market liberalization, and both human and animal population pressures. The human population of Jordan is 4.29 million with a high annual growth rate estimated at 4.39 percent for 1995 (World Bank, 1996) and the small-ruminant population tripled from 1.236 to 3.159 million heads from 1974-1976 to 1994-1996. In addition, for the past 50 years, land policies in the LRAs, which focused on settling the nomadic population, transformed the traditional tribal common property regime into three land tenure regimes: state ownership of forest and pasture lands; private property (*Mulk*) on village sites and their vicinity, and individually owned use-rights (*Meeri*) on agricultural lands. Demographic pressures coupled with inadequate policies have put pressure on natural resources and have major implications for efficiency, equity and the sustainability of resource access and use.

LAND POLICIES AND IMPLICATIONS

EQUITY

Land distribution in the newly settled areas was carried out in a way that recognized prior land holdings meaning that if a given farmer had appropriated 100 ha for cultivation prior to official settlement, he received 100 ha after settlement. However, transhumant herders who did

not previously cultivate were allowed to acquire land on their unclaimed tribal lands. This policy led to an equitable distribution of resources among different tribal members. Furthermore, the Meeri-rights provided an equal share of inheritance to female and male heirs.

EFFICIENCY

The transformation of common property pastures into individually cropped lands can be an efficient resource use if it increases the productive capacity of the land. However, environmental and social costs associated with this transformation can be very high and tend, in many cases, to outweigh production gains. Under tribal systems, the main tenure system was customary use-rights on pastures; presently the distribution and registration of lands favors land fragmentation, which is becoming a real problem everywhere in Jordan. For example, in the south of Jordan, the average size of the *Mulk* and *Meeri* plots is 0.5 and 3 hectares respectively, and the average numbers of landowners per field are three and eight co-owners. However, in the north, which has been settled more recently, plot sizes are much larger with an average of 3 ha and 11 ha for *Mulk* and *Meeri* respectively and an average number of two to three co-owners.

SUSTAINABILITY

The main issue of sustainability concerns the use and management of common lands following state appropriation of tribal pastures. Both the state and traditional institutions lack the necessary apparatus to control and manage common resources. The Jordanian State considers that all areas below 250mm rainfall are state lands (1973 Agricultural Law No. 20). Tribes, which continue to claim customary legitimacy over common rangeland resources considered as "facing areas", are limited by their lack of a legal basis. Community members, who are confronted with changing social and economic conditions, perceive this confusion as an opportunity to trespass and misuse the resource, resulting in numerous disputes (Figure 1).

PROPERTY RIGHTS AND LONG-TERM LAND IMPROVEMENTS

The property rights research carried out for the M&M project focused on (1) reviewing land policies and their impact on resource use and control, and (2) evaluating the effects of property rights on long term land improvements, productivity, and household income generating

strategies. Fourteen villages in the LRAs were identified and rapid Rural Appraisals and in-depth household surveys were conducted in six of them. One of the main hypotheses of this research was that insecure property rights prevent right holders from investing in long-term land improvements. The survey of 180 plots showed that 26 percent of the plots were improved through de-stoning (21 percent), Terraces (1 percent), fruit trees (2 percent) and wells (2 percent). De-stoning is the major type of investment because in these marginal areas, farmers are obliged to remove the rocks to enhance the productive capacity of their lands, and because of subsidies on de-stoning.

The results from the Probit model (Table 1) show the importance of the property rights variables on farmers' propensity to invest in long-term land improvements. The coefficients for both Meeri and *Mulk* are positive and significant for all the modes of acquisition. However, the differences between marginal effects of *Mulk* and *Meeri* lands are not so significant (Figure 2). This confirms the general feeling among Jordanians that, even though *Mulk* rights offer more options to rights holders because they can shift resource use from agriculture to housing, both rights offer the same opportunities when it comes to agricultural production. They both guarantee to their holders the possibility to reap the full benefits of their investments.

CONCLUSION

Research results show that *Mulk* and *Meeri* land rights in the LRAs of Jordan do not prevent farmers from making long term improvements to their lands. Farmers have long-term security on these lands that are officially registered. The main difference arises over the ownership of the resource. Under *Mulk*, the holder owns both the resource and the use rights. While under the *Meeri* right, the resource is owned by the state (*Mulk ayni*) and the use-rights are owned by the holder (*Mulk Manfaa*). The main problem in the LRAs of Jordan is lack of stewardship on common rangelands that is fostering unsustainable resource use and disputes.

Table 1: Probit analysis of long-term land improvements for 180 plots in the LRAs of Jordan

Improved	Coefficients	Standard error	z	P>z
Plot variables				
Distance	-0.018	0.022	-0.827	0.408
Area	0.074	0.021	3.598	0.000
Low slope	0.078	0.475	0.163	0.870
Medium slope	1.077	0.306	3.519	0.000
High fertility	1.250	0.400	3.128	0.002
Medium fertility	0.873	0.336	2.596	0.009
Salinity	0.606	0.554	1.094	0.274
Year of acquisition	0.020	0.008	2.425	0.015
Tenure variables				
Meeri				
bought	2.503	0.736	3.398	0.001
inherited-divided	3.077	0.631	4.879	0.000
inherited-undivided	2.800	0.708	3.954	0.000
Mulk				
bought	2.852	0.985	2.897	0.004
inherited-divided	4.299	0.819	5.249	0.000
Constant	-44.864	16.653	-2.694	0.007

Figure 1: Number of trespass offenses on state land recorded in Jordan (1990-1995)

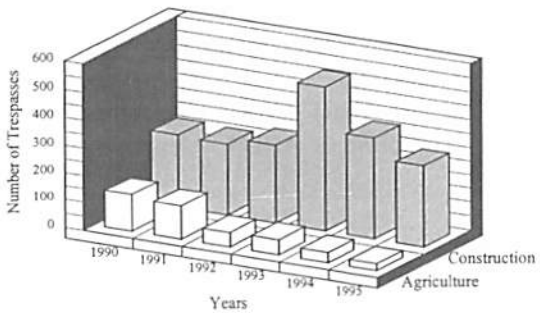
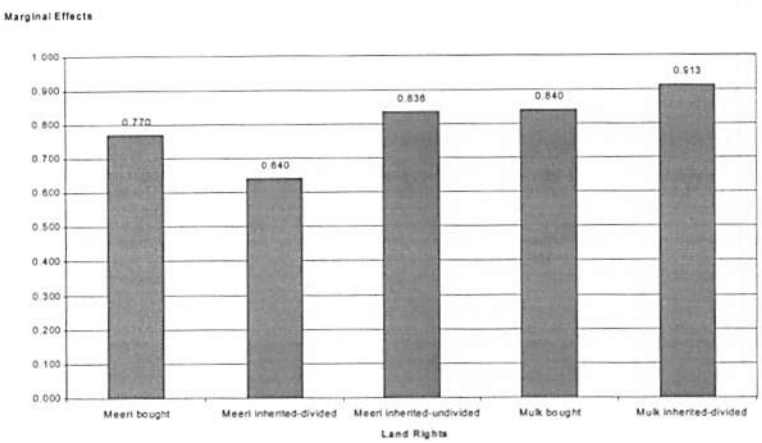


Figure 2: Marginal effects of the probability to invest in long-term land improvements in the LRAs of Jordan



SOCIO-ECONOMICS OF SHRUB PLANTATIONS IN SYRIA

J. Rae, School of Geography, Oxford University, London, England
G. Arab, ICARDA, Aleppo, Syria,
K. Jani, Steppe Directorate, Palmyra, Syria
N. Murad, Steppe Directorate, Aleppo, Syria
T. Ngaido, IFPRI/ICARDA, Aleppo, Syria
T. Nordblom, ICARDA, Aleppo, Syria,

In the semi-arid areas of West Asia/North Africa, the transplanting or reseeding of shrubs has been at the technological core of rangeland improvement efforts. In the steppe areas of Syria, which constitute over half of the country, or some 10.2 million hectares, the government and development agencies are currently propagating this technology through publicly run shrub plantations.

Previous attempts to establish shrubs in the steppe have often failed. However, despite the tentative beginnings of shrub plantations in 1983 greater government and agency interest and funding became apparent by 1988; the following four years saw their rapid spread across the steppe. In 1996, ICARDA, with staff of the Steppe Directorate of the Syrian Ministry of Agriculture and Agrarian Reform, initiated an in-depth institutional and socio-economic study to provide feedback to policy makers.

Users of four government plantations were covered in a spring-1996 survey. All heads of groups leasing grazing rights in the four plantations were interviewed regarding group organization, and institutional matters, as well as practical sheep management issues. Lists detailing all households of each group were drawn up. Households were then randomly sampled and asked if they would participate in a more detailed study of the plantation program. In all, 20 group heads and 30 individual households participated in the survey.

During the spring grazing period the survey raised questions about hand-feeding and water use of flocks inside and outside the plantations. In the cases of all four plantations, far fewer flock owners hand-fed their sheep when grazing inside the reserves than when outside. Mean levels of hand feeding inside ranged from zero to 1.2 kg/head/day, and outside from 1.1 to 2.0 kg. On the other hand, mean levels of water consumption were higher for animals grazing saltbush inside, ranging from 3.8 to 4.2

liters/head/day, compared to those grazing pasture outside, reported at 3.3 to 3.5 liters.

Cost figures were summarized for the establishment of a fifth, more recent reserve, AObaisan,≅ which covers about 7,325 hectares 110 km SE of Aleppo. Costs listed for site selection, including government employee wages and fuel, totaled about $551 (or $0.08/ha). Costs given for excavating the meter-deep and half meter-wide border trench around the periphery totaled $18,000 (or $2.46/ha). Site preparation costs, including bulldozer ripping and supervision, ran to $83,805 (or $11.44/ha). The greatest cost category was that for preparation of shrub seedlings, including seed preparation (collecting, threshing, drying), seed-bag preparation (plastic bags, soil, manure, and filling labor), planting, watering, care, and eventual transport, totaling $113,826 (or $15.54/ha). The planting of seedlings, including employee wages and fuel costs, totaled $16,404 (or $2.24/ha). Forecasted security costs, for two guards watching over the plantation day and night for four years, are expected to be $6,700 (or $0.92/ha). The total government expenditure for establishing this plantation was $239,345 (or $32.68/ha).

Local costs of lost grazing access were not calculated, the official idea being that people can simply graze>elsewhere= during the period of plantation establishment, before returning with limited grazing contracts that they must pay for themselves. Such contracts, which have been negotiated at other reserves for about $2.50/ha for two months of grazing, allowed a maximum of three or four sheep per hectare.

It is important to note the small expenditure forAsite selection≅, less than 1 percent, compared to the cost of excavating the boundary trench around the plantation, and for security, together over 10 percent of total cost. This is consistent with the observation that the locations of these plantations were set without regard to the local people or their claims to the land; most of the government plantations overlap two or more clan boundaries. In addition to incurring unnecessary costs, this may easily confound future management of these areas.

Any notion of program sustainability with community participation would seek to understand and accommodate the needs and desires of the individual recipients and their existing organizations and institutions. From program conception, through design to implementation and long-term management, the targeted communities should be intimately involved.

Recent policy seems to imply a view of the steppe as homogeneous in fertility, soils, water supply and geomorphology. A fresh approach would recognize the heterogeneous nature of the environment and the

farming systems that incorporate it. This could be done by exploiting new technologies in resource mapping with GPS and remote sensing. Adoption of a mosaic management paradigm would provide an overarching framework flexible enough to accommodate both the views and desires of the local communities as well as those of government agencies. Agriculture, shrub planting and protected areas can all have their places in the physical and social fabric.

Management questions on stocking rates and dates, firewood collection, choice of range plant species for new plantations and practical control and protection of the reserves would benefit from closer working relations between the communities of range users and the responsible government agencies. Explicit recognition of informal institutions raises issues of communal property rights. The *de facto* existence of traditional community property rights institutions offers an important building block for lower cost and more sustainable range rehabilitation programs.

PROPERTY RIGHTS, LONG-TERM LAND IMPROVEMENTS AND INCOME SHARES IN THE LOW RAINFALL AREAS OF SYRIA

T. Ngaido, ICARDA/IFPRI, Aleppo, Syria
Y. Sweidan, Directorate of Agricultural and Scientific Research, Douma Syria
S. Nasser, Ministry of Agriculture and Agrarian Reform, Damascus, Syria
A. Khnefiss, Directorate of Agricultural and Scientific Research, Douma Syria
A. Minla-Hassan, Directorate of Agricultural and Scientific Research, Douma Syria
H. El-Ashkar, Directorate of Agricultural and Scientific Research, Douma Syria
Abdullah al-Attr, Directorate of Steppe, Palmyra, Syria

INTRODUCTION

For the past 40 years, the government of the Syrian Arab Republic has been devising new policies to improve agricultural productivity and natural resource management in the rangelands while tackling equity, efficiency, and sustainability issues. These land policies have changed the land tenure system, land distribution, and rights over common property resources. However, their impact on the welfare of local communities and on common property resources in the low rainfall areas (LRAs) of Syria has not been well studied. The present research, which is being conduction by the Ministry of Agriculture, the Syrian Agricultural Research Center, ICARDA and IFPRI under the M&M project, explores the effects of present property rights on long-term investments and on income generating strategies of rural producers in these regions.

LAND POLICIES, EQUITY, EFFICIENCY, AND SUSTAINABILITY

The objectives of any land tenure policy should be to achieve efficient agricultural growth and equitable wealth distribution amongst community members, and resource use and practices which sustain the level of benefits. However, finding a balance between these objectives

is not easy, and in the case of Syria, land policies have generally favored one or other of these objectives to address a specific problem.

EQUITY POLICIES

The first target of land reform polices was to reduce social disparities by confiscating land from large landowners and distributing them to landless peasants, agricultural laborers and tenant farmers (1955 law No. 84 and 1958 la No.161). Beneficiaries received up to 8 hectares of irrigated and 30 hectare of rainfed land, and were required to (1) work and cultivate these lands according to the plans of the Ministry of Agriculture and Agrarian Reform and (2) to join a farmers' cooperative. If they failed to satisfy these conditions, the fields were seized and granted to other farmers. However, land confiscation did not dispossess landowners completely, but set ceilings on land ownership, which allowed landowners to register up to 40 hectares of irrigated and 160 hectares of rainfed land to their children and spouses. The data from 99 households show that 47 percent were cultivating their own lands, 28 percent of household were holding additional lands from agrarian reform, state leases, individual leases or sharecropping, and 25 percent were landless.

EFFICIENCY

Subsequent land policies have refined the procedures for access to land by taking into consideration land quality and water availability (1963 Law No. 88 and Law No. 31). Moreover, other incentive measures were implemented to improve agricultural productivity. For example, land reform grants provided long-term security to farmers as long as they were members of a cooperative. In addition, beneficiaries of land grants were exempted from paying three quarters of fees and service costs and contributed the remaining quarter to their village cooperative. Such contributions allowed cooperatives to build a capital reserve to provide input and machinery credits payable after the harvest. Such measures were sought to provide better services and improve agricultural productivity. However, the question is whether land reform grants were a sufficient incentive for farmers to invest in these lands and improve their income generating strategies.

Settlement of the nomadic Bedouin population and subsequent agricultural policies favored the cultivation of rangelands, which replaced pastures with crops. For example, the March 19, 1973 decision (no. 13) allowed farmers to cultivate rangelands and the 1988-1993

agricultural plan aimed at cultivating 100 percent of the Syrian territory. Moreover to generate income on state lands, the Government of Syria (GOS) set rental prices for state lands in the Badia at SYP10 as a minimum for rainfed lands, SYP150 for irrigated and SYP100 for lands planted with fruit trees (Circular No.9 of May 1, 1992). These rental prices were applicable "regardless of whether the renting was imposed for the first time or was a modification or extension of existing contracts." The major consequences were both an expansion of barley cultivation and an increase of the animal population because many sheep breeders relied on their own production to feed their animals.

In general, 'efficiency' considerations have played an important part in the degradation of rangelands. Overstocking and land appropriation reduced natural pastures. The per-capita area of pasture available to sheep declined from 7.0 ha per head in 1961 to 2.6 ha in 1993. This decrease in pasture availability was accompanied by a decline in the quality of the pastures.

SUSTAINABILITY: PROTECTING AND CONSERVING RANGELAND REOURCES

The first attempt of the Syrian Government to protect and conserve rangeland resources was the July 15, 1970 decree (No. 140), which prevented appropriation of rangelands and banned cultivation on non-irrigated steppe lands. The lifting of this measure in 1973 led to a rapid extension of barley cultivation on rangelands (Figure 1). However, since the beginning of the 1990s, sustainability issues have been at the forefront of national agricultural policies. In September 15, 1992, the Prime Minister's decision (No. 17) requested the governors "to observe strictly the prohibition of cultivation of the non-irrigated steppe lands which will remain dedicated for natural and planted rangelands and shrubs. Deterrent measures will be taken against transgressors as per the provisions of laws and by-laws in force" (Art .1). Article 3 stipulates that "areas which uses are regulated under the provision of the Steppe Protection Law will be gradually planted with shrubs within five years starting from the 1992/1993 cropping season."

On December 6, 1994 (Circular No. 4553/1), the GOS banned cultivation on rainfed steppe lands "to protect the natural vegetation in the Syrian Steppe and stop its degradation because natural vegetation is an essential source for grazing." Moreover, the Prime Minister requested that all governors "take all measures to stop illegal cultivation in the steppe lands and to arrest and take preventive measures against the trespassers." Finally, on December 3, 1995, the GOS took Decision No.

27 to also terminate irrigated cultivation of steppe lands. All existing licensed wells were authorized to cultivate until December 3, 1997 while non-licensed wells were forbidden.

In general, these different policies radically affected the property rights environment under which farmers and herders make their productive decisions and determine their livelihood strategies. The M&M project research reported below was designed to quantify these impacts.

RESEARCH SITES AND METHODOLOGIES

The property rights research in Syria focused on the provinces of Aleppo, Hama, Hassake and Raqqa in three rainfall zones: Zone 3 (350-250 mm), Zone 4 (250-200mm) and Zone 5 (less than 200 mm). Rapid Rural Appraisals were conducted in 12 villages among which six were selected for in-depth household and plot surveys. 110 households were randomly selected within these selected communities and a complete plot census was conducted for each selected household to evaluate their production strategies. The tenure regimes for the 341 plots were private property (*Mulk*) with 62 percent of the plots, state ownership with 34 percent and agrarian reform lands with 4 percent. The dominant mode of acquisition was divided inheritance (42 percent) followed by rented lands (31 percent) (Table 1).

PROPERTY RIGHTS AND LONG-TERM LAND IMPROVEMENTS

A Probit model was used to test the effects of property rights on the propensity of farmers to make long-term land improvements such as planting fruit trees (9 percent), digging wells (15 percent), de-stoning (19.1), water-harvesting (2 percent) on 341 plots. Tenure variables were discrete and rented privately owned fields were used as a base in defining dummy variables for property rights. All the property rights variables in the model were positive but insignificant except state leases and inherited-divided Agrarian reforms, which were positive and significant, and appropriated agrarian-reform land which was negative.

The positive and significant signs for state leases and inherited-divided Agrarian reform land both reflect clearly the security felt by holders who settled or were granted these lands to cultivate. Holders of these rights invested in long term land improvements because they were expecting to secure ownership on these lands. Moreover, some farmers even affirmed selling their privately owned lands in their former villages

once they settled in these areas. In addition, inherited-divided agrarian-reform rights are significant due to the expectation of right holders that these lands would be transformed into private property. In both cases, investment on the land is perceived as a means of strengthening ownership claims.

PROPERTY RIGHTS AND INCOME SHARES

Rural producers in the LRAs of Syria rely on different income sources to attenuate income losses associated with rainfall variability. Amongst 99 households, the average shares of income were 62 percent from cropping, 15 percent from livestock, and 23 percent from off-farm income. A Tobit regression model was used to estimate three equations modeling the effects of property rights on shares of income from cropping, livestock and Off-farm (Table 3).

CROP-INCOME SHARES AND PROPERTY RIGHTS

The coefficients of inherited-divided (0.00) and inherited-undivided (0.003) private (*Mulk*) lands have a significant and positive effect on crop-income shares whereas the coefficients for appropriated state (-0.0001), inherited agrarian-reform (-0.146), and purchased private (-0.014) lands are significant but negative. These results suggest that households with agrarian-reform, state, and purchased private lands in the LRAs are unlikely to derive the majority of their income from cropping. The negative sign of state leased lands, indicates the ban on cultivation that precludes holders of these lands from deriving crop income.

LIVESTOCK-INCOME SHARES AND PROPERTY RIGHTS

The coefficients of rented *Mulk* (0.17), leased state (0.002), inherited-divided agrarian-reform (0.005) and purchased*Mulk* (0.011) lands had a significant and positive effect on livestock-income shares whereas inherited-divided *Mulk* lands (-0.002) were significant but negative. These results suggest that households relying on livestock as their primary source of income are likely to hold agrarian-reform, state and purchased private lands. The former two reflect the outcome of the settlement and agricultural policies in marginal lands, while the positive effect of purchased *Mulk* lands shows the growing interest of livestock's owners in purchasing land.

OFF-FARM-INCOME SHARES AND PROPERTY RIGHTS

The results from the off-farm income share equation shows that inherited-undivided *Mulk* (0.006) and leased state (0.007) lands have a significant and positive effect on off-farm-income shares whereas the coefficients for appropriated state (-0.006), appropriated agrarian-reform (-0.039), and rented *Mulk* (-0.022) lands are significant but negative. These results suggest that households whose inherited *Mulk* lands are held as a common property and tenants of state lands are likely to derive the majority of their income from off-farm activities.

CONCLUSIONS AND IMPLICATIONS

The results from the present study suggest that land rights obtained from land reform policies and past agricultural policies favoring cultivation of rangeland promoted investments in long-term land improvements more than on rented fields. In both cases, rights holders expected that in the near future these lands could be upgraded into private property. The 1994 cultivation ban, however, challenged such expectations. The results for income sources, which show that leased state lands have positive and significant effects on shares of income from livestock and off-farm, but a negative impact on crop income shares, suggest that households with state leased lands rely mainly on livestock and off-farm activities for their livelihood. The ban on cultivation had stronger effects on households whose livelihood depended on crop production.

The implications are different, however, for livestock owners and for farmers who depended on these lands to support their families. For the former, these policy changes may affect their overall welfare but they can continue to use their holdings for grazing whereas the latter have to rely on off-farm income to support their families. Thus, in LRAs, environmental conservation and protection policies may have negative welfare implications when former policies were developed on the basis of agricultural efficiency. Consequently, such environmental policies need to provide income-generating alternatives to cropping households before implementing the ban on cultivation.

In addition, the results show that the variable "women household heads" has positive and significant effects on crop-income shares, suggesting that women heads derive most of their incomes from cropping. This highlights the importance of secure property rights if women household heads are to ensure the livelihood of their families.

Table 1: Distribution of land rights and mode of acquisition for 341 plots of 110 households in the LRAs of Syria, 1996

Mode of acquisition	Agrarian-reform (%)	*Mulk* (Private property) (%)	State owned (%)	Total (%)
Appropriated	2	0	7	9
Inherited-divided	2	40	0	42
Inherited-undivided	0	9	0	9
Purchased	0	9	0	9
Rented	0	4	27	31
Total	4	62	34	100

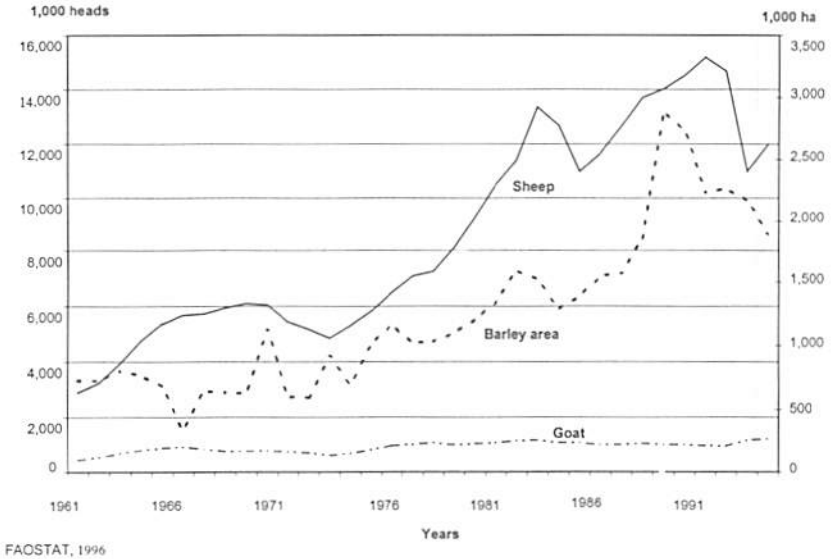
Table 2: Results from the probit analysis of 341 fields, Syria 1996

Variables	Coefficients	Standard error	z	P>z
Plot variables				
Distance	0.038	0.031	1.240	0.215
Area	0.004	0.009	0.387	0.699
Highlands	0.391	0.600	0.652	0.514
High-slope	-0.508	0.403	-1.261	0.207
Medium slope	-0.495	0.233	-2.128	0.033
Low slope	-0.015	0.364	-0.041	0.967
Salinity	-0.005	0.325	-0.017	0.987
Medium fertility	0.294	0.430	0.684	0.494
High fertility	-0.260	0.505	-0.514	0.607
Date of acquisition	-0.001	0.005	-0.265	0.791
Tenure variables				
State Leased	1.618	0.571	2.835	0.005
State appropriated	0.537	0.603	0.890	0.373
Agrarian-reform appropriated	-0.370	0.746	-0.495	0.620
Agrarian-reform inherited	1.513	0.517	2.923	0.003
Mulk inherited-divided	0.690	0.511	1.349	0.177
Mulk inherited-undivided	0.404	0.539	0.750	0.453
Mulk purchased	-0.011	0.553	-0.019	0.985
Constant	1.865	10.369	0.180	0.857

Table 3: Tobit Regression of income shares for 99 households in the LRAs of Syria, 1996

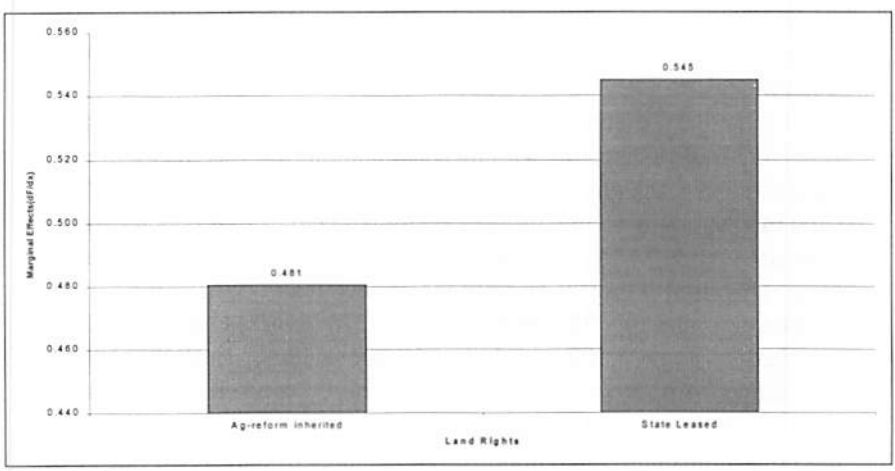
Mode of Acquisition and Tenure regime	Shares of crop income	Shares of livestock income	Shares of off-farm income
Tenure variables			
Leased state lands	-0.0016 (0.0029)	0.0025* (0.0011)	0.0065* (0.0026)
Appropriated state lands	-0.0006* (0.0003)	-0.0010 (0.0035)	-0.0162* (0.0061)
Appropriated agrarian-reform	-0.0148 (0.0122)	0.0048 (0.0096l)	-0.0394* (0.0160)
Inherited-divided agrarian-reform	-0.1456* (0.0203)	0.0938* (0.0120)	-0.1196 (0.0748)
Inherited-divided *Mulk*	0.0020* (0.0006)	-0.0017* (0.0009)	-0.0028 (0.0031)
Inherited-undivided *Mulk*	0.0035* (0.0012)	0.0019 (0.002)	0.0062* (0.0023)
Purchased *Mulk*	-0.0143* (0.001)	0.0110* (0.0020)	0.0016 (0.0043)
Rented *Mulk*	-0.0013 (0.004)	0.017* (0.001)	-0.0216* (0.0041)
Household variables			
Age of household head	0.0015 (0.0017)	0.0011* (0.0002)	0.0005 (0.0041)
Women heads of household	0.0761* (0.0109)	-0.0366 (0.0328)	-0.2363* (0.0792)
Household size	-0.0012 (0.0009)	0.0004 (0.0035)	-0.0028 (0.0031)
Number of plots	0.0347* (0.0120)	-0.0351* (0.0029)	0.0178* (0.0080)
Small ruminants (sheep and goats)	-0.0011* (0.0003)	0.0018* (0.0007)	-0.0020* (0.0008)
Owning a tractor	-0.0479* (0.0061)	0.0636 (0.0586)	-0.0595 (0.0463)
Irrigation	0.1564* (0.0184)	-0.1074* (0.0152)	-0.0993 (0.0757)
Constant	0.5431* (0.0363)	0.2370* (0.0577)	0.4517* (0.1714)

Figure 2: Evolution of cultivation and livestock in Syria (1961-1994)



FAOSTAT, 1996

Figure 2: Marginal effects of long-term land improvements in Syria for significant tenure variables



RANGE REHABILITATION AND LAND TENURE SECURITY IN SYRIA: OBJECTIVES AND COMPONENTS OF A "COMMUNITY MODEL"

T. Nordblom, ICARDA, Aleppo, Syria,
S. Nasser, Ministry of Agriculture & Agrarian Reform, Damascus, Syria
M. Bendaoud, Institut National de Recherches Agronomiques, Settat, Morocco
T. Ngaido, IFPRI/ICARDA, Aleppo, Syria
F. Shomo, ICARDA, Aleppo, Syria,
J. Rae, School of Geography, Oxford University, London, England
G. Arab, ICARDA, Aleppo, Syria,
N. Murad, Steppe Directorate, Aleppo, Syria
N. Chaherli, IFPRI/ICARDA, Aleppo, Syria
G. Gintzburger, ICARDA, Aleppo, Syria

THE PROBLEM

The objective of this "community model" is to quantify the likely impacts of different policy and property rights scenarios and approaches to range rehabilitation, on the level and stability of household and community incomes. The resource base, farming systems and constraints of the Twaimat community of Aleppo Province provide the components of the model.

The land represents Syria's agricultural stability Zone 5, covering some 10.2 million hectares with mean annual rainfall less than 200 mm. Since late 1994, the government has banned cultivation throughout Zone 5 and range grazing is now the only permitted land use. By decree, these lands are owned by the state, which is formulating plans for a massive range rehabilitatio project on millions of hectares.

The community's 32,900 hectares, in 27 sub-areas, are seasonally occupied by some 2,900 people in 350 households. Household flock sizes range from zero to over 500 sheep (only 34 households have such large flocks) for a community total of about 52,700 animals. Previously, 300 households cultivated about 7,300 hectares of barley, all but 19 of whom had fields smaller than 50 hectares; a third had fields of five

hectares or less. In past decades, more than double this area was cultivated for barley, destroying perennial range vegetation and leaving large areas almost barren.

Barley grain, when harvested, was sold or stored for winter-feeding; straw was also conserved. More frequently, however, instead of harvesting, the crop was grazed by the household's sheep to supplement and extend the winter/spring range-grazing season before the summer/autumn migration to the higher-rainfall and irrigated districts outside the community's lands.

Community land resources fall into four classes: 'wadi', depressions, plains and heights. Prior to the ban, annual cultivation of barley on some 7,300 hectares was practiced in pockets; most frequently in the "wadi" and large depressions where rainwater runoff and deeper soil is concentrated. These areas have the greatest potentials for range rehabilitation. There are roughly 7,000 hectares of 'heights': hilltops with rock out-cropping and shallow soils, regarded by locals as the poorest rangelands and totally unsuitable for cultivation; rehabilitation of range vegetation on such areas with shrub planting would be technically challenging and, most probably, uneconomic. The remaining areas are 'plains'; suitable for grazing but not for cultivation in most years. Large year-to-year variations in rainfall affect the growth of range vegetation and that of cultivated barley; estimates of these effects and their frequencies are quantified for the model.

Range rehabilitation is a long-run consideration and should be carefully executed. After the initial investment costs are committed, the treated area must be protected from grazing for a limited time, according to rehabilitation technique. Controlled grazing can begin when shrubs capable of reproduction in this environment (such as the indigenous *Atriplex halimus*, *Salsola vermiculata* and *Artemisia herba alba)*, are well enough established; this allows the improved rangeland to be sustained indefinitely, providing that it is properly managed

An optimizing model using the GAMS (General Algebraic Modeling System) program is currently in development. The purpose of this study is to design a community model that will enable the evaluation of new technologies, analysis of key policy reforms and simulation of institutional and property rights changes. It is designed so that combinations of scenarios can be simulated over time to quantify their likely joint impacts on the community. Several scenarios are proposed for this study. These include policy alternatives on land-use (without and with barley in the wadis), policies affecting prices of inputs and outputs, and plans for fast or slow paces of range rehabilitation.

ENVIRONMENTAL EDUCATION AS A KEY SUSTAINABLE RANGELAND DEVELOPMENT IN ALGERIA

Noureddine Redjel, Haut commissariat du Developpement de la Steppe, Tebessa, Algeria
Jamal Boukheloua, Haut commissariat du Developpement de la Steppe, Tebessa, Algeria
Mustapha Malki, Institut Technique des Grandes Cultures, Algiers, Algeria

THE PROBLEM

For more than three decades, the development program of the pastoral steppe zone has focused mainly on the "structural or hardware" aspects of rangeland rehabilitation. By treating only the consequences of natural resource erosion and degradation, it has neglected the social and educational, or "software" aspects, which should be one of the most important components of any development program if the causes of degradation are to be resolved. In most cases, such as the 1985-1989 government steppe program, the investment allocated to sensitizing and "education" of the pastoral communities did not exceed 0.16 percent of the total. As a result, and despite the importance of their overall investments, theses programs were unable to ensure the sustainability of the resource.

The current program of rangeland rehabilitation includes in its objectives the task of increasing the pastoral community's awareness of the fragility of their environment and the importance of the preservation of introduced or native plant species. The financial allocation to this activity represents 4.58 percent of the total program investment. This paper describes the first results of this approach and its effects on the behavior of the pastoral communities.

METHODS AND MATERIALS

In the past, Algerian rangeland improvement programs consisted of rehabilitation schemes characterized by a technocratic vision where the state imposed its development program. They treated the consequences rather than the causes of natural resources depletion without taking into consideration the cultural heritage, traditions, knowledge and education

of the pastoral society, and as result accelerated the desertification and depletion of rangeland resources.

Based on this experience, a new comprehensive approach (Figure 1) was designed to treat all factors affecting rangeland desertification. The human factors were prioritized through an interactive and communicative method between the technicians in charge of the implementation of the programs and members of pastoral societies (Table 1). This approach aimed at fulfilling the following objectives:

1. Direct and voluntary involvement of the pastoral communities in the development process that may induce changes of perception and negative behavior towards fodder shrubs and trees. Members of pastoral communities, local agricultural technical staff, and administrative authorities, participated in evaluation sessions.
2. Rehabilitation of rural women's contribution to family welfare by promoting diversification into poultry and fruit trees. A total of 23,870 fruit trees and 6,181 heads of poultry were distributed, 965 and 377 beneficiaries, respectively.
3. Education of primary and junior students in schools located around rangeland reclamation projects to promote more positive attitudes and behavior and attitudes towards the environment and pastoral resources. For example, during the 1996/97 academic year, the HCDS (Haut Commissariat au Developpement de la Steppe) with the participation of teachers from the targeted schools and the financial support of pastoral NGOs edited a booklet entitled "Basic knowledge and issues on the steppe environment". Subsequently, theoretical teaching sessions and practical work involving shrub production and transplantation were carried out. Three hundred and eighty fodder shrub beds and 45 fruit trees beds were planted in schoolyards. This teaching program was implemented in five schools with 421 schoolchildren from the 6^{th} to the 9^{th} grade.

RESULTS AND DISCUSSION

Eighteen local professional associations were created, based on the traditional tribal model but with new tasks and objectives. Tribal leaders and state agents were involved in the program on a contractual basis, with shared responsibilities. These leaders will no longer be expected to solely achieve project objectives through routine participation because now they are empowered and have the rights to refuse or accept projects. However, once they agree to participate in the project, they become responsible for the sustainability of the investment. For example, they

contributed financially in 1997 to the editing of the educational materials and the rehabilitation of equipment of public common wells.

This organization facilitated the transfer of technology and the implementation of the rangeland development program, not only in state perimeters but also (and more importantly), on private farms. The number of private investors increased by more than fivefold in only three agricultural years and the areas planted with shrub and Opuntia species increased by more than eight times (Table 2). It is anticipated that this trend will continue in the 1996/97 agricultural year.

The initial experience of the children's education program, which was a rich experience for the HCDS staff, will provide a framework for future programs. The attendance was lower than expected due to poor weather and insufficient number of class sessions (an average of six per school) (Table 3). The most significant finding, which confirmed the conclusions that were drawn from the tests and consultations with the teachers and served as guidelines for the teaching booklet, was that the children of pastoral communities have a limited knowledge of their ecosystem and are ignorant about the fragility of their environment. This lack of knowledge explains the difficulties they faced for understanding the teaching materials. About 78 percent of the tested children failed to answer more than 40 percent of the exam questions. Regardless of the causes of this situation, the test results provide a warning on the gravity of the problem because today's ignorant children might be the main cause of tomorrow's desertification.

The evaluation of the practical education, which were part of the awareness program, and the planting of Atriplex and fruit trees in schoolyard nurseries and neighboring homes, showed considerable interest and care. For example, the rate of success of seedling production and plantation was 85 percent. Moreover, given that the same species were and still are being cut or uprooted by students' parents, there is a need for a greater and more broadly based educational effort to combat the depletion of rangeland resources.

CONCLUSION

Desertification and natural resource depletion are mainly caused, directly or indirectly, by human activity, either through ignorance or selfishness. Thus, it is futile to "kill the pain and ignore the disease." For this reason, rangeland rehabilitation programs have to make environmental education the central pivot of their development efforts. However, the success of this approach will depend on the contribution

and effective participation of all the institutions involved in rural development education, including the pastoral people themselves.

Table 1: Matrix of the education program

	Actions			
	Rural animation programs	**Training**	**Assessment and evaluation**	**Technology transfer**
Objectives	Education of the pastoral communities to respect their environment and pastoral function; Rehabilitation	Skills perfection, knowledge, and terminology updating	Assistance and modification of the implemented rangelands reclamation and management models	Implementation of shrub species plantation techniques and rangeland grazing models
Population concerned	Farmers, women, school children	HCDS, DSA,[17] and CAW Technical staff	HCDS and DSA Technical staff in charge of the program	DSA, CAW, School children, farmers and women
Major assumptions	Education program agreement by DEW,[18] participation and contribution of the local administration and CAWs[19]	Collaboration and participation	Determination of the assessment and evaluation method	Participation of the pastoral communities
Input	Financing the on-site meetings and acquiring the didactic means	Financing and elaboration of teaching documents	Knowledge and skills	Research results
Output	Behavioral changes and technology comprehension	Knowledge and skills transfer adoption	Development programs success	Technology transfer adoption

[17] Direction des Services Agricoles
[18] Direction de l'Education de Wilaya
[19] Chambre d'Agriculture de Wilaya

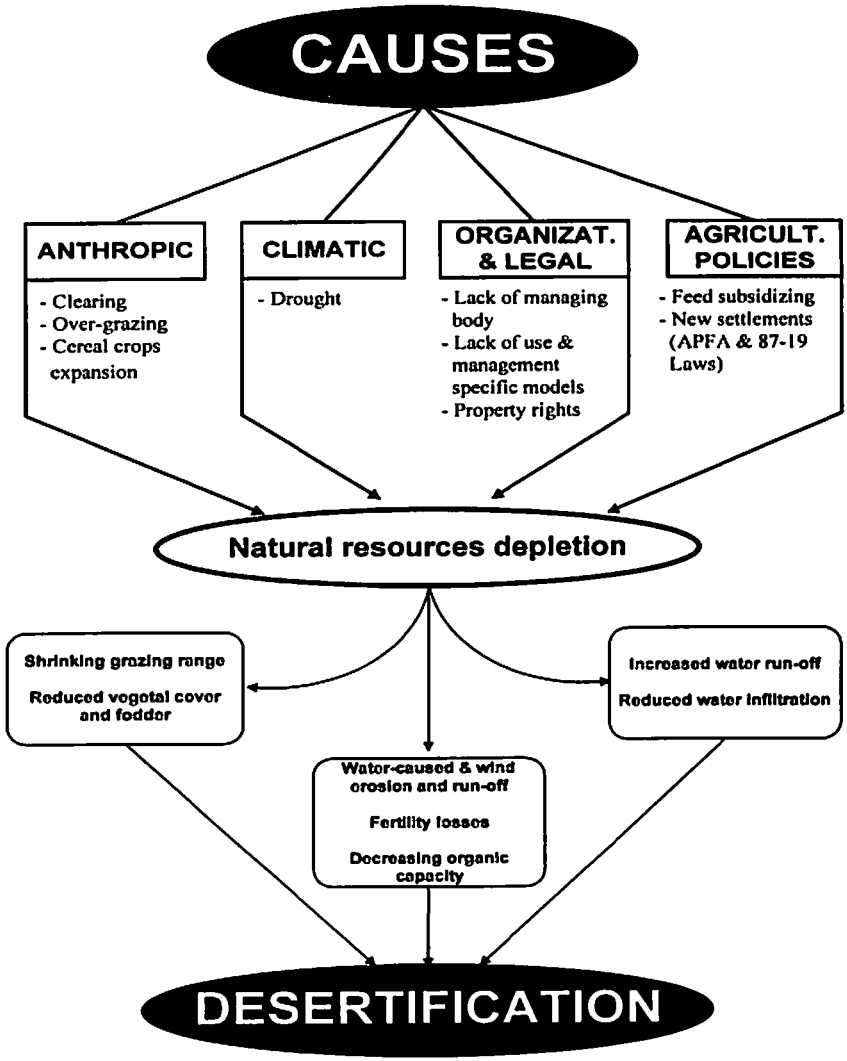
Table 2: Evolution of number of beneficiary partners of shrub and Opuntia species plantations in the eastern region

	Number of partners by classes of planted area (ha)						
Ag-year	0-5	5-10	10-20	>20	Total	Total area/year	Average (ha/partner)
1993/94	249	0	0	0	249	500	2.01
1996/95	275	19	2	0	249	500	5.14
1995/96	720	17	5	2	794	2396	3.02
To	1294	36	7	2	1339	4418	3.30

Table 3: Evaluation of the school education program

Location	*School*	Numbers of school children			Level of comprehension		
		Involved	Attended	Tested	>60%	60-40%	<40%
Khenchela	Boufissane	62	62	0			
	H. Gousset	45	30	0			
Souk Ahras	Cheguaga	53	32	16	03	07	06
	O. Abid	49	25	13	04	10	09
O.E. Bouaghi	B. Chergui	213	60	23	04	10	09
Total		421	209	52	11	21	20
		%	49.64	24.88	21.15	40.39	38.46

Figure 1: Framework for the causes of the depletion and desertification of rangelands



LAND TENURE REGIMES IN THE ALGERIAN STEPPE RANGELANDS: THE PRESENT SITUATION AND FUTURE CHALLENGE

Noureddine Redjel, Haut commissariat du Developpement de la Steppe, Region East, Tebessa, Algeria
Mustapha Malki, Institut Technique des Grandes Cultures, Algiers, Algeria

THE PROBLEM

During the last two decades, the land tenure regimes of the Algerian rangelands have undergone continuous changes due to their unstable legal basis. This has been a major cause of natural resource depletion in the rangelands by:

- inhibiting private initiative, investment and participation of the range users which are fundamental to the development and sustainability of the resource base. Until 1990, public services in rangelands was the only source of investment;
- stimulating speculative use of the resources by (1) an exploitative land mining: which reduced feed production by 67 percent; (2) clearing the native vegetation that reduced rangeland areas by 25 percent; and promoting crop production by doubling the cropped area.

Between 1974 and 1993 the property rights regime of the rangelands has been characterized by antagonism between the formal and informal land tenure regimes, and by numerous laws and regulations that have been promulgated to regulate this fragile resource, both on ecological and socioeconomic grounds. This regulatory arsenal has had a common objective of overthrowing customary rights and breaking the traditional organization of the pastoral society.

The objective of this paper is improve understanding of the evolution of rangeland property rights during the post independence period, with regard to their effects on the natural resources, and to address the key issues of sustainable development of the resource basis.

THE DYNAMICS OF LAND TENURE REGIMES IN THE RANGELANDS

The traditional land tenure system of pastoral society in the rangelands is based on tribal collective ownership. Each tribal member has its own territory, delimited by the collectivity. This land tenure regime was established to guarantee use and access rights to each tribal member, with an equitable distribution of available resource; to ensure its sustainability so that no degradation could occur; and to protect the tribal economy, but with ownership belonging to the collectivity, the tribe. This form of property allocation is motivated by the concern of the tribe for its security and survival. However, during the last two decades, 1974/83-1984/93, the traditional land tenure regimes on rangelands have been very unstable.

FORMAL LAND TENURE REGIMES ON RANGELANDS

Period from 1974–1983. In November 1971, the Algerian government launched the Agrarian Revolution (Ordinance 71 – 73) aimed at reducing inequalities in the distribution of land holdings and rural incomes by abrogating previous legal and customary land tenure systems and property rights. The FNRA (National Fund of Agrarian Revolution) was created through the nationalization or donation of collective and public land, leading to new land tenure regimes.

The pastoral code 75 - 43, which was implemented in 1975, ended the legal vacuum on steppe rangelands and classified the pastoral space in three categories: (1) degraded rangelands to be protected, (2) rangelands designated for the settlement of cooperatives CEPRA (Cooperative d'Elevage Pastoral de la Révolution Agraire); and (3) rangelands commonly used by the livestock owners. The implementation of the pastoral code, which was named the Third Phase of the Agrarian Revolution, gave birth to 200 CEPRA covering 431,315 hectares for 1385 beneficiaries and 124,800 sheep (Anonymous, 1988).

Period from 1984–1996. Following the 1980/1984 five-year plan, CEPRAs were dissolved in 1984 and since then rangeland access and use have been regulated through customary tenure systems. These customary rights can lead to absolute ownership claims. This evolutionary approach to establishing property rights was supported by the promulgation of the 87-19 law, which allowed the distribution of rangelands located on DAS's (Domaines Agricoles Socialistes) to individuals for collective usufruct (EAI, EAC). Since then Algeria has

headed toward land tenure changes related to the establishment of the free market economy system.

The 90-25 law promulgated in November 1990 abrogated the agrarian revolution and its related rules and regulations. Consequently the rangelands did not receive the legal or institutional support necessary to prevent the informal land tenure that had been taking place since 1984.

INFORMAL LAND TENURE REGIMES (CUSTOMARY RIGHTS)

In the rangelands there are four types of land rights: (1) Melk or private lands are freehold; (2) collective arable lands (Bled Jamaa) are parts of the tribal lands that are distributed to tribal members and grazing is restricted; (3) collective pasture lands are unrestricted for grazing; and (4) state lands that are commonly used by tribes. These different forms of land tenure regimes evolved as if a legal basis existed, with continuous adjustments of customary tenure systems to protect tribal rights.

In this process of tenure changes, formal land tenure regimes have been of considerable importance. Most of the regulations, however, have focused on restructuring the tribal concept, which constituted the main strength of the rangeland tenure regimes. Consequently, the dislocation of tribal institutions and the weakening of their regulatory power created a legal vacuum on the rangelands, which fostered land conflicts. Moreover, individual interests have emerged and collective interests have been transgressed. In 1990 it was estimated that 90 percent of the rangeland were considered state lands and 10 percent were privately owned (HCDS 1991). A just and more equitable alternative is urgently needed to reconcile the growing conflict between traditional and individual claims on rangelands.

CONFLICT GENERATION

Pastoral societies perceive rangelands as open and unrestricted resources and are continuously trying to secure these common spaces to maximize their profit from its uses. This basic principle on common resources and unstable land tenure regimes are the key causes of land conflicts. These conflicts could be classified into four types:

- *Access conflicts*: Access to rangeland resources is regulated both by the pastoral society, through customary rights, and by the state by implementing comprehensive laws and regulations. However, in both cases unanticipated situations arise leading

to conflicts between tribes and/or among tribal members. These conflicts account for about 15 percent of cases.

- *Boundary conflicts:* Boundary limits, which account for 50 percent of the dispute cases, were the major land conflicts. These disputes, which were intensified by the different regulations, have been aggravated by the growing demographic pressures on the rangelands (the population growth rate is 3.82 percent a year) (Bedrani, S. et al. 1994). Moreover, the scarcity of the resource is becoming a major concern of the livestock owners
- *Access to water:* Access to water, which account for 5 percent of the cases, is ancient cause of conflict in rangelands because of land encroachment and water scarcity in the arid and semi arid zones.
- *Legal conflicts:* These disputes, which account for 30 percent of the cases, grew out of the differences in perception and implementation of different laws and regulations. The ambiguities of the new laws and regulations have generated conflicts between tribes and between tribal members.

These conflicts highlight the difficulty of achieving an ideal property rights solution. However, they could also provide a basis for viable use and management of rangelands by reconciling the traditions of pastoral societies with education objectives and ecological considerations.

RESOURCE CHANGES

In the last 20 years, rangelands have been encroached by cropping and their degradation has been worsening. In general the following trends could be noted:

- Rangeland areas have declined from 41 million hectares in 1974 to 31 million hectares in 1993, or by 25 percent in 20 years. This reduction has affected the natural equilibrium of the country by aggravating the process of desertification and the depletion of natural resources;
- Their feed production capacity has fallen from 1.6 billion Forage Units (FU) in 1978 to 525 million FU in 1993 , increasing the dependency of flocks on imported feed, which averaged 1.8 billion FU/year during the period 1984-1993, representing 39 percent of the maintenance requirements of the ruminant livestock;
- Cereal cultivation has extended the cropped area from 1.2 million hectares in 1974 to nearly 2.4 million in 1993, doubling

in two decades. This extension of cereal cultivation in marginal areas is a major contributor to soil erosion losses estimated at 120 million tons/year at the national level (MAP, 1996)

These trends indicate the importance of land tenure stability for the sustainability of economic productivity even though there may be other factors, such as agricultural policies, affecting rangelands. There are two conflicting trends in the land tenure policies:

- The regulation of the land tenure regimes during the 1970s had a positive impact on rangeland productivity by guaranteeing a viable productive environment and income to the local population. Fore example, in 1974 a sheepherder's income was 1,100 USD/year (Boukhoubza, 1978), while in 1993 it was 1,200 USD without accounting for inflation.
- The current mix of formal and informal property rights has accelerated resource depletion and stimulated rangeland appropriation by the pastoral society. The process of desertification is worsening and Chellig (1978) estimated that 300,000 hectares of rangelands were being annually transformed into desert.

CONCLUSION

The review of land policies on rangelands suggests that there is no simple solution for promoting sustainable development and revival of the pastoral societies. The compromise requires finding a way to restore the vocation of the rangelands as "sheep country". This conclusion is supported by the ongoing land reforms that have overthrown the traditional pastoral society and set up a new peasant society. This constitutes a major challenge to policy makers and legislators for promulgating a rangeland tenure law that will help to boost the pastoral economy. Moreover, there are key property rights issues that need to be addressed to resolve conflicts and prevent resource depletion. Who are the owners and the managers of the rangelands? What are the management limits of the traditional organization? What are the forms of property rights in the rangelands that could ensure a rational use of the resources by optimizing ecological conservation?

Today, the major concerns of policy makers are to find a comprehensive legal basis for rangelands for their sustainable development. This task is not easy because of the difficult choice between restoring traditional rules or making new ones. The search for compromise, which would reconcile pastoral traditions with ecological

concerns and satisfy the needs of pastoral communities in a self-sustained rangeland economy without changing rangeland vocation, is challenging. Shaping future land tenure policies in rangelands should be based on the realities of pastoral societies with respect to tradition, culture, objectives and education that rule the relationships between them and their environment. Moreover, these legal reforms should be flexible and enable the progressive introduction of needed reforms for alleviating poverty, and optimizing and sustaining the economic and ecological potential of rangeland resources.

RANGELAND DEVELOPMENT IN LIBYA

Adnan Sbeita, Agricultural Research Center, Tripoli, Libya
Suliman Abul Khair, Agricultural Research Center, Tripoli, Libya
Seddik Mlatim, Agricultural Research Center, Tripoli, Libya
Ahmed Shmakhy, Agricultural Research Center, Tripoli, Libya
Mohamed Idrissi, Agricultural Research Center, Tripoli, Libya
Suliman Oshen, Agricultural Research Center, Tripoli, Libya
Saleh Hemmaly, Agricultural Research Center, Tripoli, Libya
Grera Shtewi, Agricultural Research Center, Tripoli, Libya
Sassi Haragha, Agricultural Research Center, Tripoli, Libya

INTRODUCTION

For the past 20 years, rangeland development has been an important investment priority for the Libyan Government. Rangelands account for 128,000 km sq and are located in areas with under 50-150mm average annual rainfall. To date nine large rangeland development projects have been implemented in Libya (Gharian – Jadu, Bir El-Ghanam, Benghazi Plain, Jabal El Akhdar, El Kharruba, Zlieten, Middle Zones, Wadi Sasson, and El-assa Range). Different types of range improvements including rehabilitation of the natural vegetation, shrubs plantation (Atriplex), medic introduction, and range protection (fencing), have been introduced. Considerable financial resources have been expended on these development projects and it is important to assess their successes and evaluate their impacts.

For this purpose the Garian-Jadu rangeland-grazing project was selected as a case study due to its proximity to Tripoli and the availability of valuable information. The project is situated about 120 km southwest of Tripoli, in the western mountains between longitude East (12.23 – 12.07) and latitude North (37.52 – 31.48), at about 700-800 m above Sea Level. It is bounded to the north by the mountains of Zintan and Gharian, to the south by the wadis Wames and Mizda, to the east by El-urban, and to the west by the Rojban hills. The project covers 93,250 ha and is divided into three parts: Garian I (Zintan) with 35,900 ha, Garian II (Tilit) with 37,000 ha and Garian III (Ghdama) with 20,350 ha.

The physiognomy of the area is undulating to hilly and there are wadis such as Wadi Wamis, Wadi Om-harmel and Wadi Tlieb. Some areas of these rangelands have been used for cropping (barley and wheat)

and some of the trees and shrubs have been cut or uprooted for fuel. As a result, the vegetation cover in the area is deteriorating leading to soil erosion by wind and water. The density of plant cover is now less than 30 percent and the erosion is evident in all the areas where the slopes reach 30 percent.

The Natural vegetation of the area could be classified into four categories: steppe, Artemesia herba-alba, Hammada shrubs, seeded plants and grasses. The steppe, which is found along the northern part of the project and on the higher eastern mountains, is dominated by Stipa spp. Rainfall averages 175 mm/year and in good rainfall years, the steppe covers 50 percent of the area. In addition, most of the flat lands in these areas have been cleared of stones for cropping and are covered by annual grasses and forbs. The Artemesia extends from East to West across the project area. The Hammada shrubs, which are found in the Southwest and south, are well established on stony undulating areas and in areas with less than 125 mm per year. In general, annual plant productivity ranges between 50 and 100/kg/ha/year on Hammada shrubs, 100 and 200 kg/ha in the Artemesia herba-alba and 400 and 800 kg/ha on the Steppe.

RESULTS AND DISCUSSION

The results are based on interviews carried out in the project area amongst 17 project staff and 27 herders and farmers.

FODDER SHRUB PLANTATIONS

Local Atriplex species (Halimus) grow naturally in 77 percent of the project area. In addition, the project introduced new Atriplex species (Numularia). The introduction of Atriplex was more successful in the areas where local Atriplex was found. The majority of the project staff consider that Atriplex have an important nutritive value (69 percent) and are palatable (77 percent) (Table 1). Amongst livestock owners, however, 24 percent reported that the nutritional value was poor and 20 percent reported poor palatability. The major difference between these two groups is the use of Atriplex after cutting. The majority of livestock owners (94 percent) believed that dry Atriplex was not good as feeds while project staff were divided. Forty six percent believed that it was fair, 46 percent that it was poor and 8 percent that it was good (Table 1).

Regarding the management of the rangeland project, the majority of the project staff (77 percent) was not happy with the grazing system because of the absence of any grazing management program. The

grazing system was based on the traditional grazing system. However, the remaining 23 percent believe that the traditional grazing system is good because it is simple and practical under project conditions. Amongst livestock owners, however, it was clear that the majority of the landless livestock owners (93 percent) were more eager to keep the present situation while the majority of landowners (46 percent) consider that the present management was not good (Table 2).

The survey also found a difference in grazing strategies between landowners and landless. On average, livestock owners spent 75 percent of their time on public rangelands, 20 percent on the project and only 5 percent on their own rangelands (Table 3). But, landowners spent 63 percent of their grazing time on public rangelands while landless use these rangelands for 86 percent of their time. Moreover, 90 percent of private lands are used by the landowners themselves. In addition, the utilization of the project by landowners is greater (28 percent) than landless (13 percent). Before the project, landless livestock owners used these areas more for grazing but since the development of the rangeland project, previous landowners have returned to the project area. Consequently, the grazing pressure on the land has increased and the resource has deteriorated.

FENCING AND PROTECTION OF REHABILITATED RANGELANDS

Fencing was another strategy used to protect and rehabilitate rangelands. However, the majority of the project staff (77 percent) questioned the efficiency of fencing due to the high establishment costs and to inadequate protection because users could easily remove these fences. For example, members of the local tribes have played a major role in the removal of these fences to protest against the project and its establishment on their traditional lands. Moreover, they argued that they were not sure of project benefits. Those who supported fencing (23 percent), do so because they cannot see any better alternative for delimiting project boundaries and for protecting the project. Fencing was only effective at the beginning of the project when patrols were present to protect it.

These differences of opinions were also expressed by the technical assistance of the project. Both GEFLI (1974) and Le Houerou (1983) advised fencing project areas while Jansen et al (1985) reported that fencing was inefficient given the current situation of the project. Local experts, however, concluded that fencing determines only project boundaries and that adequate protection requires other measures, such as protective patrols by project personal or the effective involvement of

local people. Others argue that dividing and distributing the lands to local farmers would also have been a practical solution since beneficiaries would protect their own farms from encroachment. However, the interviewed livestock owners (76 percent) believed that individualization of rangelands was not a good idea. Both landowners and landless livestock owners supported this view (Table 4).

Property Rights Issues

Amongst the 44 interviewees, 77 percent stated that land tenure issues were the main problem from the inception of rangeland development. The majority of the livestock owners (92 percent) considered the project area as tribal lands while 4 percent reported that these lands were private because in the last few years some of these tribal lands were divided among households. The remaining 4 percent of the sample stated that these lands were public and free for all (Table 5). It was obvious that the latter group may be benefiting from the project and would like to maintain the present situation.

The traditional land tenure system regulated access and use of the tribal lands for both grazing and cropping. More recently, the introduction of perennial range plants such as Atriplex spp. has become part of the livestock grazing system and some of the farmers are planting rows of salt bushes in their barley fields. This has proved acceptable to local farmers and has been one of the objectives of the rangeland project. Although it has been reported that inter-cropping barley with Atriplex spp may damage the root system of the Atriplex, this conflicts with the opinions of landowners and other observers.

Although property rights issues were seen as the major problem by 75 percent of the staff; causing many difficulties for the project administration and management; about 25 percent of the respondents felt that there were other problems of equal or greater importance, such as protection of fodder shrubs. However, 87 percent of the respondents are still hopeful about the success of this project.

Rangeland Development and Herd Ownership

The number of animals in the area has decreased drastically since 1985. For example, the number of sheep decreased from 7,906 heads before 1985 to 520 presently (Table 6). The majority of the livestock is privately owned (Table 7). In the past, shepherds owned no land but were responsible for grazing livestock on tribal rangeland and were paid by the community. Since the establishment of agricultural development

projects in the 1970s, the conditions of the shepherds have improved. Local people no longer shepherd the livestock of other people unless they are joint owners. Nonetheless, local shepherds sometimes cooperate in grazing to reduce costs.

CONCLUSIONS

The survey highlighted some of the contradictory views between project staff and livestock owners regarding the improvement of rangelands and the necessity to fence improved areas. It was clear that livestock owners do not favor the individualization of the rangelands. Both landowners and landless livestock owners support the common use of the rangelands. However, when it comes to the present management, landless livestock owners support more the present situation than landowners.

REFERENCES

Jansen, H. C. et al. 1985. Range Inventory, Analysis, Management and Sheep Husbandry. Recommendations for the Gharian Grazing Project. FAO

Le Houerou, H. N. and I. M. Aly. 1982. Prospective and Evaluation study on Agriculture Development. FAO

Table 1: Perceptions on the quality of Atriplex as feed for 17 project staff and 27 livestock owners in the project area, Libya

	Project staff			Livestock owners		
Item	Good %	Fair %	Poor %	Good %	Fair %	Poor %
Nutritive value	69	31	0	68	8	24
Palatability	77	15	8	68	12	20
Direct grazing (as green)	85	15	0	85	10	5
Dry utilization (after cutting)	8	46	46	0	6	94

Table 2: Opinions regarding the present grazing management amongst 27 livestock owners, Libya

Land distribution	All livestock owners (%)	Landowners (%)	Landless (%)
Good	67	39	93
Not good	26	46	7
Fair	7	15	0
Total	100	100	100

Table 3: Sources of grazing among 27 livestock owners in the project area, Libya

Type of rangeland	All livestock owners (%)	Landowners (%)	Landless (%)
Rangelands	75	63	86
Private pastures	5	9	1
Improved rangelands	20	28	13
Total	100	100	100

Table 4: Opinions regarding land distribution in the project area of 27 livestock owners, Libya

Land distribution	All livestock owners (%)	Landowners (%)	Landless (%)
Good	20	17	23
Not good	76	75	77
Fair	4	8	0
Total	100	100	100

Table 5: Perception of property rights in the project area before improvement amongst 27 livestock owners, Libya

Tenure Regimes	All livestock owners (%)	Landowners (%)	Landless (%)
Tribal	92	93	91
Private	4	7	0
Public	4	0	9
Total	100	100	100

Table 6: Livestock distribution in the project area

	Before 1985	After 1985
Sheep	7,906	520
Goats	450	122
Camels	6	1

Table 7: Herd ownership amongst 27 livestock owners

Categories	Percent
Private	85
Not private	0
Both (together)	15
Total	100

TRANSFORMATION OF PROPERTY RIGHTS INSTITUTIONS IN LEBANON

A. Baalbaki, Lebanese University,
Beirut, Lebanon
H. Hassan, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon
G. Fren, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon
M. Goush, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon
H. Hameih, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon
H. Jaafar, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon
A. El Rami, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon
I. Harfoush, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon
T. El Takash, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon
M. Hameih, Lebanese Agricultural Research Institute,
Tel Amara, Lebanon

INTRODUCTION

The land tenure system in Lebanon is deeply influenced by the application of Islamic land rules imposed under the Ottoman State in 1858. The Ottoman State made two important provisions that greatly affected the traditional land tenure system in Lebanon:

- The Ottoman state gave to local municipalities the power to rent common mountain ranges (heights of Mount Lebanon) and forests to individuals.
- Use-rights, that were granted to individuals who either reclaimed or cultivated virgin or abandoned lands in the province (*wilaya*), were transformed into ownership rights if farmers planted trees. In the district areas, ownership rights were granted by cultivating any crop or by fencing.

The transformation of the land tenure system, which was based on two major Islamic principles (development and acquisitive prescription), promoted the privatization of common village lands. The first principle states that "whoever develops land without any claims is the rightful owner" whereas the second states that whoever abandons a field for a certain period (generally 10 years) loses his rights over that field. Moreover, considering common forests as rangelands facilitated the application of these principles. For example, powerful leaders interpreted Article 10 of 1858 Ottoman Code by equating common pastures to virgin lands if only one-tenth of the vegetation was cut annually. These interpretations allowed leaders to allege first occupancy and lay claims on large areas of the common forests and pastures.

This "legal" privatization of rangelands and the lease of pastures by municipalities resulted in the reduction of pastures and exclusion of farmers, especially small landholders, in Mount Lebanon in particular. The municipalities could hardly manage the leasing system or challenge the power of influential families who occupied these lands.

During the French colonization (1919-1946), the authorities maintained the same system, which was subsequently adopted by the independent Lebanese government. The major state intervention in low rainfall areas (LRAs) since independence was in 1971 when the Lebanese government claimed ownership rights (*haq al-raqaba*) over rangelands while granting use-rights to local communities. The government also made two other important provisions that (1) gave to local municipalities and village committees the power to manage access to these lands and (2) vested the Department of Forests of the Ministry of Agriculture with the right to grant cutting licenses.

However, these different provisions did not prevent encroachments and over-grazing of common rangelands. The mismanagement of common forests and mountain ranges by municipalities and the lack of protection of these resources in poor, isolated and dry rural areas led to their deforestation. This situation is worsened by the inability of the government to organize and manage the uses of rangelands, and to prevent powerful local leaders from appropriating large areas of the rangelands.

TRANSFORMATION OF THE AGRICULTURAL SYSTEMS IN LEBANON

During the past 40 years, the agricultural sector in Lebanon underwent many changes, which altered property rights institutions. Among the factors that prompted these changes were (1) the movements

of the population, (2) marketing policies, and (3) lack of a relevant legal and institutional framework to control and regulate ongoing property rights changes. This process of transformation could be divided into four phases.

First Stage: 1950s

The major feature of LRAs in the 1950s, was the predominance of small land holders who practiced mixed farming of cereals in winter and vegetables in summer, associated with herding (average 60 head) and charcoal production in the tribal western foothill forests. In 1959, the total areas of Bal'bak and Harmal districts (research area) were respectively 215,900 hectares and 54,100 hectares among which 70 percent and 62 percent were rangelands, (Table 1).

Demographic movements to and from the northern part of the Bekaa and the movement of herds in the eastern and western parts of the plain prompted many changes in the production systems.

Second Stage: 1960-1975

This stage was characterized by the introduction of new tribal policies by Shihabi who came to power in 1958. Tribes were enlisted and powerful tribal leaders were given the function of providing soldiers to the Lebanese army. In addition, the government provided employment opportunities to educated tribal people and promoted the education of rural communities.

As a result, farmers with small and average land holdings reduced the number of their flocks and shifted from rainfed farming of cereals and vines in the low mountain lands to intensive agriculture in the plains where they obtained land either by renting, sharecropping, or purchasing land with their savings. This resulted in the transformation of agriculture in the LRAs from a traditional system, that was highly dependent on labor and rainfall, to intensive farming that depended on mechanization, irrigation, chemical inputs, and links to large scale commodity and market production.

Third Stage: During the Civil War (1975- 1990)

Movements of farmers with small and medium land holdings, from the low mountain lands to the plains, were precipitated during the civil war. The most important effects of these movements were the reduction of livestock numbers, especially cattle, and a 50 percent decrease in number of animal breeders (Table 2). Moreover, forced outmigration

during the civil war forced many landowners to sell their properties. For example in the Bekaa valley, 27 landowners were obliged to sell about 38,000 hectares of land.

The expansion of vegetable production, particularly after the petroleum boom, and the production of illegal drugs (hashish and heroin) generated revenues that contributed to development of fruit plantations and the digging of artesian wells in LRAs. For example, in Arsal, large areas of lands were planted with fruit trees and in Kaa 110 horticulture projects were developed; irrigated areas expanded from 12,000 to 39,000 hectares. All these developments, which were done at the expense of pasture lands, led to over-grazing of the remaining pastures by local and Syrian flocks.

The process of agricultural intensification was also associated with precarious short term leases (one year) that pushed tenant farmers to seek short term production gains by using large quantities of chemical fertilizers and pesticides. These practices favored the development of diseases and loss of fertility. For example, large-scale potato farmers moved to the plains of northern Bekaa' and abandoned the wetter and more fertile southern plains.

FOURTH STAGE: 1990S

Cultivation in the northern Bekaa' expanded in the Baal'bak district from 65,500 hectares in 1959 to 90,300 hectares by early 1990s. A different situation developed in the Harmal district where cultivation declined from 20,000 hectares in 1959 to 12,300 hectares, due to out-migration.

This recent stage is characterized by the implementation of government policies promoting the shift from growing illegal drugs to tobacco. Drug growing, which used to occupy about a quarter of the most fertile and wettest plain areas, is being replaced with tobacco (1215 hectares). The areas devoted to tobacco are expanding in the southern and western areas of Baal'bak (Deir Ahmar, Majdaloun, Balabak, etc.) that were hardly affected by the prohibition on drug production. The commitment of the Lebanese government to purchase all the production of tobacco at preferential prices has encouraged the development of sharecropping arrangements defining each party's contribution (land, water, license and labor). Tenant farmers make up 22.3 percent of the total number of beneficiaries of the project.

These changes also involved the development of (1) extensive planting of nut trees in the eastern and western foothills, vines in Kaa, and cherry trees in the mountainous areas of Arsal; (2) drilling wells; and

(3) the extension of rental arrangements from one year to three years to allow tenant farmers and sharecroppers to grow watermelon. Moreover, the introduction of trickle irrigation systems has led to the development of new labor and sharecropping arrangements with Bedouin families who provide intensive and cheap labor.

CONCLUSION

LRAs of Lebanon have been vulnerable to changes in economic and political environments. In general, economic policies were implemented suddenly without the creation of any legal or institutional framework to enable agricultural producers to benefit from the positive long-term aspects of these policies or to alleviate their adverse consequences.

Moreover, the ineffectiveness of present legal texts to regulate access and use of resources in the LRAs hampers the sustainable management of rangelands and private properties. Consequently, enacting a Rural Code has become urgent in order to support agricultural growth and regulate rental and sharecropping arrangements between landowners and tenant farmers. Recently, the Lebanese government introduced to the Representatives' Council Committees a draft law that will upgrade use-rights on registered *miri* lands to private property.

Table 1: Distribution of land use in Ba'lbak and Harmal districts in 1959 (hectares), Lebanon

District	Irrigated	*Rainfed*	Irrigated	Rainfed	Rainfed rocky	Area of arable land	Total area of district
Ba'lbak	447.2	5377.5	17,227.5	36,589.1	5,974.9	65,616.4	215,266
Harmal	113.2	379.9	3,468.2	14,897.1	1,214.4	20,073.6	54,185

Source: "Aspect general de l'Agriculture Libanaise", Tome II, Tableau page 104, Ministere de l'Agriculture, Service statistique, Beirut 1960.

Table 2: Number of breeders and flocks in the Bekaa' (1980-1990), Lebanon

Type	Years	Flock (head)	Number of breeders
Cattle			
Mixed local and Holland	1980 1991	4,309 6,175	1,236 580
Holland and Similar breeds	1980 1991	1,858 150	540 25
Local breed	1980 1991	2,529 500	1,135 350
Sheep	1980 1991	81,987 103,000	1,354 1,000
Goat	1980 1991	149,124 150,000	1,759 1,211
Total	1980 1991		6,014 3,166

Source: (1) 1980 data: inventory by OPA, FAO, UNDP and 1991 data: Research work carried out by Dr. Ahmad Baalbaki (UK) for IFAD (Animal Production Project - CRI) and other research work carried by Dr. Mohamed Farran (AUB).

PART IV

ANNEX 1. WORKSHOP PARTICIPANTS

Dr. Abdel Hamid Abdouli
Int'l. Fund for Agricultural Dev't. (IFAD)
Project Controller Near East and North
Africa Division
Programme Management Department
Rome, Italy

Dr. Fawzi Lafi Ammari
Director General Land and Survey Department
P.O. Box 2099
Amman, Jordan

Mohamad Araji
Administrative Officer
Agricultural Research Institute
Tel Amara-Beekaa, Lebanon

Dr. Mohamed Salah Bachta
Institut Nat'l. Agronomique de Tunisie
(INAT)
43, Av. Charles Nicolle
1082 Tunis, Tunisia

Dr. Ahmad Baalbaki
Institut des Sciences Sociales
Lebanese University, Lebanon
P.O. Box c/o ICARDA-Beirut Beyrouth, Mina
WI-Hosne Imm Wassouf

Mr. Geert Balzer
Team Consult
Malerwinkel 6
22607 Hamburg, Germany

Dr. Adel El-Beltagy
Director General
ICARDA
P.O. Box 5466
Aleppo, Syria

Badr Ben Ammar
Director of Planning in Ministry of Ag.
P.O. Box 1002 Alain Savary 30
Tunisia

Prof. Houcine Boughanmi
Ministry of Agriculture
ESA - Moghrane
Zaghonan, Tunisia

Dr. Heinz Bühler
Director General
DSE
Rauchstr. 25
10787 Berlin, Germany

Dr. Nabil Chaherli
IFPRI/ICARDA
P.O. Box 5466
Aleppo, Syria

Mohamad Fouad Dhneh
Head of Department of Projects
Ministry of Agriculture & Agrarian Reform
Damascus, Syria

Dr. Nasrat R. Fadda
23 Penton Court
Jamnagar Close
Staines, TW18 2JU, United Kingdom

Mr. Youseif Ben Gharsa
Director of Rangelands Development
Secretariat of Animal Health
Tripoli, Libya

Dr. Gustave Gintzburger
ICARDA
P.O. Box 5466
Aleppo, Syria

Dr. Nasri Haddad
ICARDA
P.O. Box 950 764
Amman 11195, Jordan

Mr. Salah Haj Hassan
M&M Project National Coordinator
Agricultural Research Institute
Tel Amara, Rayak
Bekaa, Lebanon

Dr. Peter Hazell
Director EPTD
IFPRI
1200 Seventeenth Street, N.W.
Washington, DC 20036-3006 USA

Atyah Al-Hindi
Director of Agricultural Policies
Ministry of Agriculture & Agrarian Reform
Damascus, Syria

Abdelmajid Ammari El Idrissi
Head of Information and Training Dir.
INRA - P.O. Box 6512
Rabat, Morocco

Dr. Amer S. Jabarin
Dept. of Agricultural Economics
University of Jordan
P.O. Box 13021
Amman 11942, Jordan

Mr. Joseph Jabbour
Chef de service d'agriculture du Ministere de l'Agriculture
CHAYAH Galerie Seman
Zahle Bekaa
Beirut, Lebanon

Dr. Mysire Majeed Jarjees
President
IPA Agriculture Research Center
P.O. Box 39094
Baghdad, Iraq

Dr. Yassin Karieneh
Ministry of Agriculture and Agrarian Reform
Directorate of Agr. Sci. Research
Douma - P.O. Box 113
Damascus, Syria

Mr. Mohamad Khozmah
Director of Agricultural Economics
Al-Jabri Street
Hijaz Square
Damascus, Syria

Mrs. Gundula Kreis
Training Consultants
Berger Str. 2
82319 Percha, Germany

Mr. Mohamed Ben Makhlouf
Directeur des Aménagements Fonciers
Ministère de l'Agriculture de l'Equipement et de l'Environnement
Avenue Hassan II
Rabat, Morocco

Mr. Mustapha Malki
Secretary General
Institut Techniques des Grandes Cultures (ITGC)
B.P. 16 - El-Harrach
Algiers, Algeria

Mr. Qassem Mamdouh
M&M Project National Coordinator
National Center for Agricultural Research and Technology Transfer (NCARTT)
P.O. Box 639
Baqa', Jordan

Dr. Mohamed Salah Mekni
North Africa Regional Coordinator
ICARDA
B.P. 435
El Menzah
1004 Tunis, Tunisia

Dr. Mohammed El-Mourid
M&M Project National Coordinator
Head, Centre of Aridoculture
Institut National de la Recherche Agronomique
(INRA)
B.P. 589
Settat 26000, Morocco

Dr. Mohamed Moussaoui
Ecole Nationale d'Agriculture
B.P. S/40
Meknes, Morocco

Dr. Uwe-Jens Nagel
Institute for Agricultural Extension and
Communication Sciences
Humboldt University of Berlin
Luisenstr. 53
10099 Berlin, Germany

Mr. Mahmoud Al-Naif
Ministry Center R. & A. Rakka Syria
Rakka, Syria

Salim Al-Najafi
Mosul University, Iraq

Mr. Shabab Nasser
Ministry of Agriculture and Agrarian Reform
Planning Directorate
P.O. Box 30487
Damascus, Syria

Dr. Fatima Nassif
Centre Regional de Recherche Agricole (CRRA)
Institut National de la Recherche Agronomique
B.P. 589
Settat, Morocco

Dr. Ali Nefszaoui
M&M Project National Coordinator
Institut National de Recherche Agronomique de
Tunisie (INRAT)
Rue Hedi Karray
Ariana 2049
Tunis, Tunisia

Mr. Karim Nesheiwat
Director of Monitoring and Evaluation Unit
Ministry of Agriculture
Al-Jamiha St
P.O. Box 926630
Amman, Jordan

Dr. Tidiane Ngaido
IFPRI/ICARDA
P.O. Box 5466
Aleppo, Syria

Dr. Tom Nordblom
ICARDA
P.O. Box 5466
Aleppo, Syria

Mr. Peter Oram
IFPRI
1200 Seventeenth Street, N.W.
Washington, DC 20036-3006 USA

Dr. Per Pinstrup-Andersen
Director General
IFPRI
1200 Seventeenth Street, N.W.
Washington, DC 20036-3006 USA

Mr. Suliman Raheel
Director of South Gabal Akhdar Project
Secretariat of Agriculture
c/o Director General
Agricultural Research Center (ARC)
P.O. Box 2480
Tripoli, Libya

Mr. Noureddine Redjel
Haut Commissariat du Developpement de la Steppe - Region Est
Cité Ezzouhour
Route d'El Kouif
12005 Tebessa, Algeria

Mr. Jürgen Richter
German Foundation for International Development (DSE)
Food and Agriculture Development Centre (ZEL)
Wielinger Str. 52
82340 Feldafing, Germany

Mr. Mohamed Sahbi Hajej
Director General
IRESA - Ministere de l'Agriculture
30 Rue Alain Savary
1002 Tunis, Tunisia

Mr. Albert Sasson
Director
Directorate of Planning & Economic Affairs
Ministère de l'Agriculture de l'Equipement et de l'Environnement
Avenue Hassan II
Rabat, Morocco

Mr. Adnan Sbeita
M&M Project National Coordinator
Agricultural Research Centre
P.O. Box 2480
Tripoli, Lybia

Dr. Anna Schmidjell
Schloss Neu-Egling 6
82418 Murnau, Germany

Dr. Grera Shetewi
Agricultural Research Centre
P.O. Box 2480
Tripoli, Libya

Dr. Nahi Shibani
Director of Statistics and Planning
Ministry of Agriculture and Agrarian Reform
P.O. Box 30487
Damascus, Syria

Dr. Kamil Shideed
M&M Project National Coordinator
IPA Agricultural Research Centre
P.O. Box 39094
Baghdad, Iraq

Dr. Ahmad E. Sidahmed
Technical Advisor (Livestock & Rangeland Systems)
Technical Advisory Division
IFAD
107, Via del Serafica
00142 Rome, Italy

Dr. Abdelmajid Slama
Director
Technical Advisor Division
IFAD
107, Via del Serafico
00142 Rome, Italy

Dr. Mahmoud Solh
Director
International Cooperation
ICARDA
P.O. Box 5466
Aleppo, Syria

Mrs. Petra Stolp
Seminar Assistant
Sorbenweg 6
06217 Merseburg, Germany

Mr. Yassin Sweidan
M&M Project National Coordinator
Directorate of Agricultural Research
Douma
P.O. Box 113
Damascus, Syria

Dr. Awni Taimeh
Director General
National Center for Agricultural Research and Technology Transfer (NCARTT)
P.O. Box 639
Baqa' 19381, Jordan

Mr. Abdelhaq Tber
Direction de l'Elevage
Ministère de l'Agriculture de l'Equipement et de l'Environnement
Departement of Agriculture
Avenue Hassan II
Rabat, Morocco

Dr. Richard Tutwiler
Anthropologist
ICARDA
P.O. Box 5466
Aleppo, Syria

Prof. Dr. Winfried von Urff
Department of Agricultural Policy
Munich University of Technology
85350 Freising-Weihenstephan, Germany

Mr. Ali Zeghida
M&M Project National Coordinator
Institut Technique des Grandes Cultures
Station Experimentale El-Khroub
Constante 25100, Algeria

ANNEX 2. CONFERENCE AGENDA

International Conference

Under the Patronage of His Royal Highness Crown Prince Hassan

AGRICULTURAL GROWTH, SUSTAINABLE RESOURCE MANAGEMENT AND POVERTY ALLEVIATION IN THE LOW RAINFALL AREAS OF WEST ASIA AND NORTH AFRICA

2-7 September, 1997

FINAL PROGRAMME

Monday, 01 September	Arrival of Participants
1600 - 1800	Registration
2000	Dinner

Tuesday, 02 September

Session I Opening Ceremony

	Welcome Addresses
0900 - 0905	A. Taimeh, Director General NCARTT
0905 - 0910	A. El-Beltagy, Director General ICARDA
0910 - 0915	P. Pinstrup-Andersen, Director General IFPRI
0915 - 0920	H. Bühler, Director General DSE
0920 - 0925	A. Slama, Director Technical Division IFAD
0925 - 0945	Opening His Royal Highness Crown Prince Hassan of Jordan
0945 - 1030	Coffee/Group Picture

Session II Problem Analysis

1030 - 1045	Presentation of Conference Objectives and Programme N. Fadda

1045 - 1115	Current Situation and Outlook for WANA Agriculture and the Low-Rainfall Areas A. El-Beltagy
1115 - 1145	Environmental Threats to the Low-Rainfall Areas and their Causes A. Taimeh
1145 - 1215	Interrelationships among Agricultural Sustainability, Growth and Poverty Alleviation P. Pinstrup-Andersen
1215 - 1245	Plenary Discussion
1245 - 1345	Lunch
1345 - 1445	Guided Tour of Country Posters for M&M National Research Findings T. Nordblom, N. Chaherli, T. Ngaido
1445 - 1500	Working Method, Terms of Reference for Working Groups and Formation of Working Groups U. Nagel, P. Hazell
1500 - 1530	Coffee
1530 - 1800	Working Groups A - D on Problem Analysis
1930	Departure by Bus for Restaurant

Wednesday, 03 September

0830 - 0835	Introduction to the Day N. Fadda
0835 - 1000	Plenary Presentation and Discussion of Working Group Results

Session III Instruments

1000 - 1030	Impact of Market Reforms on the Low-Rainfall Areas N. Chaherli
1030 - 1100	Coffee

1100 - 1130	Property Rights and Natural Resource Management in the Low-Rainfall Areas T. Ngaido
1130 - 1200	The Experience with Drought Management Policies in WANA M. El-Mourid
1200 - 1230	Facilitating Wider Adoption of Existing and Promising New Technologies in the Low-Rainfall Areas N. Haddad
1230 - 1300	Plenary Discussion
1300 - 1400	Lunch
1400 - 1415	Terms of Reference for Working Groups
1415 - 1630	Working Groups on Instruments - WG A: Market Liberalisation - WG B: Property Rights - WG C: Drought Management - WB D: Appropriate Technologies
1630 - 1700	Coffee
1700 - 1830	Plenary Presentation and Discussion of Working Group Results
1930	Departure for Cocktail hosted by the Chargé d'Affaires of the German Embassy to Jordan

Thursday, 04 September

Session IV Field Interaction with Communities

0800 - 0830	Preparation of Field Trip and Terms of Reference for Working Groups N. Ngaido, Q. Mamdouh
0830	Departure by Bus
0830 - 1800	- WG A: Natural Resource Management Issues (Mhiyy) - WG B: Natural Resource Management Issues (Mkaifteh) - WG C: Co-operative Range Improvement Issues (Lajjun)

	- WG D: Private Resource Management Efforts (Mwagar)
2000	Dinner
Friday, 05 September	
0830 - 0835	Introduction to the Day N. Fadda
0835 - 1030	Evaluation of the Field Trip - Working Groups
1030 - 1100	Coffee
1100 - 1230	Plenary Presentation and Discussion of Working Group Results
1230 - 1400	Break for Prayer
1400 - 1500	Lunch
	Session V Recommendations
1500 - 1515	Terms of Reference for Working Groups
1515 - 1800	Working Groups on Recommendations - WG A: Range Rehabilitation - WG B: Crop-Livestock Integration - WG C: Technology Adoption - WG D: Public and Private Investment
2000	Dinner
Saturday, 06 September	
0830 - 0835	Introduction to the Day N. Fadda
0835 - 1030	Plenary Presentation and Discussion of Working Group Results
1030 - 1100	Coffee
1100 - 1230	Rewording and Finalization of Recommendations
1230 - 1330	Lunch

Session VI Presentation of Results to Special Invitees and Closure

1330 - 1430	Introduction N. Fadda
	Recommendations on Range Rehabilitation N. N. Participant
	Recommendations on Crop-Livestock Adoption N. N. Participant
	Recommendations on Technology Adoption N. N. Participant
	Recommendations on Public and Private Investment N. N. Participant
1430	Statement of the Jordanian Minister of Agriculture
	Closing Remarks N. Fadda
	Farewell Reception hosted by the Ministry of Agriculture
	Departure

IFPRI. The International Food Policy Research Institute has its headquarters in Washington, D.C., U.S.A., and a mandate to (1) identify and analyze alternative national and international policies for meeting food needs on a sustainable basis, with particular regard for low-income countries and poor people, and for the sound management of the natural resource base that supports agriculture; (2) make the results of its research available to all those in a position to apply or use them; and (3) help strengthen institutions in a position to apply such results in developing countries. While the research effort is geared to the precise objective of contributing to the reduction of hunger and malnutrition, the factors involved are wide-ranging, requiring analysis of underlying processes and extending beyond a narrowly defined food sector. The Institute's research program reflects worldwide collaboration with governments and private and public institutions interested in increasing food production and improving the equity of its distribution. IFPRI is a member of the Consultative Group on International Agricultural Research (CGIAR).

ICARDA. The International Center for Agricultural Research in the Dry Areas has its headquarters in Aleppo, Syria, and a mandate to improve the welfare of people through agricultural research and training in the poorer regions of the developing world, by increasing the production, productivity, and nutritional quality of food to higher sustainable levels, while preserving or improving the resource base. ICARDA meets this challenge through research, training and dissemination of information in partnership with the national agricultural research and development systems. The Center has a world responsibility for the improvement of barley, lentil, and faba bean, and a regional responsibility in West Asia and North Africa for the improvement of wheat, chickpea, forage and pasture — with emphasis on rangeland improvement and small ruminant management and nutrition — and of the farming systems associated with these crops. ICARDA is a member of the Consultative Group on International Agricultural Research (CGIAR).

NCARTT. The Jordanian National Center for Agricultural Research and Technology Transfer is a semiautonomous institute with administrative and financial independence. The Center consists of the Headquarters and the six regional centers which supervise twelve research stations representing different agro-ecologies in Jordan. NCARTT is mandated to conduct and/or coordinate applied agricultural research and technology transfer activities at the national level in collaboration with public and private agricultural institutions. Research at NCARTT is conducted through the following programs: irrigated agriculture, rainfed agriculture, integrated livestock, low rainfall areas, water and environment, genetic resources, economic evaluation, and transfer of technology. The Center houses the National Agricultural Documentation and Information Center.

DOK 1821 a

IT 711-319-97