AGRICULTURAL POLICY ANALYSIS PROJECT, PHASE II

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JORDAN AGRICULTURAL SECTOR REVIEW: SYNTHESIS

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ACRONYMS

ACSAD	Arab Center for the Studies on Arid Zones and Drylands
AMO	Agricultural Marketing Organization
AMPCO	Agricultural Marketing and Processing Co.
DOS	Department of Statistics
EC	European Community
ESCWA	Economic and Social Commission for Western Asia
FAO	Food and Agricultural Organization of the United Nations
HCST	Higher Council for Science and Technology
ICARDA	International Center for Agricultural Research in the Dry Land Areas
IFPRI	International Food Policy Research Institute
JVA	Jordan Valley Authority
JVFA	Jordan Valley Farmers Association
MCM	Million Cubic Meter
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MOP	Ministry of Planning
MOS	Ministry of Supply
MOWI	Ministry of Water and Irrigation
NCARTT	National Center for Agricultural Research and Technology Transfer
UOJ	University of Jordan
USAID	United States Agency for International Development

FORWORD

Commencing in the fall of 1992 through the summer of 1993, the Agricultural Policy Analysis project, Phase II (APAP II) has, on behalf of USAID/Jordan with the cooperation of GTZ, undertaken the task of assisting the Government of Jordan (GOJ) in developing a comprehensive Agricultural Sector Review and Implementation Plan under the auspices of the Jordanian Ministry of Agriculture (MOA). The goal of the Sector Review is to contribute to a sound and consistent policy for the Jordanian agricultural sector as well as making a substantial contribution to the development of a coherent agricultural policy. The major objective of the study is to identify strategies and policy action programs that will help in adjusting and restructuring the agricultural sector to achieve long-term sustainability within the context of Jordan's food security concerns and competition for international markets.

The "Sector Review" is a complementary activity to an "Agricultural Research and Technology Transfer Strategy and Medium-Term Workplan" which is being conducted by NCARTT in cooperation with ICARDA and ISNAR. As envisaged by the "Scope of Work", the study team, consisting of a Jordanian coordinator and a U.S. counterpart (team leader) established a Review and Planning Group (RPG) for each of the five subsectors being examined. Each RPG group, consisting of three Jordanian members, were assisted by an advisor secured through Abt Associates, prime contractor for APAP II. The Coordinating Committee, comprising the Jordanian Coordinator, the U.S. Team leader, the Group leaders from each of the five RPGs and the five APAP II Consultants under the chairmanship of the Jordanian Coordinator, oversaw the planning process, data collection and analysis, workshops and the report's completion.

Operationally, the project was constructed on a three-phase cycle which eventually culminated with the finalization of the consolidated Report and its subsequent submission to USAID, the MOA and the Agriculture Council in Jordan. During phase one, Abt Associates initiated the contract for the project activities which culminated in a first workshop on fine tuning the subsector outlines and approving the plan for submitting the draft reports to the Jordanian Coordinator. Finalization of the five subsector reports was completed by the Jordanians at the end of phase two. During the period in which the APAP II team was in Jordan, a second "Decision Thinking" workshop was convened. The objective was to identify specific policies/strategies and issues as well as the commonalities and overlapping areas among the five subsectors.

A draft of the consolidated report- a synthesis of the five sub-sector exports was completed by Dr. Nabil Khaldi (Abt Associates). The draft was then reviewed in August and September of 1993 by the Jordanian members of the coordinating committee, the Ministry of Agriculture, Professor Luther Tweeten and USAID counterparts. Project activities were coordinated in Jordan between the Ministry of Agriculture, the USAID/Jordan, APAP II as well as the Jordanian teams and their counterparts- under the leadership of his excellency then the Minister of Agriculture- Dr. Fayez Al-Khasawneh and Dr. Peter Müller (GTZ) and Dr. Walid Abed Rabboh of the Ministry of Agriculture and Mr. William T. Oliver, Director and Bastian B. Schouten Deputy Director of USAID/Amman, Dr.Carl A. Dutto, Dr. Edward L. Loomis,

Mr. Fuad Qushair and Mr.Munther Azar of USAID/Jordan as well as Dr. William Levine and Dr. Nabil Khaldi of Abt Associates.

The efforts have been rewarding to all the Jordanian participants as well as to their U.S. counterparts with the Agricultural Policy Analysis Project. There is a feeling of high expectation that the current stagnation in Jordan's agriculture may be supplanted once the sectoral/subsectoral constraints imposed by the misallocation and inefficient use of the country's limited resources have been removed. There is also the belief that Jordan's agriculture can achieve great strides through a policy action study which seeks to capitalize on the country's production comparative advantage in horticultural production, reversing the failure of low productivity of the rainfed agriculture as well as improving the sustainability and management of the country's rangelands and forests.

The APAP team is deeply indebted to Dr. Fayez Al-Khasawneh, former Minister of Agriculture, for his personal interest in this project and for the exceptional support and assistance provided by Dr. Walid Abed Rabboh (Director- Agriculture Policy Department) and his able staff at the Ministry of Agriculture as well as the collaboration and consultancy of Dr.Peter Müller of GTZ. The mission is also very cognizant of the excellent support and facilitation of Dr.Carl A. Dutto who directed/coordinated USAID/Jordan's efforts for this important project. Deep appreciation is also extended to Dr. E. L. Loomis and Mr. Fuad Qushair, Mr.Munther Azar and the staff at USAID/Jordan for their interest and for their tireless support of this project.

Much appreciation is extended to the Jordanian experts, who as a team, succeeded in putting together most comprehensive reports of the five most important agricultural subsectors in Jordan. Finally, a profound debt of gratitude is extended to Dr.William Levine (Abt Associates) as well as his staff for their excellent coordination, facilitation and management of this project.

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EXECUTIVE SUMMARY

INTRODUCTION

Jordan has an extremely small agricultural production base with only 5 percent of the land being arable. As aridity and a hostile topography limit the expansion of arable areas, much of the rainfed agriculture in Jordan (over 1.8 million dunums) is practiced on areas receiving only 200-300 mm of average annual rainfall. A meager portion of the cultivated land area located in the Jordan Valley and the highlands (less than 8 percent) is irrigated, and is devoted mostly to high value horticultural production, including Jordan's most highly prized export crops.

Agriculture in Jordan remains an important basic industry with a much greater impact on the national economy than is traditionally shown, especially through its contribution to value added in the service and industrial sector. However, given the extreme lack of resources, Jordan's agriculture is exceptionally import intensive, and the country is far from being agriculturally self-sufficient.

While the limited agricultural resource base, especially water, remains the principal hindrance to agricultural growth, perhaps equally important has been the pressure of population exerted on the sector's resources during the past decade. Jordan's resource misallocations were aggravated by the absence of detailed agroclimatic data needed to broadly develop zoning policies and planning strategies to improve production technology, as well as research and extension activities. Misutilization of land resources was also evident in Jordan's rangeland, including the "Badia," which was plagued by degradation and/or serious erosion. Water has become, however, the most critical input in Jordan where maintaining sufficient supply for irrigation will be severely constrained by the rapidly rising demand in the industrial and municipal sectors as well as by the high rate of population growth.

The sectoral/subsectoral constraints imposed by the misallocation and inefficient use of these limited resources have been greatly accentuated by the lack of consistent and sustained agricultural policies. Notwithstanding the modest resource endowment the country possesses, there are indications that the future of the Jordanian economy will continue to rely on the performance of agriculture and that the GDP contributed by this sector will continue to increase as well.

Strategies

There is increased realization that the key for Jordanian agriculture to regain a sustainable growth path hinges on transforming it into an outward oriented sector by considerably boosting the productivity of the country's land resources and improving water use efficiency. Restructuring needs include incentives to improve productivity, output optimality and the best allocation of resources. A strategy based on efficiency must encompass the development objectives of marketing and exports promotion, the optimization of water distribution and the elimination of subsidies for irrigation.

Appropriate use of resource allocations must be based upon comparative advantage criteria which lies in the production of high-value crops. The strategy must also be freed of inefficient use of the country's resource allocations vis-a-vis wheat self-sufficiency which, through, subsidies has proved costly and counterproductive. The strategy for cereal cropping should accommodate an integrated farming system where barley potential can be realized through the dissemination of new technology. The strategy for rainfed agriculture must concentrate on harnessing the cropping trends towards horticultural products through the dissemination adoption of modern technology and the implementation of soil and water conservation measures.

Development strategies must encompass modern rangeland management techniques that are economically and ecologically sound. Also, carefully selected rehabilitation practices should be diligently utilized to increase forage and livestock production with full consideration of the ecological potential and limitations of the basic land resources. A major element of this strategy is the pursuit of proper management and supervision of the "Badia" which necessitates the cooperation of the herder/transhumants to achieve strict management stability in the country's pastoral production. Greater integration between the range-based and the farm-based ruminants would afford the opportunity for productive livestock growers to acquire profits without the burden of feedgrain subsidies

Development strategies should also "cost effectively" expend greater efforts towards expanding foresty in Jordan. And, in view of the rapid expansion of urbanization, measures for the requisition of green areas evolving housing development, recreational and urban centers should involve the participation of private planners and developers.

The present report is a policy action document which seeks to adjust and restructure Jordan's agriculture by capitalizing on its comparative advantage in irrigated agriculture vis-a-vis horticultural production. The report seeks also to articulate strategies aiming at reversing, the failure of the low productivity of rainfed agriculture, optimizing livestock ruminants as well as improving sustainability and management stability of the country's rangelands and forests. A major objective of the report is to identify coherent agricultural policy/strategy programs and specific projects with measures and interventions which would focus on Jordan's agricultural policy for the following five subsectors:

- Irrigated agriculture in the Jordan Valley and the highland.
- Rainfed agriculture in the highlands.
- Agricultural systems in low rainfall zones (steppe and the "Badia)
- Livestock production as an integral part of the rainfed or irrigated farming systems and as a non-land based activity.
- Forestry on public (government or municipal) land, in communally used areas and on private holdings.

Objectives, Strategies and Policy Development
(Subsectoral Analysis)

A. Irrigated Agriculture

Agriculture under irrigation is the most prominent agricultural subsector in Jordan. Comprising mainly horticulture and to a lesser extent field crop production, irrigated agriculture accounted for over three-fifths of the total value added in agricultural GDP (4.7 percent) in 1990. Given the endowment of the highly diversified agroclimatic regions and their strategic geographical locations, Jordan could reestablish a clear comparative advantage in horticultural products for its domestic and regional markets and beyond. To exploit the potential of irrigated agriculture, Jordan must continue to shift to an outward-oriented strategy. This means restructuring incentives and strengthening institutional abilities to increase and diversify exports, especially in the traditional Middle East markets.

Because the kingdom possesses a modest agricultural endowment and may never be an exporter of horticultural products on the scale of Turkey and Egypt, Jordan will not affect international prices in any substantive way. Production for export should be part of a long-term strategy where effective research and extension can play a significant role in supporting a dynamic and sustainable horticultural subsector.

Meanwhile, Jordan's irrigated production should continue to be developed with greater attention to the efficient use of agricultural resources. Production expansion, allocation of areas and crop selection, especially for vegetables, should be augmented by clear information provided to farmers about requirements of local and outside markets and anticipated prices.

While considerable strides were achieved in the improved productivity of irrigated agriculture in Jordan, input resource allocation in irrigation, has lagged substantially behind technological adaptation. With the survival of much of the horticultural crops hinging on the availability of irrigation, a key element of the strategy for increasing total value added from agriculture should focus on improved efficiency of water use and the increased value of crop production per unit of water consumed. This should be complemented by measures to ensure the efficient utilization and improvement of the already developed land resources.

Sustainability of irrigation infrastructure and services, including the promotion of more water efficient crops in irrigated areas, will induce the subsector to use existing resources more efficiently. Also, given the recent budgetary constraints, it is imperative that a policy be implemented for meeting the operation and maintenance costs of the system, with the end beneficiaries not only bearing these costs but also being urged to adopt water efficiency systems for distribution and application.

In addition to the policy for water use efficiency, a number of key policies/measures have been recommended for the development growth of irrigated agriculture including those which are geared to promote the maximization of economic returns in horticultural production. Limiting the production of high water consuming crops is also desirable, especially those with lower net economic returns of water used, by removing their existing protective measures. Policy recommendations have also focused on the use of technology and practices which will help maintain soil fertility and acceptable standards of water quality. The generation and dissemination of technical information on the performance of various crops according to the various agroclimatic zones and according to the economic returns with optimal use of water quality and regime was addressed. For detailed description of objectives and policy recommendations, see the end of this section.

B. Rainfed Agriculture

While highly variable rainfall continues to pervade practically all the land areas in Jordan, rainfed agriculture has undergone a significant transformation over the past decade. Enhanced rural development has brought about substantial changes that affected much of peoples' life patterns, including education, health care and social services as well as infrastructure, roads and electricity. Much of the transformation, however, was achieved at the cost of siphoning off a large amount of prime agricultural land, mainly for urban development. Nevertheless, total acreage donated to rainfed agriculture increased.

As urban development in Jordan boomed during the past decade, rainfed agriculture was undergoing dramatic changes in the cropping patterns, reflecting a decline in the cultivated area for wheat and a substantial expansion in horticultural crops. Olives became the dominant tree crop, more than doubling the area of tree coverage to 548 thousand dunums over the 1991-1992 period. The area for vegetables also more than doubled. With the rest of fruit trees and vines expanding considerably over the same period, the cropping pattern of rainfed agriculture expanded significantly to 2.0 million dunums, with horticultural areas comprising 38 percent relative to the 1981-1985 average of about 20 percent.

The change in the cropping pattern reflecting the expansion of the fruit crops had a positive impact on the farmers' income in the rainfed zones. In contrast the concentration on cereal cultivation, especially in pursuit of self sufficiency, did not fare as well as the crops were not always grown in relationship to their highest production potential. This left little opportunity for exploiting barley's potential in the relatively more favorable agroclimatic zones. Instead, much of the barley cultivation remained concentrated in the low rainfall area where improved technology was quite limited. As a result, the efforts toward furthering barley technology, which elsewhere were beginning to reap benefits in recent years, remained stalled, especially in the more favorable areas. In those areas, dissemination of new technology would greatly stimulate the expansion of barley production where improved varieties could outyield wheat sufficiently to negate the price subsidy advantage.

As envisaged, the development objectives of the rainfed agriculture may be realized by implementing policies comprising improved productivity, managing natural resources, as well as improving government institutions. It is clear that the highest constraints to increasing the productivity in rainfed agriculture are the low efficiency of resource allocation and the failure to disseminate modern technology, rendering average yields low and static. Cereal production, particularly wheat, is a case in point.

Therefore, the present strategy which focuses on expanding cereal production with the aim of increasing self-sufficiency must be replaced with one that would allow for a more appropriate use of resource allocation. The new strategy must also allow for the development of barley potential more in line with agroclimatic suitability which will exert the greatest influence on the grain yields. Thus, unlike the present regressive bias of production and price policies, barley production flourishes in the context of an integrated farming system where grain, straw and residue become the major feeding source for livestock ruminants.

The proposed strategy also provides policies in support of fruit production in areas with a slope greater than 8 percent. There is also policy support for the use of treated waste water for supplementary irrigation and on-farm water harvesting.

In recognition of the adverse effect of the rapid expansion of municipal boundaries on agricultural land, a policy to ensure that urban growth can be guided to complement agricultural development is recommended. Also, laws and measures have been recommended to promote the consolidation of fragmented holdings and curb further fragmentation as well as the provision for implementing water conservation programs in the mountains of the rainfed regions. It is also recommended that NCARTT be encouraged to develop specific strategies for regions with less than 200 mm of average rainfall which will curb wind erosion and the destruction of soil structure on marginal lands. Policies for improving public institutions include the backing of the Ministry of Agriculture with necessary resources and appropriate legislation. Empowering the Agricultural Council to become an active and effective policy-making body is also recommended.

C. Low Rainfall Zone

Jordan's low rainfall zone comprises most of the native rangelands that are generally uncultivated with less than 200 mm of annual rainfall but provides the necessary forage resources for animal grazing. Embracing about 89 percent of Jordan's total area (nearly 8 million ha) that is mostly located in the eastern and southern parts of he country, rangelands comprise roughly the desert rangeland (75 percent of the total area) concentrated in the eastern and northern parts of the country with less than 100 mm of annual rainfall. Located generally east of the desert with an annual rainfall of 100-200 mm, steppe rangelands comprise about a fourth of the total rangelands area generally used for grazing, although sizeable portions have now been put under cultivation. Rangelands face serve limitation for crop production as they are

too steep and/or too dry for cultivation. With modern technology mostly unavailable, rangeland resources should perhaps be limited to improved natural forage production and livestock grazing.

In view of the continuing decline in the carrying capacity of the steppe lands, including the "Badia," can Jordan, with a serious overpopulation of livestock ruminants attain viable, sustainable ruminant production systems? This would certainly require that significant optimization be achieved in order to curb overstocking and overgrazing in the rangelands. Substantial rehabilitation with the pursuit of proper management and supervision must be realized in the "Badia". This also requires the cooperation of the herders/transhumants to achieve management stability for Jordan's steppe lands pastoral base and production. With the ultimate optimization of the range-based ruminants, grazing in the "Badia" would be augmented by substantial feed stuff, mostly cereal feedgrains. Pastoral production and range management would no longer be viewed as containing free forage, as the beneficiary livestock growers would sustain some costs to support rehabilitation efforts. Greater integration between the range-based and the farm-based ruminants, along with optimization being applied in both systems, would afford opportunities for the productive livestock growers to acquire profits. Jordan will then be reaping the benefit of greater economies from such a development without the burden of subsidizing livestock feedgrain.

As recommended, the broad strategy entails the restoration of rangelands productivity and the optimization of range-based ruminants. This would enhance environmental quality and the economic welfare of the rangelands users as well as increase ruminants meat and milk production and would hinge on implementing a number of important policies dealing with:

1. Halting and reversing the rangelands desertification process in Jordan.

2. Optimizing range-based livestock production by improving rangeland fodder production and livestock genetics.

3. Enforcing the agricultural law of 1973 to improve the rangelands and protecting then from uprooting, ploughing and overgrazing.

4. Regulating border crossing by bedouins and livestock.

5. Establishing a department of rangeland resources.

6. Establishing a rangeland resources curriculum at the universities of Jordan for the BS and the MS degree.

D. Integrated Livestock Production

Jordan's red meat production, dominated by small ruminants, accounted for 93 percent of meat and 42 percent of the country's milk supply. Historically, much of the country's small ruminants, particularly sheep, have been closely integrated into the "Badia" where Awassi-sheep are better suited to the Jordanian conditions than cattle. In fact, sheep can be fed at a maintenance level for most of the year and still perform reasonably well.

Meanwhile, integrating farm-based sheep and barley production has gained greater importance with the rapidly rising demand for livestock products. Thus, in response to higher demand, more intensive production systems evolved on farms where sheep flocks expanded int he 1960's and through the 1970's, thereafter accounting for nearly one-half of Jordan's small ruminants in the 1980's. Consequently, with the increased dependency on farm-based feeding, barley emerged as the most valuable feed source, not only for the grain, straw and stubble, but also for the green to mature grazing supply. Also, by increasing the sedentary lifestyle of the nomads in which movement of the flocks covered a smaller geographical area, barley's potential as the major livestock feed was considerably enhanced. Supplanting much of the loss in natural grazing, the use of barley intensified, becoming a major feed component not only for the farm-based ruminants but also became the major supplementary feed for the steppe-based ruminants.

As the traditional grazing pattern of the flocks is being upset by the requirement for greater pasture areas, the ewes are suffering from lower productivity, reduced fertility and milk producing capacity. It is clear that allowing the present policies and practices to continue, will depress the rangeland resources, resulting in lower productivity and increased grazing deficiency.

As envisaged, a positive development strategy for the integration of livestock production would improve the subsector's natural resources, and promote economic efficiency leading to the improvement of farmers/sheep growers' incomes. The major policy objectives hinge on the optimization of livestock production as well as the optimization of feed production.

As recommended, achieving the development objectives of the integrated livestock subsector would hinge on instituting policies which would boost grazing forage productivity as well as the production efficiency of livestock ruminants. This would transform the rangeland resources by initiating sustainable production activities. Other major policy recommendations, include:

- Phasing out feed subsidies.[1]
- Rehabilitation and management to achieve a high level of sustainable livestock production and productivity.
- Establish economically feasible and justifiable livestock management systems and husbandry practices and utilize national feed resources more efficiently.
- Strengthening animal health care services.
- Conserving and improving livestock breeding programs, including livestock selection and crossbreeding and related applied research.

E. Forestry

Jordan's forest vegetation is judged to be quite limited, with about 76,000 hectares dominating portions of the mountain height region, extending from the Yarmouk River in the north to the Ras Al-Naqap in the south. Barely comprising one percent of total area (88.9 mil ha), Jordan's forested vegetation rises from 800 m above sea level in the Irbid area to 1,000 m in the Ajloun and Balqa and rises again to exceed 1,200-1,500 m in the Tafila and Shoubak areas.

Although forest policies have been implemented through various laws and regulations since 1923 (one year after the Emirate of Jordan was established), forests of Jordan have still been characterized by extensive government intervention, and the virtual disappearance of private forests. While some positive changes have occurred in forest policy since 1960, the pattern of land use in Jordan remains one of a steady and continuous destruction of the forest cover.

From an economic point of view, forestry in Jordan is subsidized and can barely provide a net return to the government. Nevertheless, the forestry subsector is an extremely important part of the national patrimony which contributes essentially to the overall well-being of the Jordanian society. While perhaps difficult to quantify, forests of Jordan provide benefits and services that contribute directly and tangibly to both environmental stability and the socio-economic conditions of the country.

There is now a greater realization that apart from the removal of constraints, the opportunity for a more viable forestry subsector in Jordan hinges on creative and well thought

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[1] A closely related issue involves feed subsidies, mainly for barley, which have risen substantially to about JD 15 millions in recent years. Considering the income derived from raising sheep in Jordan and profits realized from exporting the lambs to Saudi Arabia and the Gulf States (about one-fourth of the Jordanian sheep flocks) and also the sheep/barley price ratio (is nearly 50 percent higher than other countries), would suggest that the sheep growing business is lucrative. This is especially so for farmers integrating sheep growing with barley production. Thus, it appears that aside perhaps from a few hard-core sheep growers in the "Badia", feed subsidies are an added burden on the government budget. In fact, allowing for the continuation of feed subsidies would be counterproductive to the optimization program vis-a-vis the problem of sheep overstocking in the "Badia".

out policy objectives. These policies must contribute to achieving the maximum sustainable productivity of the Kingdom's renewable natural resource base.

Therefore, within the context of forestry development in Jordan, the following are the major proposed policies which include:

- Increasing the area under forest cover;
- Improving the management of existing forest areas; and
- Improving national capability for forestry development
- Promote the requisition of green areas along side housing developments as well as recreational centers, parks and others amenities in the cities and urban centers through the participation of private planners and developers.

A summation of recommended policies, objectives, strategies, and implementing institutions, broken down by agricultural subsector follows:[2]

AGRICULTURAL POLICIES, OBJECTIVES, AND STRATEGIES

I. IRRIGATED AGRICULTURE SUBSECTOR

Implementing Institutions: MOWI, MOA, MOF, NCARTT, MOIT, AMO

A. Policy

1. Policies aiming at maximizing the efficiency of water storage, conveyance, distribution and on-farm application are as follows:

a. Develop suitable water storage structures on and off farms to minimize evaporation and seepage.

b. Convert to more efficient closed pipe systems in the Jordan Valley and install closed pipe systems to convey water within the highlands.

[2] Some of the policy recommendations contained in the summantion are general in nature. For their implementation, more in depth analysis will be required.

c. Replace remaining surface irrigation usage with drip systems.

d. Upgrade the management of water distribution.

e. Strengthen the national capacity for generation and dissemination of water saving technology, water quality and conservation of watersheds, while assuming responsibility to approve the design and installation of irrigation systems.

f. Coordinate overlapping issues and responsibilities for management of water resources between the MOA and the MOWI.

2. *Policies to raise economic returns on the use of irrigated water in agriculture.*

a. Promote horticulture crops with highest demand and highest net economic returns per cubic meter of water used. Develop water regimes which will maximize the net value of output per cubic meter of water used.

b. Limit production of high water consuming crops with lower net economic return of water used. Remove import protection measures enjoyed by these crops.

c. Promote use of technology which will aid in maintaining soil fertility and acceptable standards of water quality. Safeguard soil and water quality from contaminated surplus drainage water containing pesticides and herbicide residues and surplus mineral fertilizer. Waste water treatment plants must take measures to safeguard recycling water. Water conservation, improvement of soil quality and treatment of recycled water to meet standard requirements for irrigation should be accorded a high priority.

3. *Implementation of the policies will be accomplished by:*

a. Enforcing the regulation for monitoring the recharge and discharge from the aquifers.

b. Monitoring the quality of soils, ground water and implementing action programs for desalination and the removal of pollutants.

c. Curbing salinity of effluent of waste water treatment plants through improved treatment and the desalinization of effluents and/or mixing effluents with fresh water.

d. Enforcing regulations for licensing of ground water wells in cropped areas and enforce environmental protection on all water development projects.

4. Policies for maximization of net return on production investment and amelioration of risk to Jordan's regional trade while minimizing production and marketing costs.

a. Strengthen information services to producers and exporters on demand-supply balance and projections of commodities produced in Jordan. Minimize losses of farmers due to market price fluctuation.

b. Organize farmers and exporters to assume greater responsibility for improvement of marketing activities. Strengthen the generation and dissemination of technical information on minimizing pest risks.

c. To maximize returns on Jordan's horticultural products, greater emphasis should be given to the expansion of high value crops from which the country enjoys a production comparative advantage.

d. Such an objective maintains the present policy exempting all improved imported inputs from custom duties, while removing protective measures such as the import ban on domestically produced commodities.

e. Strengthen all services leading to the promotion of greater exports through the dissemination of international market trade information. An important objective would be to build greater confidence among producers and exporters for long-term trade relations.

B. Policy Objectives

1. Develop and utilize production resources, especially land and water with consideration for efficiency and optimality and maximization of economic returns and concern for the environment.

2. Maximize the net returns of producers investment.

3. Maximize the ratio of value added on the total commodities produced in irrigated areas

4. Maximize export contribution of irrigated areas in the national trade balance.

C. Strategies

1. With the endowment and diversified agroclimatic regions, Jordan could maintain a comparative advantage in much of horticultural products in domestic, regional markets and beyond. Therefore, production for export should be part of a long-term strategy where effective research and extension can play a significant role in supporting a dynamic and sustainable horticultural subsector.

2. Establishing export opportunities in the EC and Scandinavia and Eastern Europe should be a primary objective of Jordan's horticulture strategy. Identifying "windows of export opportunity" for highly specialized crops such as strawberries, asparagus and flowers should be exploited. This requires that the country's exports must be produced efficiently with sufficiently low production and marketing costs to meet international standards.

II. RAINFED SUBSECTOR

Implementing Institutions: NCARTT, MOA, MOI, MOS, Agricultural Council, Various International Research Institutes

A. Policy

1. Improved Productivity

a. Productivity of rainfed agriculture can be raised through improved efficiency in resource allocation and the dissemination of yield raising technology. A strategy should be formulated that would economically optimize wheat production and provide the opportunity to exploit the potential of barley production. Research strategy should focus on developing technological packages tailored especially for each ecological zone.

b. Price support programs for grains will seek to pay farmers at levels which correspond closely to international prices and will not discriminate against barley compared to wheat.

c. Expansion of fruit production in rainfed agriculture should be encouraged in areas with a slop greater than eight percent. Expansion of the upland resources in olive and deciduous fruit, nut and vine production would bring greater economic returns than from annual crops presently cultivated. It would provide greater means for soil and water conservation through the establishment of orchards and vineyards, and enhance export opportunities for vegetables in certain Gulf markets requiring mixed shipments of fruits and vegetables. Secondary policies include:

1. Short-term training programs for extension staff and farmers on tree and vine crop husbandry.

2. Increasing the diversity of tree crops in addition to olives to include grapes, peaches, apples, almonds and pistachios.

3. Expanding the network of roads and infrastructure in the rainfed mountainous regions.

4. The private sector should be encouaged to increase its role in the production of nursery stock. The MOA should focus its regulatory functions mostly on the development of fruit tree seedling production. At a future stage, as the MOA withdraws from seedling production, its freed manpower resources may then be directed to the control of nursery stock production in private nurseries.

d. The use of treated waste water for supplementary irrigation and on-farm water harvesting should be encouraged. This would:

1. Provide agriculture with a means for benefitting from the municipalities water development which would improve productivity and preserve the adjacent primary agricultural lands.

2. The application of supplementary irrigation in areas receiving 300 mm of rainfall could increase wheat yields from 1.2 ton/ha to about 4 ton/ha and would ensure that the poor or inadequate rainfall will not result in the loss of production potential.

3. Agronomic and summer weather conditions (cool nights) make it more suitable than those of the Jordan Valley for the production of high value fruit and nut crops. Possibly forage production could compete for available waste water in the uplands.

4. The MOA should support farmers carrying out simple on-farm water harvesting methods.

2. *Managing Natural Resources*

a. Rapid expansion of municipal boundaries on agricultural land should be discouraged. Steps to halt the rapid conversion should include:

1. Documentation of the rate of urbanization on prime, rainfed agricultural land over the past 20 years.

2. Imposition of a five year freeze on the expansion of urban boundaries while policies are being put in place.

3. A conversion tax should be levied on the price of farmland sold for urban development in order to discourage its sale for urbanization and industrial development.

4. Urban waste water should be treated and monitored for quality for irrigated land immediately adjacent to urban boundaries.

5. Current work on soil and land use classification of the rainfed region should be accelerated.

b. Present fragmented holding should be consolidated and further fragmentation discouraged. Minimum plot sizes should be imposed as follows:

1. 10 du for tree and vine crops.

2. 15 du for any land with access to irrigation.

3. 25 du for any land located in regions with greater than 350 mm of annual precipitation.

4. Land with more than 75 percent of its surface covered with bedrock could be subdivided for urban or industrial use.

c. Soil and water conservation should be encouraged. Public sector involvement should be expanded with a pivotal role for encouraging the private sector to invest in fruit farming aimed at increasing productivity and protecting water and soil resources.

d. NCARTT should be encouraged to develop specific recommendations for regions with less than 200 mm of average rainfall, including:

1. Curbing wind erosion and destruction of soil structure on marginal lands; planting strips of wind breakers which are productive and utilizable. The direct seeding of native shrubs which are capable of self reseeding. These hedges will control wind erosion and provide grazing resources in drier years. Strips between the hedges will continue to be used for barley production and other feed crops.

2. NCARTT in cooperation with regional and international research institutions should undertake a barley breeding program to develop a dual purpose barley cultivar (grain and forage) adaptable to the local environment\ that could be grazed in years of low rainfall and left for grain in years of high rainfall.

3. Improving Government Institutions

a. This should include: An effective MOA and political commitment backed by necessary resources and appropriate legislation.

b. Empowering the Agricultural Council to become an active policy-making body. It should contain a core staff working under the supervision of the Agriculture Policy Department at the Ministry. Among their duties, the core staff should gather and analyze agricultural statistics.

c. A national agricultural census should be carried out and agricultural statistics improved.

B. Policy Objectives

1. Improve the economic efficiency in allocation and utilization of agricultural resources.

2. Curb urbanization encroachment on prime agricultural land.

3. Encourage public and private sector involvement with natural resource conservation and development efforts in rural areas.

4. Providing government services to on-farm activities.

C. Strategies

1. Strategies for energizing rainfed agriculture should be based on strengthening positive trends and incentives to gain a greater participation of the private sector

2. Programs designed to support soil and water conservation and encourage the flow of private capital from urban areas to rural villages and the countryside should be established.

3. Expansion of perennial production (olives, grapes and stone fruits) hold promise for a significant source of growth in rainfed agriculture, especially with the availability of supplementary irrigation. Development of rainfed horticultural production would result in increased production and should be emphasized.

4. Dissemination of new grain technology would provide the opportunity to exploit potential of barley production in the more favorable agroclimatic zones. Research findings show that barley yields are higher than wheat yields in rainfall areas of about 300 mm within lower and upper levels of between 280 and 380 mm of average rainfall, respectively. Under these conditions, shifting to barley production would result in beneficial net changes in terms of grain and biological yield and foreign exchange savings. It would also result in net economic benefits which would be affected by the extent of increase in the relatively higher wheat prices.

III. LOW RAINFALL ZONE SUBSECTOR

Implementing Institutions: MOA, MOF, MOWI, MOI

A. Policy

1. Land Tenure Reform.

a. Agricultural law 20/1973 regarding land tenure must be enforced.

b. Land tenure law must contain clear mechanisms to restore rangelands and provide management geared for optimal sustained production.

c. A modern modification of old grazing systems, "El-Hema", should be developed.

d. A mechanism must be provided for the government to reinstate jurisdiction over unregistered, submarginal lands under barley cultivation.

e. Tribal rights must be formally respected.

2. *Establishment of a Department of Rangeland Resources.*

a. The DRR, within the Ministry of Agriculture would oversee and regulate all aspects of rangeland development. The DRR would also interact with other government institutions to resolve common problems.

3. *Optimize Range-based Livestock Production by Improving Rangeland Fodder Production and Livestock Genetics.*

a. Effective application of known and accepted rangeland management and animal husbandry practices must be followed, requiring close cooperation among livestock producers and governmental agencies.

4. *Halt and Reverse the Rangeland Desertification Process*

a. Committees would coordinate anti-desertification activities at all levels of government and promulgate rules and regulations.

5. *Regulate Border Crossing by Bedouins and Livestock.*

a. Cooperation with neighboring countries and crossing by bedouins and livestock as well as grazing rights would be promoted. Renewed emphasis will be placed on the El-Hammad project whose mandate was to oversee and control rangeland management practices.

6. *Establish Rangeland Resources Curricula at the Universities of Jordan for the BS & MS Degree level.*

a. Long term success of a program for proper development and management is dependent on an educated, professional staff. Thus, a professional staff at the universities must provide training at the BS & MS degree levels.

B. Policy Objectives for the sub-sector

1. *Stop rangeland degradation; reverse desertification process.*

2. *Restore rangeland productivity; Stabilize range, forage, livestock production.*

3. *Enhance environmental quality.*

4. *Improve economic welfare of people inhabiting these lands.*

C. Strategies

Develop strategies aimed at problems for rangelands since very few exist. Consider the economic, environmental and social impact of such policies.

IV. INTEGRATED LIVESTOCK PRODUCTION SUB-SECTOR

Implementing Institutions: MOA, MOI, MOS, NCARTT, ICARDA, JCO, Faculty of Agriculture - University of Jordan, Veterinary Department, Jordan Veterinary Association, Jordan Center for Veterinary Vaccines, Jordan University of Science and Technology, Chamber of Commerce, Chamber of Industry.

A. Policy

1. *Establishment of a Department of Rangeland Resources.*

Establishment is justified because of the inefficient management of rangeland programs due to responsibilities scattered between multiple institutions. This department would also address development strategies as well as acting in a general monitoring capacity.

2. *Phasing Out Feed Subsidies.*

Feed subsidies will be phased out gradually (within a clearly defined time period) to maximize the positive benefits and minimize negative effects of the change. A compensatory support price will be adopted on forage and red meat production during the transitory period. This planned, gradual phase out of animal feed subsidies is aimed at lessening the short-term impacts of this policy change.

3. Natural Grazing Resources.

Natural grazing resources should be rehabilitated and managed in order to achieve a high level of sustainable livestock production and productivity within the potential capacity of those feed resources. The government in close cooperation with livestock producers and governmental agencies would allocate areas for the improved sustainability of the areas through communally supported conservation practices.

4. Research, Extension Education and Farmer Training.

Steps must be taken to establish economically feasible and justifiable livestock management systems and husbandry practices in order to utilize national feed resources more efficiently. Through a Livestock Policy Development Project, technical assistance will be provided to examine resource allocation issues, efficiency of input use, production, farmer income and government expenditures. Various projects are all ready underway such as Allocation of Irrigation Water for Forage Crops, the Integrated Crop Livestock Dryland Farming Systems Extension Project and The Livestock Nutrition Research Project.

5. Animal Health Care Services.

Animal Health care services for livestock and poultry can be improved by strengthening government services and supporting private veterinary practices. The private sector is already heavily involved in poultry health, and to a lesser extent in cattle, sheep and goats. However, animal health is greatly lacking the human resources, facilities, finance and management. Hence, cooperation between government and these various animal health agencies is essential.

6. Animal Genetic Resources.

Elements of this policy would include upgrading of local breeds of sheep and other small ruminants through selection, and conducting research on the commercial feasibility of crossbreeding the local acclimatized breeds of sheep with imported breeds.

The six main development policies will be supported by the following priority policies:

1. Clarify responsibilities of institutions involved in agricultural sector development.

2. Private sector role in production, processing and marketing will be increased relative to government.

3. A national farmers union will be established to strengthen participation of cooperatives, processors, farmers and livestock producers in development policy.

4. A National Dairy Development Association would be established.

5. A National Red Meat Development Association would be established to improve the systems of live animal marketing, slaughtering and processing,

6. A National Poultry Development Association would be established to improve processing and marketing.

7. Price regulation of livestock and poultry products will be phased out gradually to maximize the positive benefits and minimize negative effects of the change.

8. Export, import trade policy: An open, unlimited, unrestricted import policy will be followed.

9. Gender issues in livestock development roles will be taken into account in the provision of extension education and training services.

10. Government will apply aggressively the principle of cost recovery for supplying inputs and services.

11. The provision of credit for livestock and poultry production will be supported commensurate with their contribution to the national economy and potential increase in productivity.

12. Provision of livestock and poultry compound feed and feedstuffs by the private sector will be supported. The system of public quality standards control of commercial feed and feed products will be improved.

B. Policy Objectives

1. Optimization of livestock production.

2. Optimization of feed production.

3. Increasing the feed productivity of the rangeland, agricultural by-products, roughage and forage crops.

4. Promoting feeding and husbandry management systems with special attention to balanced rations and production cycles.

5. Promoting health care of livestock with special emphasis on common diseases between humans and livestock.

6. Promoting the efficient processing and marketing of livestock.

C. Strategies

1. Rehabilitation and management of the rangeland to achieve a high level of sustained productivity by the formation of small ruminants cooperatives. Irrigated forage production should be studied within the framework of crop rotation and resource allocation.

2. Since the traditional pastoral system for ruminants has undergone a great deal of shifting away from the traditional approach, there is a need to establish new feeding regimes and balances in which feeding requirements of local and imported breeds would be adjusted to the new conditions.

3. Livestock health care plays an important role in raising production efficiency. Together with the vaccination services provided by the Veterinary Department in the MOA, there is a great need to involve the private sector in such activities.

4. Processing and marketing of livestock products need ample efforts both from the public and the private sectors. There is room for improvement in the processing of cheese, chicken, eggs and red meat.

5. Genetic and environmental factors must be considered for productivity improvement. The local ruminant breeds must be upgraded through selection and research must be conducted on cross breeding of imported exotic breeds with local stock. Also, management of feeding, health and reproduction must be consistent and synchronized.

V. Forestry Subsector

Implementing Institutions: MOA, MOI, RSCN

A. Policy

1. Increasing the area under forest cover.
Strategies for achieving this policy objective should include:

a. Definition of forestry resources. Clarifying what constitutes forest resources and legal status of the land.

b. Solution of the uninhabited land situation and the confusion arising therefrom, particularly in the south where much of the areas should be designated as forest land because of the site limitations which restrict its land-use to forestry.

c. Consolidation of forest land: Refers to the formation of contiguous forest units by legal means. These units are areas where private land holdings inhibit the practice of forestry management.

d. Expansion of forest cover: Opportunities for the expansion of forest cover will be dependent on parallel activities aimed at acquiring unsettled lands, for resolving land-use prescriptions on other areas in general and on the capability of the government forestry institutions to carry out such activities.

e. Establishing principles restricting conversion of forest lands: Any attempt to affect the stability and productivity of a given forested site must be carefully considered. Conversion must be carried out under strict guidelines and safeguards. Establishing a clear guideline for forest land conversion and updating the present legislation governing all aspects of forest area management will be necessary.

2. *Improving the Management of Existing Forest Areas:* Management must clearly take into consideration the production and protection capabilities of the forest and formulate strategies that would enhance their contribution to development through improved management.

a. Forestry as an important land-use option: Jordan's great variety of forest resources in various stages of development will require an aggressive approach to management throughout the country. Much of the basic "know-how" is already available and the various aspects must be identified and legalized and finally applied to the management of the forest resources throughout the country.

b. Protection strategies for forest resources: Without an affirmative action program aimed at protecting the existing forest resources, it will be difficult, if not impossible to successfully manage and protect forest resources.

c. Extending the knowledge of forest resources: Development of the subsector must rely on a sound scientific base, including the identification of research needs and prioritized research plans.

3. Improving National Capability for Forestry Development: Increasing public and popular understanding of support for forestry would be enhanced by the following strategies:

a. Strengthening of forest management capabilities: Foresters should be provided with resources including support staff and regular budgets to enable them to assume increased management responsibilities.

b. Institutional coordination among relevant parties. Care should be taken to avoid duplication of efforts by institutions by identifying the institutions involved in environmental issues, clearly understanding their mandates, internal strategies and existing agreements. Essential to effective coordination will be the development of a communication process between participating institutions focusing on forestry, agriculture and water resources.

c. Public awareness and involvement in forest and environmental issues: The best strategy to intensify national awareness and environmental involvement is to begin within the educational systems. Curricula from the primary through secondary schools should be reviewed to include environmental awareness and engagement.

d. Direct public involvement and funding: Governmental funding will probably not be adequate to reach the budget needs and goals for forestry management. Therefore non-governmental organizations must become involved. For such an approach to expand and flourish, a number of steps must be followed:

1. Design and establishment of the legal basis for recognition of non-governmental and/or private voluntary organizations (NGOs and PVOs), including the nature of cooperation anticipated between the public and private sectors;

2. Identification and promotion of interested responsible institutions to participate in these activities;

3. Fund raising; and

4. Coordinating operations of such private sector organizations with their public sector counterparts.

THE AGRICULTURAL SETTING: OVERVIEW

Compared to other agriculturally endowed countries in the region, the contribution of agriculture to the Jordanian economy appears somewhat modest, reaching just about 8 percent during the late 1980's. However, agriculture in Jordan remains an important basic industry with a much greater impact on the national economy than is traditionally shown, especially considering the sector's contribution to the value added in the service and industrial sectors. Thus, in contrast to the traditionally measured contribution which minimizes the importance of agriculture to the national economy, agribusiness would boost its share by more than 20 percent.[1]

There are strong indications that the future of the Jordanian economy will continue to rely on the performance of agriculture and that the GDP contributed by this sector will continue to increase as well. Even though the sector would provide the major source of income for about one-fifth of the population, Jordan would remain, however, far from being agriculturally self-sufficient. In fact, relative to other countries in the region, Jordan is extremely lacking in agricultural resources. It is, therefore, not surprising that the country's agriculture is

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[1] In a recent study prepared for Agricultural Policy Analysis Project Phase II (APAP II Technical Report No. 131) the concept of agribusiness, including agriculture and agricultur induced activities was clearly shown to reflect better the total contribution of agriculture to the economy. While based on a traditional definition of national accounts, agriculture comprised only 6 percent of national income from 1987-1991. By disaggregating and regrouping the elements which make up the agribusiness sector in Jordan, the share increased nearly four-fold to an average ranging between 20-24 percent compared to the traditional definition of national accounts in which the contribution of agriculture covering the period between 1987 through 1991 was just over 6 percent. The contribution of agribusiness was most impressive in Jordan when it was viewed by the contribution to economic growth. Thus, whereas agriculture, as traditionally defined, contributed 11 percent to growth (behind industry and services) the agribusiness sector contributed the most of any other sector over the same period:

Jordan: Contribution to Gross Domestic Product of Agribusiness and Other Sectors, 1987-1991 Averages

Measures	Agribusiness Percent	Non-Agribusiness Percent	Non- Agribusiness Services Percent	GDP Percent
Share	27.9	17.1	55.0	100.00
Growth	143.5	0.8	5.9	---
Weighted Growth	3.8	0.1	3.2	7.1
Contribution to GDP's Growth	52.8	1.8	45.4	100.0

exceptionally import intensive, including the 37,500 to 50,000 foreign workers, (exceeding in number the Jordanian laborers engaged in agriculture) who remit a portion of the value added in agriculture (JD 16 million in 1987) abroad.

Unsuitability of land tenure along with the typically small size farm holdings is another important characteristic that is critical to consider when designing an agricultural strategy for Jordan. Land distribution is highly skewed, with many small fragmented farms in the highlands (fragmentation has been legally constrained in the Jordan Valley). The 1983 census indicated that 25 percent of the 57,000 agricultural holdings (an increase of over 7,000 holdings since the mid-1970's), were less than 10 dunums and occupied less than 2 percent of the area, while 50 percent of the holdings were less than 40 dunums. Holdings with an area of less than 20 dunums also increased substantially. The minimum size of a holding was first set in 1969 at 4 dunums but raised later (in 1982) to 10 dunums.

Extreme land fragmentation, combined with small size holdings which pervades farming in Jordan, has deterred and/or delayed mechanization of some farming activities due to scale diseconomies. It has also led to the less efficient use of labor, resulting in lower agricultural productivity and income.

Grazing is the principal land use, since the country lies mostly in the low rainfall region where 8.5 million ha (over 91 percent of the total area) is technically considered an arid zone with less than 200 mm of average rainfall. The largest portion (70 percent) of the arid zone receives 50 mm of average rainfall which essentially excludes it from any agricultural use. The balance of the land areas are used for forests (which at 76,000 ha is quite limited) and selected tree crops and cereals as well as an estimated one million ha as natural rangeland and planted pastures. Less than 5 percent of the land area (about 450,000 ha) receives sufficient rainfall to support cultivated areas, mostly cereal (primarily wheat) and tree crops- primarily olives and grapes. A meager portion of the cultivated land area (less than 8 percent) located in the Jordan Valley and the highlands is irrigated, with horticultural crops being dominant, comprising about one-half of the value of Jordan's crop production.

Even with such a modest endowment of agricultural resources, Jordan was able to benefit from economic opportunities in the region during the late seventies and early eighties. That period, which was seen as an economic miracle for the country, was accompanied by an impressive growth from which the Jordanian agricultural sector also received its share. However, as this period drew to a close, the negative forces which were beginning to adversely affect the national economy were also affecting the performance of agriculture. As a result, the growth of the sector diminished and eventually became static for most of the 1980's and on into the 1990's.

It is clear that the limited production resource base has been a principal impediment to expanding the agricultural sector. An important factor contributing to this limited production was the pressure brought to bear on Jordan's agricultural resources base during the 1980's. This pressure was caused by the unprecedented exploitation of the agricultural resources which

accelerated the misallocation/misuse of the country's land, water and the areas of the rangelands "Badia". It has rendered much of the resources underproductive, while plaguing the rest of the resources with irreversible degradation and/or serious erosion.

There is now increased realization that the key for Jordanian agriculture to regain a sustainable growth path hinges on transforming it into an export led sector with considerable boosting of the productivity of the country's land and water resources. This would include economically rational restructuring with incentive provisions to improve productivity and optimize agricultural output through the increased efficiency of these highly limited resources, as well as through the improved efficiency use of factor inputs. Consequently, with the common knowledge that focusing on the efficiency objective is the preferred strategy alternative, Jordan has the potential to renew sustainable agricultural growth.

This, combined with the underpinning support for the dissemination of modern technology would help capitalize on Jordan's comparative advantage in horticultural production. This could lead to an increase and diversification of the country's exports beyond the traditional Middle East markets.

Jordan also has the potential to reverse the failure of the low productivity of rainfed agriculture with the adoption of new and improved technology. The implementation of soil and water conservation would also facilitate the dramatic and more productive expansion of fruit production. At the same time, farmers in the rainfed regions should be encouraged to exploit barley production in the more suitable agroclimatic zones where the returns to the new technology would be maximized and the crop's comparative advantage assured.

The country can "cost effectively" improve rangelands and management and develop policies/programs to improve livestock production. Also, a better alternative to the cultivation of the marginal/sub-marginal lands must be found to guard against degrading the land resources.

In addition, Jordan can "cost effectively" expend greater efforts towards a more viable forestry subsector by expanding forestry in Jordan and move towards the creation of a "Green Jordan."[2]

A key issue in the country's resource allocation of subsidies is wheat self-sufficiency in Jordan. To accommodate self-sufficiency, wheat production remained supported by price subsidies which continued to be costly and ineffective. Portions of irrigated lands were committed to wheat production which never was competitive with other cropping alternatives. But despite the generous producer price incentives (based on subsidized prices averaging some

[2] From His Majesty, King Hussein's speech to the Comprehensive Development Conference in 1988.

JD 34 per ton above world market price), Jordanian farmers continued to plant less wheat and more fruits and vegetables throughout the past decade.[3]

As estimated, shifting planted acreage from fruits and vegetables to wheat may have resulted in the Jordanian farmers' accruing a considerably high opportunity cost with the foregone value of fruit and vegetables production reaching JD 1,100 per hectare.[4] In fact, the extent of resource misallocation and the negative impact on food security due to shifting the plant acreage to wheat production, is confirmed. Thus, when comparing the average revenue productivity of land, water and labor for competing crops in irrigated farming, wheat ranks last in a list of twenty alternatives (see Shepley).

Meanwhile, expanding wheat production in the rainfed areas may not be that profitable with yields being low compared to those prevailing in the region- 700 Kg/ha versus over one ton/ha. NCARTT research programs and trials in farmers fields have developed a variable wheat input and cultivation package that produced 2-3 tons/ha on lands with rainfall above 300 mm annually and 1.5 tons/ha on lands receiving less than 300 mm annually. There is now clear evidence that improved technology has had a positive effect on wheat productivity in the rainfed regions. Farmers have already adopted elements of the improved wheat technology in spite of limited governmental efforts to increase production through concentrated applied research and extension campaigns.

A more appropriate strategy should, however, be focused on cereal cropping (wheat and barley) as a component of an integrated farming system where comparative advantage based on the agroclimatic suitability of production is the determining factor. With the past focus on the low yielding wheat being ineffective, the new strategy should also allow for the development of barley potential in areas which can exert the greatest influence on the grain yields. Thus, treated without the regressive bias of production and price policies, barley production would greatly flourish in the context of integrated farming systems where grain, straw and residue would become the major feeding source for livestock ruminants, including the "Badia" and for the range-based flocks.

As depicted by the IFPRI field survey (450 cereal farmers in Jordan), farmers employing elements of the new technology have accrued a much higher output per hectare. Also, research by ICARDA has confirmed the "conventional wisdom" that barley yields are higher than wheat yields in rainfall areas of about 300 mm. This suggests that a great scope exists for barley

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[3] The exception was the continued commitment of GOJ to the objective of reducing wheat imports in 1986 when lands in Disi and Mudawara (with a stabilized area of 40 thousand dunums since 1989) were leased for 25 years to private sector companies at nominal rents and with conditions to grow wheat and barley and to be procured by the government at subsidized prices.

[4] Shepley, Seteven. C. 1988- Wheat Subsidy Policies in the Hashemite Kingdom of Jordan- An Economic Analysis. Tech. International, Inc.-Financed by USAID.

where production optimization would be possible with the spread of technology, especially in the more favorable agro-climatic zones.

Resource Use Efficiency and Allocations:

A key element of the strategy for increasing total value added from agriculture should be geared toward efficiency enhancement in order to ensure a better water resource use, and increase the value of crop production per unit of water consumed. This would be complemented by measures to ensure the efficient utilization and improvement of the already developed land resources.

It is common knowledge that Jordan is among the least endowed areas of the world with respect to water availability. This natural scarcity is aggravated by an alarming population growth rate, and the consequent increased demand due to a higher standard of living, industrialization and irrigation. It is a well established fact that Jordan's lack of water resources have reached a critical stage. Water is now one of the most scarce resources in the country and is a major constraint to further economic development. The current annual deficit of about 190 million cubic meters of water is being met by over pumping from 9 out of 15 of the ground water aquifers, with increases in pumping depth and cost, resulting in a declining water quality.

Sustainability of irrigation infrastructure and services, especially with regard to maintaining the same proportion of water availability will induce the sector to use existing resources more efficiently, including the promotion of more water efficient crops in irrigated areas. Also, the recent budgetary constraints have created a greater need for meeting the operation and maintenance costs of the system, with the end beneficiaries not only bearing these costs but also being urged to adopt water efficiency systems of distribution and application. As clearly indicated by the following table, the cost of supplying irrigation water in the Jordan Valley has remained heavily subsidized by the government budget over the years. Only 22 percent of the cost of operation and maintenance was recovered prior to the 1989 water tariff increase from 3 fils per cubic meter to 6 fils per cubic meter, and only 44 percent after the increase:

Table 1
Irrigation Water Costs Subsidies in the Jordan Valley

Year	Water Delivered (Mm^3)	Total O&M Costs (JDmil)	O&M Costs ($fils/m^3$)	Subsidy (JDmil)
1985	143	2.35	16	1.92
1986	97	2.29	24	2.00
1987	136	2.48	18	2.07
1988	119	2.26	19	1.90
1989	125	1.96	16	1.35
1990	109	2.13	20	1.52
1991	83	2.15	30	2.16
1992	111	2.67	24	2.00

Source JVA

There is a compelling need for more economically rational water pricing policies which would help Jordan to ration irrigation water effectively and efficiently. As can be noted in Table (1), the O&M cost recovery of the Jordan Valley irrigation system is shown to average between 19 and 24 $fils/m^3$ which is 3 to 4 times higher than the present water user charge.[5]

These estimates indicate that the O&M charges may not impose a heavy financial burden on farmers in the Jordan Valley, as current charges comprise only about 3 percent of total direct costs of vegetable production. Therefore, it is likely that setting the water charges to cover the O&M costs would be possible (accounting perhaps for no more than 10-15 percent of the total production cost). Such charges, however, would have only a modest impact on the level of water use efficiency. On the other hand, opting for charges that are consistent with the full economic cost of water irrigation may not only boost the portion of water cost (raising it perhaps to over a fourth of total production cost for most horticultural crops), but could also improve the water use efficiency considerably.

An important question to consider is to what extent will the full economic charges on water adversely affect Jordan's comparative advantage in horticultural crops? Studies quoted by

[5] JVA's O&M cost estimates reflect the financial cost of operating the system , which may be 20-25% greater than the economic cost due to overstaffing. About 65% of the O&M costs are for salaries. The larger number of staff needed during the project implementation phase are now no longer necessary and are gradually being reduced. If a water delivery standard of 190 Mm^3 (150 Mm^3 in the Jordan Valley and to 40 Mm^3 in the Southern Ghors) was consistently available and staffing cost were reduced by 20% (the assumed level of overstaffing), the price necessary to cover O&M would be 11.5 $Fils/m^3$. Furthermore, if the full requirement of 280 Mm^3 could be provided at current staffing levels, the cost recovery would be only 9.4 $fils/Mm^3$ (in 1989 currency).

the World Bank Report (June, 1990) on Jordan suggest that many of the higher value crops would remain profitable, while the production of some of the lower value crops would be unprofitable.

Farmers interviewed, especially those at the canal tails indicated their willingness to pay four to five times more for water if they could be assured of reliable delivery at the times and in the quantities needed. Some farmers attending the workshop indicated their willingness to pay O&M fees if the government actually maintained the irrigation system. However, a number of projects have been implemented on the East Ghors canal without the farmers participating in the O&M coverage costs.

Although, the GOJ firmly believes in the necessity for a more effective pricing mechanism to help ration water effectively and efficiently, it is unlikely that Valley farmers would be willing to contribute toward the cost of water irrigation unless there were very tangible offsetting gains and measures to alleviate hardship to any category of farmers adversely affected by such an increase. One possibility is for the government to opt for a technological intervention strategy to convert the surface system to pressurized systems. This conversion would undoubtedly improve conveyance efficiencies, although the intervention alone would not be adequate to optimize on-farm water use and management practices.

The government may additionally ameliorate the situation by offering the farmers a host of enticing tangibles, including:

A. Removing restrictions on horticultural retailing;

B. Privatizing AMPCO or at least limiting its freight privileges with Royal Jordanian Airlines, which adversely affect private exporters;

C. Reducing staffing cost to cut O&M fees;

D. Permitting entry of other airlines into the international air freight business, which would reduce marketing costs.

Even if Jordan is able to gain substantial economies from the development of water efficiency systems, it seems likely that irrigated agriculture will still eventually be affected by diminished water allocations. The present water shortage will only increase in severity as the population grows and demand continues to exceed the available supply. It is clear from all estimates, that demand for water in Jordan will begin to exceed supply by 1995, even if all conventional sources have been developed.

Potential for increasing the water supply in Jordan, beyond developing the Yarmouk River, is considered to be limited, since only modest resources remain unexploited. In fact, with the construction of the AL-Wehdah Dam, Jordan will have exhausted all known existing water resources. Estimates of the cost of this dam indicate that marginal costs of water development

will rise to about 56 fils/m^3. Adding the O&M costs would increase the marginal costs to within a range of 65-75 fils/m^3.[6] Non-conventional alternatives such as desalination remain beyond affordability at present.

Pricing water at its full economic cost would have a major impact on production costs, water use and crops produced. Water charges would then comprise about one-third of the production cost for most horticultural crops. The net return per 100 m^3 indicates, however, that under present management conditions (and price structures) many of the higher value crops would still remain profitable with a full cost recovery water price. Also, if full water charges are applied to agricultural crops, farmers will be induced to adjust towards optimal and superior cropping patterns and irrigation technology. And, farmers adopting modern irrigation methods and technology will accrue higher income through greater production efficiency.

Another fundamental question is what are the alternatives available for irrigated agriculture to adjust to increased water scarcity in Jordan? There is an increasing consensus that with the projection of accelerated water shortages affecting the supply, reduced allocations to agriculture and increased water charges to cover rising costs will be inevitable.

Combining the marginal cost of water development with the O&M cost would considerably raise water charges, imposing a heavy financial burden on the Jordanian farmers. Under prevailing crop production technology and prices, water use efficiency alone will not be sufficient to ameliorate the cost increase. Given these circumstances, irrigated agriculture will, in addition to gaining all possible economies from water use efficiency, have to focus on increased land intensification and shift towards improved cropping patterns and innovative irrigation technology.

Important economies can be realized in irrigated agriculture if cropping intensity is increased. As reported, cropping intensity remained below 100 percent for both the winter and summer seasons, but barely rose to 130 percent for the year. In the case of the Jordan Valley, however, cropping intensity increased continuously over the period between 1973/1974 and 1984/1985 from 40 percent to 90 percent, but decreased somewhat in 1985. Thereafter, increasing water shortages became common occurrences limiting crop intensity to around 115 percent. This is also corroborated with data provided by MOA suggesting that resource use remained relatively poor, with one-fifth of the cropping area being idle, especially in winter when water availability is greatest. Thus, with less waste in water use, increasing crop intensification must be considered as an important element in water saving and water use efficiency. In spite of the employment and equity benefits that can be derived from the expansion of the irrigable land base, the option for intensifying land use must be the preferred strategy for expanding production, since the alternative of committing large investment outlays to irrigation is less efficient.

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[6] A. Sadik and S. Barghouti- Water problem of The Arab World. Draft Paper, World Bank, July, 1993.

Notwithstanding the impressive growth of Jordan's irrigated agriculture in the past decade, development of rainfed agriculture has also been quite dramatic. The push toward self-sufficiency has stalled, and the drive for more wheat production in the rainfed has been almost abandoned by the Jordanian farmers. Instead, there is a new configuration in rainfed agriculture in Jordan in which farmers are becoming reoriented to the more lucrative high value horticultural crops. This could afford the opportunity for higher incomes in the local markets as well as in those of the neighboring countries. Thus, expending more efforts on the improvement of rainfed agriculture through the provision of modern technology would go a long way toward boosting productivity. Also, facing up to the threat of expanding urbanization, land fragmentation and erosion, the upland rainfed agriculture is rapidly transforming itself. This new era will have a major, positive impact on the economy of Jordan and the well-being of many rural families who have not yet had the opportunity to contribute to and benefit from Jordan's economic progress.

No subsector is as fraught with degradation and erosion and languishes more in low/under productivity than Jordan's rangeland. In fact, without sound land management and improvement polices and effective strategies for their timely implementation, both the economic and environmental loss will continue, as deserts replace areas that once were stable and productive.

Jordan has reached the point where a commitment must be made to reverse the desertification process and move quickly toward sustainability of the rangelands. With the pressures of rising demand, there has already been substantial overstocking and clear signs of the declining carrying capacity rendering the range-based system less viable for the sustenance of the sheep flocks. With the failure of pastoral production to provide sufficient feed for the range based ruminants, better areas became cultivated with cereals, especially barley.

At the same time, more extensive barley production systems were evolving on the farms as well as encroaching into the marginal/sub-marginal lands. With the sheep population rapidly rising, supplementary feeding became more intensified, providing the nutrient needs often for up to six months, comprising the winter and fall seasons. However, in what was once the base for raising sheep, resources of the "Badia" became severely limited as much of the best land areas were plowed and planted with barley (producing mostly uneconomic harvests).

An important question to consider is how can the carrying capacity of the "Badia" be restored? A basic element of the solution is to treat the range grazing forage as an economic good (not completely free).

One alternative for ameliorating the conditions in the "Badia" would be for the GOJ to embark on the rehabilitation of the pasturelands with an implementable program which would require extensive local participation:

A four step program would consist of:

1. Setting up pilot perimeters to monitor systems and demonstrate resulting benefits.

2. Establishing grazing associations with fixed grazing areas, "using perimeters whose utilization would not be challenged by other groups."

3. Requiring herders who wish to join, to first settle disputes with their neighbors.

4. Once the concept is well-defined and accepted, the system must be extended legally to the entire rangeland area.

Successful implementation of the program will help in the optimization of sheep flocks raised on the range. The presumption is that, with optimization, a close proportionality may be achieved whereby the less crowded sheep flocks would become an instrument for alleviating much of the overgrazing problems in the "Badia". However, it is highly likely that any policies keyed to improvement of rangeland management will raise serious concerns among the present users.

Also, notwithstanding the substantial economies that are anticipated from implementing such a program, costs will also be incurred in monitoring and supervising the rangeland management which will have to be charged to the grazing associations involved.

A closely related issue evolves feed subsidies, mainly for barley, which have risen substantially (to about JD 15 million) compared to the relatively meager water subsidies in the Jordan Valley. GOJ faces a dilemma for its acquiescence to the removal of the subsidies. Removing the subsidies without simultaneously improving range management, will however, likely alienate pastoralist and all other livestock producers. On the other hand, following the recommendation of the "Thinking Decision" workshop to only phase out the subsidies as range improvements are phased in, may be politically popular, but without clear cut criteria for dispensing with the subsidies, the plan would have very little chance for success.

Greater integration between sheep and barley production (range-based and farm-based rumnants) has provided greater opportunities for efficient livestock growers to increase their incomes. Raising sheep in Jordan and exporting the lambs to Saudi Arabia and the Gulf States (about one-fourth of the Jordanian sheep flocks) would suggest that sheep growing is profitable. Part of this profitability undoubtedly results from government feed subsidies, but, farmers have indicated that, even without the subsidies, their integrated operations would remain profitable. Thus, feed subsidies are an added and economically unnecessary burden on the government budget. In fact, allowing for its continuation would be counter productive to proposed conservation policies dealing with the problem of sheep overstocking in the "Badia".

The forests of Jordan, which barely cover one percent of the land area, are characterized by their slow growth and the poor quality of the forest trees. A near absence of effective laws has left much of the forest trees vulnerable to all types of damage, including grazing, illicit cutting and smuggling, as well as fires and diseases. Low productivity with urban and farming encroachment have also plagued the forestry subsector in Jordan. Treated as a low priority subsector, forests in Jordan remain relegated to mountainous areas or areas where the rainfall exceeds 200mm annually. The remaining forests and woodlands consist of either the marginal areas, or very steep or unclaimed lands only suitable for range purposes.

Forests continue also to be subjected to exploitation and discrimination in the absence of well thought out policies to protect them. It is, therefore, not surprising that over the last 30 years, more than 15 percent of the private forests were cut and converted to other agricultural uses or to urbanization. In addition, more than 50,000 dunums of government forest land was transferred over to non-agricultural activities, especially for municipal purposes such as cemeteries, schools, roads, buildings, housing and service centers.

The absence of sound national land-use policies and the corresponding legislative framework have generated increasing pressure on the forests of Jordan. Therefore, the need for a well thought out and comprehensive forestry policy is imperative. It should focus on extending the country's forest cover, improving forest productivity, developing forestry institutions and their public administration as well as developing revenue generating activities and providing forestry education.

It is clear that comprehensive policy objectives should also be augmented by:

a. Strong legislation to conserve all the country's forest cover (private forests, roadside plantations) with clear instructions concerning safe land use which include plans to curb continuing soil erosion of privately owned hilly slopes after removal of the existing tree cover.

b. Strong legislation to secure protection of government forest lands and provide sound guidelines for conversion to any other use.

c. Legislation to facilitate the conversion of government land in the low rainfall and steep sloping areas to forest areas, where feasible.

d. Providing alternatives which would allow the exchange of private forest areas for government owned bare lands to facilitate the expansion and consolidation of forest resources.

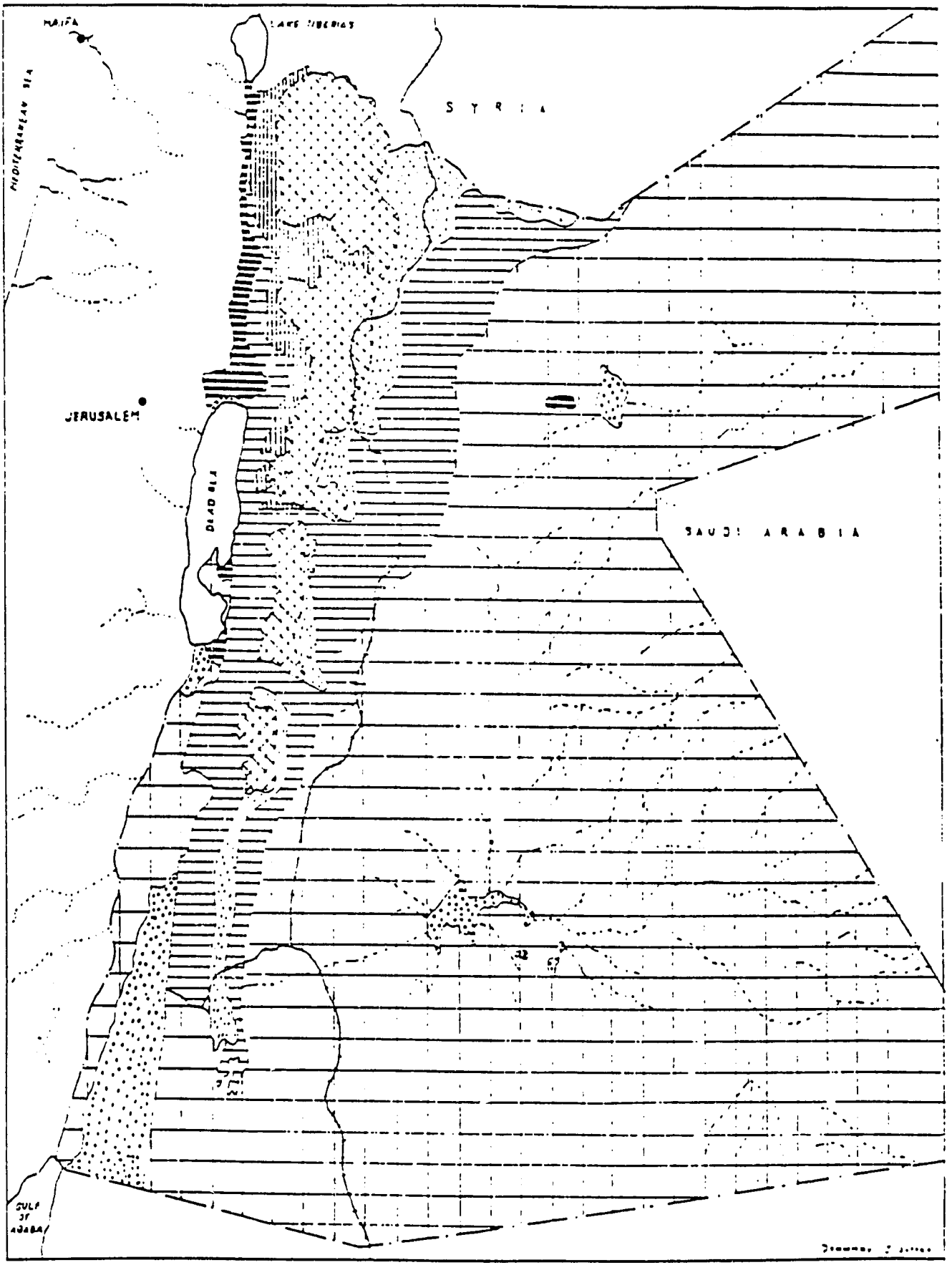
e. Encouraging coordination between forest policies and policies of other sectors as well as shifting away from the narrow sub-sectoral approach to one which would integrate forestry with agriculture, livestock, industry and development planning.

In addition to the important roles of the forestry subsector as detailed in its subsector report, a valuable role which should not be overlooked, relates to urban development planning. In view of the rapid expansion of urbanization in Jordan, a contribution to the national well-being would be to enact specific legislation for the requisition of green areas along side housing developments as well as recreational centers, parks and other amenities in the cities and urban centers through the participation of private planners and developers.

THE MINISTRY OF AGRICULTURE

JORDAN

GENERAL MAP OF EASTERN JORDAN SHOWING POTENTIAL USE CAPABLITIES



IRRIGATED FARMING

DRY FARMING FORESTRY AND HORTICULTURE

DRY FARMING AND GRAZING

GRAZING

LIMITED GRAZING

FOREST GRAZING COMBINATION

NO POTENTIAL USE

I. IRRIGATED AGRICULTURE

A. Introduction and Background

Irrigation is the most prominent agricultural subsector in Jordan. Comprising mainly horticulture and to a lesser extent field crops production, irrigated agriculture accounted for over three-fifths of the total value added in agricultural GDP (4.7%) in 1990. In terms of gross value, vegetable production accounted for 57 percent of the total value of irrigated agriculture and fruit trees comprised 38 percent. This left only 5 percent of the total value for irrigated field crops.

Due largely to diminishing foreign assistance, remittances and the decline in petroleum prices in the 1980's, which reduced economic growth in the Gulf region, Jordan's economy (including agricultural exports) became generally depressed. These factors, along with the relatively high exchange rate, resulted in the loss of some export markets and created a domestic glut of these irrigated subsectoral commodities. Jordan's ability to compete internationally was also constrained by the shrinking regional market as well as the high costs of labor, (although these costs were being offset somewhat by the use of foreign farm laborers).

Despite these constraints, horticultural production remained the most successful agricultural activity in the past decade, with noted increases of the important vegetables, fruits, and citrus resulting from higher productivity. Both public and private sectors continued to invest significantly in the development of infrastructure, water resources and yield-raising technology. Starting from a few farmers using drip irrigated systems and sprinklers in 1980, substantial numbers were reported a decade later (by 1991) to have invested well over 70 million JD in irrigation technology, with drip and sprinkler systems affecting nearly 70 percent (62 and 7 percent respectively) of the total area. Private investments were also committed to the technology of vegetable production, including plastic houses, plastic tunnels and mulch, resulting in more than a doubling of the country's horticultural production.

The dramatic expansion of horticultural production resulted from the dissemination of modern technology and increased use of irrigation in Jordan. To provide for much of the increase in horticultural production (from 404 in 1980 to 699 thousands tons in 1991), consumption of water through irrigation rose at an annual rate of 8 percent, reaching a record level of 657 million cubic meters compared to 285 millions in 1980. Thus, a 75 percent increase in production was achieved at a cost of a 140 percent increase in water consumption. However, irrigation has not been the sole claimant to Jordan's water endowment. Rapid urbanization, population increases and industrial growth have begun to place tremendous pressure on the use of irrigation water. Consequently, growing scarcity of water for irrigation has in recent years, become the most serious constraint on the development of horticultural production in Jordan.

Production Performance in Irrigated Agriculture

Cropping under irrigation has, over the past decade, increased substantially in Jordan. Between 1980 and 1991, the area cropped under irrigation reached a record high at 699 thousands dunums which represented a rise of 73 percent, averaging a 1.6 percent increase annually over the entire period. Favored by 60 percent in area expansion, highlands cropped area (at 362 thousand du) comprised more than half of the country's irrigated agriculture compared to 1980 when the cropped area in the Jordan Valley and Southern Ghors accounted for 70 percent (Table 2).

Irrigated agriculture continued to be dominated by horticultural crops (84 percent in 1991), although changes in the cropping patterns during the past decade have clearly favored the area expansion of fruit tree crops which increased to encompass a third of the total cropped area. Meanwhile, despite the 40 thousand dunum increase, the proportion of vegetables in total cropped area actually declined to 50 percent compared to 72 percent in 1980. Except for potatoes and watermelons, all the important vegetable crops, including tomatoes, eggplant, squash and cucumbers have shown a decline in area and proportion in 1991 compared to 1980.

The changes were more favorable, however, for fruit crops where allocations increased from merely 62 thousands dunums to 233 thousands dunums, raising the share from 15 percent to about one-third of the country's total. Of the fruit trees, the most notable area increases were in olives which rose sharply to 72 thousand dunums, experiencing a 7 fold increase over the 1980 area, followed by grapes (from 5 to 31 thousand dunums), apples (from 2 to 16 thousand dunums) as well as peaches which rose 11 fold over merely one thousand dunums in 1980. Similarly, areas for citrus nearly doubled to 59 thousand dunums and for bananas, the area more than doubled to 13 thousand dunums (see Table 2).

The smallest portion of irrigated agriculture (16 percent in 1991), continues to be allocated to field crops. Traditionally cultivated under rainfed conditions, areas allocated for field crops have, nevertheless increased significantly over the period between 1980 and 1991. From about 50 thousand dunums, field crops more than doubled in area (reaching 113 thousand dunums) which increased at an annual growth rate of 8 percent over the same period. Most of the increases (about 64 thousand du), have taken place in the highlands with wheat, barley, alfalfa and clover being the dominant crops. Wheat remained the most prominent crop, reaching 66 thousand dunums and comprising nearly four-fifths of the total field crop areas. Vegetable yields showed a remarkable improvement, although production fluctuated significantly even under fully irrigated conditions during the period between 1980 and 1991 (see Table 3). Tomatoes, which occupy nearly one third of the vegetable area have experienced substantial productivity increases (at 3.9 t/du in 1991- more than two fold the 1980 level). Tomatoes continued to be the most prominent vegetable crop in Jordan with production more than doubled at 445 thousand tons despite a 4 percent decline in the cropped area.

Table(2)
Changes in Hort..cultural Cropping Patterns In Jordan
1980-1991

	Area 1000 Dunums		%Share in Total Irrigation	
Crop	1980	1991	1980	1991
Olives	9	72	2.0	11.0
Citrus	33	59	8.0	9.0
Grapes	5	31	1.0	4.0
Bananas	6	13	1.4	2.0
Apples	2	16	0.4	2.0
Peaches	1	11	0.2	2.0
Others	7	32	2.0	5.0
Total Fruits I	63	234	16.0	35.0
Tomatoes	118	114	29.0	16.0
Potatoes	4	38	1.0	5.0
Watermelon	8	26	2.0	4.0
Eggplant	31	21	8.0	3.0
Squash	33	18	8.0	3.0
Cucumber	47	15	11.0	2.0
Others	51	116	13.0	17.0
Total Vegtables II	292	348	72.0	50.0
Wheat	31	66	8.0	10.0
Others	19	47	4.0	6.0
Total Field Crops	50	113	12.0	16.0
Total (I+II+III)	404	699	100.0	100.00

Sources (1) Ghors: Department of Statistics, Annual Agricultural Statistics for the years 1986-1991, and Agricultural Statistical Yearbook and Agricultural Sample Survey for 1980. Amman, Jordan, 1993.

(2) Highlands: Ministry of Agriculture. Amman, Jordan 1993.

Table 3

Productivity levels for major vegetables grown under irrigation in Jordan in 1991 compared to those in 1980 and variability of productivity in 1991 among regions, productivity in ton/per dunum.

	National Average				Variation Among Major Regions In 1991	
Crop	1980	1991	Record	Year	Lowest	Highest
Cucumber	1.3	6.4	7.5	1989	2.0 Irbid	7.9 Balqa
Watermelon	2.6	4.0	4.5	1989	2.0 Amman	5.0Mafraq
Tomatoes	1.6	3.9	5.6	1989	1.7 Irbid	7.1Mafraq
Eggplant	1.7	3.4	3.5	1988	1.9 Irbid	4.0 Zarqa
Squash	1.0	2.0	2.0	1991	1.0 Zarqa	2.0 Ghors
Potatoes	1.2	1.8	2.9	1987	1.7 Ghors	3.3 Balqa
All Vegetable	1.7	2.8	3.1	1990	1.0	7.9

Source (1) Ghors: Department of Statistics, Annual Agricultural Statistics for the years 1986-1991, and Agricultural Statistical Yearbook and Agricultural Sample Survey for 1980. Amman, Jordan, 1993.

(2) Highlands: Ministry of Agriculture, Amman, Jordan, 1993.

Similarly for cucumber, eggplant and squash for which the cropped areas showed more decline, yield increases were remarkably high for cucumber (6.4 t/du in 1991) and was also doubled for eggplants and squash at 3.4 and 2.0 t/du, respectively (see Table 3). In the case of potatoes, which are rapidly becoming a major crop, the significant increases in the cropped area and yield combined to increase production to 68 thousand du- more than five and a half fold the level in 1980. For watermelons, which also experienced a substantial rise in the cropped area, yield increases (more than one and a half times) were combined to increase production to 104 tons- about five fold the level in 1980.

Productivity trends of planted tree crops are not easily discernable, especially when areas are continually expanding. Although yield increased gradually to reach a maturity plateau (between three to six years), most of the tree crops, especially olives, grapes, citrus, bananas, pome fruits and stone fruits demonstrated relatively constant yields. As derived from the aggregate data, fruit production rose to 330 thousand tons in 1991, about six fold the level of production in 1980.

B. Objectives, Strategies and Policy Development

The spread of plasticulture and concomitant implementation of modern production technologies, resulted in overproduction of vegetables which flooded Jordan's small domestic market.[7] Meanwhile, market saturation of some horticultural crops, coupled with inefficient input use, let to a decline in farmgate and wholesale prices at a time when production costs continued to rise, resulting in lower farm profit margins. The establishment of plasticulture in a number of Arab States in recent years also limits opportunities to market Jordan's horticultural surplus in the region.

At the same time, aggressive horticultural market entrants such as Turkey, Cyprus and Greece, with lower prices and higher quality products, have managed to capture an increasingly widening share of Jordan's traditional markets. Following the peak period between 1980 and 1984, horticultural production became adversely affected by declining prices which reduced the contribution of sectoral GDP by 20 percent. Subsequently, fresh horticultural exports continued to decline although modest increases in domestic demand and expanding exports of processed vegetables and poultry/egg products assisted in recovery. By 1988, agricultural GDP exceeded the 1980- 1984 plateau. In the following year (1989), production and exports responded to the increased prices brought about by the 1988 currency devaluation and the revenue of horticultural exports increased by 60 percent over the 1988 level. Thereafter, a new peak was reached in 1990 in vegetable exports reaching about 489 thousand tons (14% over 1989); although a declining trend continued in fruit exports, reaching 49 thousand tons in 1991 -about 60 percent below the 1989 level.

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[7] Jordan's local demand was estimated to be both income and price inelastic (ranging between 0.2 and 0.4 for income elasticity of demand for vegetables and between 0.31 and 0.74 for price elasticities) suggesting that domestic market, can best be described as "thin" with marginally small changes in demand levels from larger movements in both prices and income.

Strategies

Judging from the performance of horticultural production and consumption in Jordan, however, likely projected scenarios indicate a growing exportable surplus of main vegetables (tomatoes, cucumbers, eggplant and squash), as well as citrus fruits.[8] Jordan is also likely to become a net importer of other vegetables and fruits. Given the endowment of the highly diversified agroclimatic regions and the country's strategic geographical location, Jordan could maintain a comparative advantage in much of horticultural products in domestic, regional markets and beyond.

Because the Kingdom possesses a modest agricultural endowment and Jordan may never be an exporter of horticultural products on the scale of Turkey and Egypt, Jordan will not affect international prices in any substantive way. Production for export should be part of a long-term strategy where effective research and extension can play a significant role in supporting a dynamic and sustainable horticultural subsector.

Recapturing a significant share of the regional market and establishing export opportunities in the EC, Scandinavia and Eastern Europe should be a primary objective of Jordan's strategy. Jordan's export strategy should also be geared towards identifying and exploiting "windows of export opportunity" for the highly specialized crops, such as strawberries, asparagus and flowers. This means that the country's exports must be produced efficiently with sufficiently low production and marketing costs to meet international standards.

Objectives, Strategies and Policy Development

Jordan's irrigated production continues to expand without much attention to the efficient use of agricultural resources. Farmers made decisions to expand production, especially vegetables, and allocate areas and crops without having information about anticipated local and outside markets and prices. In some seasons supplies exceeded local consumption and external market demands at reasonable prices. Fluctuation in production led to fluctuation in prices and eventually to a decrease in farmers incomes.

Irrigation water in Jordan is the most serious constraint to agricultural growth. There is increasing realization that despite improvements in productivity of irrigated agriculture, input-resource allocation efficiency has lagged considerable behind technological adaptation. With the survival of much of the horticultural crops hinging on the availability of irrigation water, its efficient use must be given the highest priority. Irrigated agriculture in Jordan must include the following wide ranging **objectives**:

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[8]See Jiron, Orland, et al. January 1988. Agricultural Policies Affecting Production and Marketing of Fruits and Vegetables in Jordan. Abt Associates, Inc. prepared for Agricultural Policy Analysis Project, USAID/Jordan.

1. The development and utilization of production resources, especially land and water, with serious consideration for efficiency and optimality, the maximization of economic returns, as well as sustainability and concern for the environment.

2. The maximization of the net returns of producers' investments. The production of agricultural commodities that are in market demand domestically, regionally and internationally, as well as competitive in quality and price.

3. The maximization of the ratio of value added of the total commodities produced in irrigated areas.

4. The maximization of the contribution of irrigated agriculture to the total agricultural sector and GDP.

5. The maximization of export contribution of irrigated areas in the national trade balance.

Policies

It is anticipated that policies aiming at maximizing the efficiency of water storage, conveyance, distribution and on-farm application would result in substantial savings. Adequate appropriation for implementing such objectives could result in a 10 percent increase in irrigation efficiency over the current level of 62 percent. This would increase the availability of the present irrigation water by adding an estimated 60 million cubic meters for new irrigation use. As part of the efforts for realizing the overall water-irrigation efficiency, farmers would have to bear the cost of replacing the existing surface basin of furrow irrigation with drip irrigation systems. Implementing institutions such as MOWI and MOA, along with participating farmers, should be prepared to:

1. Develop suitable water storage structures on and off farm to minimize evaporation and water seepage (MOWI, MOA, Farmers).

2. Convert from the open canal conveyance and distribution systems to the more efficient closed pipe systems in the Jordan Valley, as well as install closed pipe systems to convey surface water within the highlands.

MOWI should be involved in the recovery of public sector water development costs and a portion of the infrastructure and all costs of operation and maintenance of water conveyance and distribution services.

3. Replace the present system of surface irrigation with drip systems on all the public sector water used (MOWI and farmers). At the same time, allow for costs reduction of all water saving technology, including import tax exemption on raw material (MOWI & MOF).

4. Upgrade the management of water distribution (MOWI).

5. Implement policies to strengthen the national capacity for the generation and dissemination of information on crop water requirements, water saving technology, water quality and conservation of watersheds as well as irrigation scheduling and management in each of the country's agroclimatic regions. Also, assume national responsibility to approve the design and installation of irrigation systems (MOWI, MOA, NCARTT, the universities and private sector entities).

6. Coordinate overlapping issues and responsibilities for management of water resources between the Ministry of Agriculture and the Ministry of Water and Irrigation (MOA, MOWI).

In as much as policies for increasing the efficiency of water use would result in substantial savings in irrigation water, opting for the maximization of economic returns on water use would also help in rationalizing the crop-mix in a way that would not only maximize the return on the allocated resources but would also result in the highest possible income. Accordingly, the limited availability of irrigated water and the need for recovering the charges on its use, based on the application of the economic principle of maximization, would result in the contraction of the high water consuming crops and favor the more competitive lower water consuming ones.

A number of policies/measures could be implemented to raise the economic returns on the use of irrigated water in agriculture:

1. Promote the horticulture crops with highest demand and highest net economic returns per cubic meter of water used (MOA/NCARTT, MOWI and Universities) and develop water regimes which will maximize the net value of output per cubic meter of water used. (MOWI in cooperation with NCARTT and the Universities).

2. Limit the production of high water consuming crops, especially those with lower net economic return of water used and remove import protection measures enjoyed by these crops (MOWI, MOA and MOF).

3. Promote the use of technology and practices which will help maintain soil fertility and acceptable standards of water quality. Also provide the necessary measures to safeguard the soil and water quality from contaminated surplus drainage water containing pesticides and herbicide residues and surplus mineral fertilizer. Safeguarding measures are also necessary for recycling water, especially effluent from waste water treatment plants.

Notwithstanding the serious constraining influence of the scarcity of irrigated water on Jordan's agriculture, perhaps equally constraining is the extensive over exploitation causing significant depletion in ground water aquifers, and increased deterioration of the recycled water as well as the spreading of salinity in much of the irrigated areas. Therefore, policies aiming at water conservation and the improvement of soil quality, and providing for the proper treatment of recycled water to meet the standard requirements for irrigation should be accorded a high priority.

A number of priority measures will be necessary to assure the successful implementation of these polices. This may be accomplished by:

1. Enforcing the regulation for monitoring the recharge and discharge water from the aquifers (MOWI). And, conserve the recharged watersheds of major aquifers to ensure sustainability of both quantity and quality of the recharged water (MOWI & MOA).

2. Monitoring the quality of all soils, surface and ground water and implementing action programs for desalinization and the removal of sources of pollutants (NCARTT, RSS in cooperation with MOWI and MOA).

3. Curbing salinity in effluent of waste water treatment plants through improved treatment and the desalinization of effluent and/or mixing effluent with fresh water (MOWI).

4. Enforcing regulations, including licensing of ground water wells in the cropped areas (MOWI & MOA); and enforce environmental protection on all water development projects, especially reservoirs and waste water treatment plants (MOP, MOWI, MOA).

The second major objective of irrigated agriculture in Jordan, maximization of net returns on production investment, attaches high importance to the risks as encountered in trade (usually beyond Jordan's control) among the countries in the region. Two principal policies are advanced for ameliorating the risk to Jordan's regional trade and for minimizing production and marketing costs. Measures to ensure successful implementation of the first policy (ameliorating the risk) may comprise the following:

1. Strengthen the information service to producers and exporters on demand-supply balance and projections on commodities produced in Jordan (AMO, private and public sector marketing establishments). And, minimize losses of farmers due to market price fluctuation (Farmers organizations, AMO, MOA, private and public sector marketing establishments).

2. Organize farmers and exporters to assume a greater responsibility for the improvement of marketing activities, including the development of new markets and new crops (MOA, AMO, producers and/or exporters); also strengthen the generation and

dissemination of technical information on minimizing pest risks (NCARTT, universities, private sector and farmers organizations); and strengthen post harvest technical services on fruit and vegetables, including monitoring of pesticides, residue analysis, quality control standards, packing specification, storage precooling treatment and transport management of fresh commodities (AMO, MOA, NCARTT, Higher Council for Science and Technology, producers and exporters).

Given the objective of maximizing the returns on Jordan's horticultural products, the policy should be aimed at employing the country's resources in a way that will maximize the returns on their productive use. Accordingly, Jordan's irrigated agriculture which has proven quite suitable for the production of the high value crops, should provide greater opportunities to farmers to expand the production of these commodities with a greater emphasis on those from which the country enjoys a production comparative advantage.

Realizing such an objective would require a number of measures ranging from maintaining the present policy of exempting all improved inputs from custom duties, to removing protective measures such as the import ban on domestically produced commodities. The relevant ministries, along with the private sector involved in trade, should meanwhile utilize trade relations and agreements with other countries to further Jordan's benefits and promote the expansion of greater exports on the basis of production comparative advantage.

Finally, to raise export earnings (Objectives 4, 5 and 6), the present policy of promoting exports needs to be maintained and strengthened. An important element of this policy is to end import barriers, to have better access to export markets, as well as build a greater level of confidence among producers and exporters for long-term trade relations (MOA, MOF, MOIT) and to strengthen all services leading to the promotion of greater exports through the dissemination of international market trade information (AMO).

II. RAINFED AGRICULTURE

A. Introduction and Background

With inadequate and erratic rainfall predominant in practically all of its land areas, the productivity of rainfed agriculture is extremely unpredictable in Jordan. Of the estimated 89 million dunums, nearly 90 percent is marginal land receiving less than 200 mm of average rainfall. The remaining 10 percent (nearly 8 million dunums) which receives more than 200 mm of average annual rainfall, comprises the main areas of rainfed agriculture. Thus, except for upland farming, which benefits from supplementary irrigation, rainfed agriculture is identified with the highland plains and mountains that typify the traditional agriculture of Jordan. Not all of the rainfed lands are totally cultivable, however, since they include areas occupied by the forests, villages, population centers and related infrastructures. Also, considerable portions of the rainfed areas feature steep slopes eroded with shallow soils not suitable for cultivation.

Rainfed agriculture has undergone a significant transformation over the past decade. Rural development has brought about substantial changes in education, health care and social services as well as infrastructure-roads and electricity. Much of the transformation, however, was also reflected in the conversion of large areas of prime agricultural land to urban uses. As Jordan's population doubles every 19 years, it is anticipated that the cultivated land within the present boundaries of villages and cities will eventually be used for non-agricultural purposes, and that the rate of annual loss in agricultural land will likely continue to accelerate. Thus, even with the conservative extrapolation of the annual loss of 262 thousand dunums in the country's agricultural land holdings (as reported for the 1975-1983 period), the loss since then will have grown by more than one-third of a million dunums, leaving slightly over 3 million dunums in agricultural holdings- a one-fifth decline from the original total in 1975.

In the absence of updated data on the current distribution of rainfed areas by rainfall and slope, the following table provides insight on how the rainfed agriculture has been affected.

Table 4
Rainfed Agriculture by Rainfall Slope: Jordan-1975

Rainfall Zone (mm)	Slope % (1000 Dunums)		Total Area (1000 Dunums)
	0-8	9-25	
200-300	790	1050	1840
300-400	359	476	832
>400	447	589	1036
Total	**1596**	**2112**	**3708**

As is shown in Table (4), much of the continued rise in urbanization has affected the relatively wetter areas. As a result, rainfed agriculture now contains a substantially greater portion of low productivity areas (200-300 mm) of average rainfall[9] as reported in Table (4).

As urban development in Jordan was booming during the past decade, rainfed agriculture was undergoing dramatic changes in cropping patterns. Despite a self-sufficiency policy, cereal production stagnated while tree, vine and vegetable production spontaneously expanded. With the pursuit of self-sufficiency, wheat was not always grown in relationship to its highest production potential. Meanwhile, much of the barley cultivation remained concentrated in the low rainfall area where the opportunity for exploiting its potential with improved technology was quite limited.

Despite the rapidly rising demand, domestic cereal production grew more deficient. Of the many reasons behind this weak response, the lack of attention to agroclimatic suitability for establishing production potential and the dissemination of new technology, as well as the preoccupation with wheat self-sufficiency greatly influenced the resulting lower production yields. Thus, from 167 thousand m.t. in the 1970's, local cereal production declined by about one-third in the 1980's and showed a drastic decline in the rate of self-sufficiency to about 9 percent compared to nearly 49 percent in the 1970's.

Efforts expended on providing improved practices and technology packages in cereal production, especially wheat, did not fare well. These improved practices were ineffective in overcoming the adverse effects of high risk, low return, non-availability of modern inputs and equipment as well as the problem of land fragmentation. Abandoning cereal cultivation became

[9] Only the area within the 300-400 mm of average rainfall zone appears to be most suitable for the production of various crops with limited technical constraints. The rest, land with less than 300 mm of rainfall, is characterized as having limited production potential because of shallow and low quality soils.

inevitable as areas allocated for production were squeezed out by urban encroachment and the shift towards fruit production accelerated during the past decade.

While rainfed fruit production made considerable gains, cereal productivity gains were minimal. Consequently, the income derived from cereal production was considerably lower than that derived from fruit production. In fact, as shown in Table (5), the large discrepancy in the net income returns suggest that much more land area (a factor of 12 fold in hectarage) would be required for wheat compared to peach production in order to realize a total income of 2,000 Jordanian dinars annually (see Table 5).

Augmented by supplementary irrigation resembling the rapid expansion in the Jordan Valley, olives, vines and deciduous fruits expanded rapidly as wheat cultivation continued to diminish in the rainfed zones. Over a span of 9 years (see Table 6), the average wheat area was contracted by nearly one-third to an average of 650 thousand dunums over the 1981-1992 period. In contrast, however, barley emerging as the most important source of animal feed, expanded by over two-fifth to an average of more than one-half million dunums (518,000 Du) over the 1981-1992 period.

The most substantial expansion was in horticultural crops where olive was the dominant tree crop, more than doubling the average area of 548 thousand dunums over the 1981-1992 period. The area was also more than doubled to 54 thousand dunums for vegetables. With the rest of fruit trees and vines expanding considerably over the same period, the cropping pattern of rainfed agriculture expanded to 2.0 million dunums, with horticultural areas comprising 38 percent relative to the 1981-1985 average of about 20 percent.

The change in the cropping pattern reflecting the decline in the cultivated area for wheat and the expansion of the fruit crops area had a positive impact on the farmers' income in the rainfed zones. Thus, concomitant with the cropping pattern change, there was a significant rise in the total value of rainfed agriculture during the late 1980's. From about JD 20 million in 1989 (14 percent of AGDP), rainfed agriculture rose by 75 percent, accounting for over 35 percent of AGDP in 1991. Much of the value increases were due to the expansion of fruit trees, including olives, vines and deciduous fruit whose contribution was 20 percent higher than that of grain production.

B. Objectives, Strategies and Policy Development

Objectives

There is increasing realization that developing and maintaining rainfed agriculture in Jordan could be successfully achieved through the rational use of domestic resources from which efficiency maximization would be realized through possible alternatives. Therefore, there is a serious need to focus on the development objectives that will energize rainfed agriculture by:

1. Improving the economic efficiency in allocation and utilization of agricultural resources;

2. Curbing urbanization encroachment on prime agricultural land;

3. Encouraging public and private sector involvement with natural resource conservation and development efforts in rural area;

4. Encouraging public and private sector investment; and

5. Providing government services to on-farm activities.

Achieving the objectives of rainfed agriculture should be based on appropriate strategies and policies which would pay greater attention to the rising trends of horticultural production, the dissemination of wheat and barley technologies and the amelioration of encroaching urbanization.

Table 5

Net income per dunum generated by different crops under present agricultural practices and number of dunums needed to generate JD 2000, 3000, 4000

Rainfed Land Cultivated With:	Net Income JD/DM	Number of Dunums Needed to Generate an Income of JD/Year		
		2000	3000	4000
1-Wheat at ≥350mm rainfall	16	125	188	251
Wheat at 200-350 rainfall	11	179	268	358
2-Barley at ≥350mm rainfall	12	167	251	358
Barley at 250-300 rainfall	10	190	258	380
3-Olives at ≥350mm rainfall	61	33	49	66
Olives at 250-300 rainfall	59	34	51	68
4-Grapes at ≥350mm rainfall	86	23	35	47
Grapes at 200-350 rainfall	12	172	259	345
5-Peaches at ≥350mm rainfall	207	10	14	19
Peaches at 200-350 rainfall	206	10	15	19
6-Apricots at ≥350mm rainfall	164	12	18	24

Source: *Jordan Agricultural Sector Review: Rainfed Agriculture*, APAP II Technical Report No. 132, Volume III, August 1993.

Table 6
Cropping in the rainfed areas during the period 1981-1992.

Crop	1981-1985		1991-1992	
	Avg. Area (1000 du)	Avg. Prod (1000 du)	Avg. Area (1000 du)	Avg. Prod (1000 du)
Wheat	860	59	651	60
Barley	361	17	518	37
Lentils	68	5	49	4
Vegetables	20	2	54	4
Tobacco	72	3	21	1
Total	1382		1293	
Olives	229	27	548	55
Grapes	92	40	108	54
Stone Fruits*	17	7	27	9
Pom Fruit**	5	3	18	6
Total	345		701	

(source: Ministry of Agriculture). Amman, Jordan, 1993.

* Stone fruits represent the production of peaches, plums, apricots and almonds as an average of 5 years

** Pom fruits represent apples and pears production as an average of 5 years.

Strategies

As recommended, the strategies for energizing rainfed agriculture should be based on strengthening positive trends and incentives to gain a greater participation of the private sector. Some direct government investment is suggested for research, extension and infrastructure as a means to increase productivity. Proposed strategies should also include programs designed to support soil and water conservation and encourage the flow of private capital from urban areas to rural villages and the countryside.

There are clear indications that the expansion of perennial production (olives, grapes and stone fruits) holds the promise of being a significant source of growth in rainfed agriculture. With supplementary irrigation now being introduced, much of the increased production has been the result of shifting of prime land away from field crops. A strategy that focuses on nurturing the development of rainfed horticultural production, mainly fruits which is estimated to have surpassed the value of grain production (at least one-fifth higher by the late 1980's) should be emphasized.

There is also a need for focusing on the dissemination of new grain technology that would provide the opportunity to exploit potential of barley production in the more favorable agroclimatic zones. The research findings, particularly those of ICARDA, show that barley yields are higher than wheat yields in rainfall areas of about 300 mm within lower and upper levels of between 280 and 380 mm of average rainfall, respectively. For areas within these rainfall zones, the implication is that with barley yields being higher than wheat yields, shifting the land resources more towards barley production would result in beneficial net changes in terms of grain and biological yield and foreign exchange savings. It would also result in net economic benefits which would be affected by the extent of increase in the relatively higher wheat prices. This is supported by the IFPRI farm survey showing that with fertilizer application and with new seed varieties, barley mean yields can outperform those of wheat.

Policies[10]

Already comprising a considerable share of Jordan's domestic fruit market, there is now a strong possibility of export opportunities to the neighboring countries.

Expansion of perennial crop production has already provided rainfed land with considerably higher returns than were accrued from cereals, including wheat. In less than a decade (during the 1980's), the expansion of fruit production became pervasive throughout the rainfed regions and rose to encompass more than 700 thousand dunums, surpassing the area allocated for wheat production.

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[10] Any present policies which contain contradictory elements to the new policies/measures should be streamlined to accommodate the new proposed strategies. A number of existing policies would have to be adjusted, including those concerning land use and land allocation, land fragmentation, soil and water conservation, agricultural research, agricultural extension, agricultural mechanization; as well as pricing policies and subsidies.

As envisaged, the development objectives of the rainfed agriculture may be realized by implementing policies comprising the following:

A. Improved Productivity

1. There is an opportunity to raise the productivity of rainfed agriculture through improved efficiency in resource allocation and the dissemination of yield raising technologies. A condition precedent to realizing such opportunities entails economic analysis to identify commodities whose production is empirically warranted. Such analysis must include all costs of production, including resource costs.

This analytic approach has not always been employed in Jordan. In the case of wheat, for example, promotion of the crop was justified on the basis of achieving self sufficiency, an objective which was manifestly unrealizable. Self-sufficiency should be supplanted with strategies that support economic optimization of commodities. Then, improved efficiencies through innovative technologies and effective resource use can be employed.

NCARTT will serve as the focal point for coordinating all these agricultural research activities in Jordan and as the conduit for all relevant research findings and recommendations to extension. NCARTT staff will also actively seek feedback from extension staff on research strategies and, among other duties, function as a technical back-up in direct work with farmers.

Research strategy should focus on developing technological packages tailored especially for each agro-ecological zone and taking into account, the physical conditions, the soil type, profitability and the socio-economic conditions as well as the chances for adoption by farmers. The reasons for low-rate adoption of certain packages should be investigated and identified and new policy measures developed to assist in their implementation if they are found technically sound and economically viable.

2. The expansion of fruit production in rainfed agriculture should be encouraged in areas with a slope greater than 8 percent.

Expanding the upland resources devoted to olive and deciduous fruit, nut and vine production would result in:

a. greater economic return for fruit production than from the traditional annual crops presently cultivated.

b. greater effective means for soil and water conservation through the establishment of orchards and vineyards.

c. enhancing the export opportunity of vegetables in certain Gulf markets requiring mixed shipments of fruits and vegetables.

As envisaged, a policy for enhancing the productivity of tree and vine crops in the uplands should be based on:

(1) short term training programs for extension staff and farmers on tree and vine crop husbandry to be implemented as part of an on-going extension program.

(2) increase the diversity of tree crops which in addition to olives, the most common fruit crop, and to a lesser extent grapes, peaches and apples, may also include almonds and pistachios.

(3) expand the network of roads and infrastructure in the rainfed mountainous region areas to facilitate the delivery of input supplies and product marketing.

(4) the private sector should be greatly involved with the production of nursery stock, whereas the Ministry of Agriculture should focus its regulatory and control functions mostly on the development of fruit tree seedling production. As the Ministry progressively withdraws from seedling production, its freed manpower resources may then be used for the control of nursery stock production in private nurseries (phytosanitary, varieties, labeling, etc.)

4. The use of treated waste water for supplementary irrigation and on-farm water harvesting should be encouraged. While most of Jordan's waste water channeled into the Jordan Valley for irrigation originates in the rainfed regions, allowing much of its use for the development of upland agriculture would result in a significant contribution since this would:

a. Provide agriculture with a means for benefitting (rather than losing) from the municipalities water development leading to improved productivity as well as preserving the immediately adjacent primary agricultural lands.

b. The application of 1500 cubic meters of water/ha as supplementary irrigation in areas receiving 300 mm of rainfall could increase average wheat yields from an average base of 1.2 ton/ha to about 4 ton/ha. In effect, supplementary irrigation would ensure that the poor or inadequate rainfall will not result in the loss of production potential.

c. Agronomic and summer weather conditions (cool night time temperatures) make it more suitable than those of the Jordan Valley for the production of high value fruit and nut crops. It is also possible that forage production could compete for available waste water in the uplands.

d. The Ministry should also support farmers carrying out simple on-farm water harvesting methods, including the establishment of impermeable slopes, contour tillage, cisterns and check dams.

B. Managing Natural Resources

1. Rapid expansion of municipal boundaries on agricultural land should be discouraged.

In so far as the goal of this policy is to ensure that development of rainfed uplands brings progress to those regions, urban growth must be guided to complement agricultural development. As pointed out earlier, the conversion rate from rainfed farm land in the uplands remains sizeable. Continuation of this conversion phenomenon could result in the elimination of much of the 3.6 million dunums of tillable land remaining in the rainfed subsector.

The policy to halt the rapid conversion should include the following:

a. Documentation of the rate of urbanization on prime, rainfed agricultural land over the past 20 years (The National Geographic Center).

b. Imposition of a five year freeze on the expansion of urban boundaries while policies and the strategy dealing with this problem are being put in place.

c. A conversion tax to be levied on the price of farmland sold for urban and industrial development in order to discourage its sale for urbanization. Revenues generated would be used for the improvement of municipal services.

d. Urban waste water should be treated and carefully monitored for quality for irrigated land immediately adjacent to urban boundaries (about 20 thousand cubic meters of waste water may be generated on a daily basis from the Irbid area alone).

e. Current work on soil and land use classification of the rainfed region should be accelerated.

2. Present fragmented holdings should be consolidated while further fragmentation should be discouraged. Laws should be enacted which will impose minimum plot sizes according to the production potential of the land:

a. 10 du for tree and vine crops.

b. 15 du for any land with access to irrigation.

c. 25 du for any land located in regions with less than 350 mm of annual precipitation.

d. Any land with more than 75 percent of its surface covered with bedrock could be subdivided for urban or industrial use (Certification would be required by the High Council for Planning).

3. Soil and water conservation should be encouraged. Apart from what has been achieved in the targeted areas (with slopes > 8 percent), there is a great deal to be implemented in the water conservation programs in the mountains of rainfed regions. Public sector involvement should be expanded with a pivotal role for encouraging the private sector to invest in the development of fruit farming with the aim of increasing productivity and protecting water and soil resources.

4. NCARTT should be encouraged to develop specific recommendations for regions with less than 200 mm of average rainfall:

a. Curbing wind erosion and destruction of soil structure on marginal lands (150-250 mm of rainfall), requires (according to studies by ICARDA in the already ploughed areas) planting strips of wind breakers which are productive and utilizable in order to be acceptable by farmers. The hedges of native shrubs (Atriplex halimos or Salsola vermiculata) which can be established by direct seeding, and more importantly, are capable of self reseeding, should be planted as multipurpose wind breakers. These hedges will not only control wind erosion, but will also provide grazing resources in the drier years. The greater part of the land (strip between the shrub hedges), will continue to be used for producing barley and other feed crops. Securing a sustainable source of animal feed and ascertaining its viability, would critically hinge on adaptive research and on-farm trials in various parts of Jordan and should be undertaken by NCARTT.

b. NCARTT, in cooperation with regional and international research institutions, should undertake a barley breeding program for the development of a dual purpose barley cultivar (grain and forage) adaptable to the local environment that could be grazed in years of low rainfall and left for grain in years of high rainfall.

C. Improving Government Institutions

This should include:

1. An effective Ministry of Agriculture which is essential for prosperous development of the rainfed subsector. Political commitment should be backed by a provision of necessary resources and appropriate legislation.

2. Empowering the Agricultural Council to become an active and effective policy-making body. The council should have a core staff to work under the supervision of the

Agriculture Policy Department at the Ministry. Among their duties, the core staff should gather and analyze agricultural statistics.

3. A national agricultural census should be carried out and agricultural statistics improved.

III. Low Rainfall Zone

A. Introduction and Background

Jordan's low rainfall zone comprises most of the native rangelands that are generally uncultivated with less than 200 mm of annual rainfall but provide the necessary forage resources for animal grazing. Rangelands face severe limitations for crop production as they are too steep and/or too austere for cultivation. Modern rangeland management techniques that are economically and ecologically sound and carefully selected rehabilitation practices should be diligently utilized to increase forage and livestock production. All rangeland uses and practices must give full consideration to the ecological potentials and limitations of the basic land resources.

Rangelands embracing about 89 percent of Jordan's total area (nearly 8 million ha) and are mostly located in the eastern and southern parts of the country. Desert rangelands which comprise over 75 percent of the total area are concentrated in the eastern and northern parts of the country with less than 100 mm of annual rainfall. Located generally west of the desert with an annual rainfall of 100-200 mm, steppe rangelands comprise about a fourth of the total rangelands area which is generally used for grazing, although sizeable portions have now been put under cultivation.

Based on the 1973 Agricultural Land Law, over 90 percent of rangelands in the steppe are privately owned and continuous cereal ploughing has resulted in substantial degradation and erosion of the soil resources. The remaining 10 percent of the steppe rangelands, which are state owned, are normally grazed by local sheep flocks. Adjacent to the steppe rangelands, a strip of 10-15 km width in the "Badia" is privately owned and mostly used for opportunistic cereal production. Also, a parallel "Badia" strip with 15-30 km in width is owned by the tribes, but partially cultivated. The rest of the "Badia" is considered desert land which receives 80 mm rainfall and is claimed by the tribes, but open to all Jordanian and non-Jordanian herds. Finally, irrigated state land(El-Azraq, El-Disi) is scattered throughout the steppe and the desert and utilized on a lease basis in the cultivation of cereal, vegetable and fodder production.

The Transformation of Small Ruminants Production

Since ancient times, most of the sheep population has been kept in Jordan by nomads on rangelands which were either non-arable or too dry to support crops. Pastoral production, however, was capable of providing winter and spring grazing for sheep as herders traversed the country's east and back west seeking forage for their flocks.

In response to the higher demand for meat and livestock products, pastoral production grew more deficient as a consequence of overgrazing and the continued decline of the steppe areas. Also, as the steppe continued to be subjected to poor farming and more extensively exposed to deterioration and soil erosion, it lost much of its carrying capacity which further

intensified the over and early grazing practices. This led to the continual decline in pastoral production, creating the necessity for greater supplementary feeding for small ruminants and livestock. Through time, with the sheep population rapidly rising, supplementary feeding became more intensified, providing the nutrient needs for a considerable portion of the year, including the winter months.

The population of the Badia (including the nomads and the transhumants) has increased at an annual rate of 2.6 percent between 1974 and 1991. Currently numbering some 146 thousand, the Badia's population has effectively more than doubled since 1974. However, while the present occupants are livestock growers by occupation and tradition, pastoralism remained a way of life more than being an exclusive source of income. Herds of camels and sheep were regarded as the only form of wealth, while nobility and prestige were also equated with the ownership of these animals.

Much of Jordan's livestock continued to depend either on the nomadic or transhumance production system[11]. The pattern of raising livestock, as originally followed by the pastoral nomads, required their continuous movements in search of water and pasturage for their animals, with such erratic movements being governed by the sporadic desert rainfall. In contrast, movements of the transhumant nomads are migrations that are regulated by seasonal forage availability which depends upon normal climatic and ecological conditions.

Meanwhile, the increased pressure of demand for feed allowed portions of the better steppe lands to be used for cereal cultivation, especially barley, which emerged as the most prominent animal feed[12]. Earlier, as barley was extended into the drier marginal lands (between 100-200 mm isohyte lines), production encroachment was beginning to also adversely affect portions of the steppe land areas. Later in the 1980's, the practice of extending barley production became even more aggressive, greatly encroaching on the pasture lands and depressing its yield and stability. This also intensified the pressure on the steppe, resulting in greater overgrazing and sheep overstocking while at the same time degrading the pastoral lands and leaving pastoral production less viable for the long-term sustainability of the flocks.

In parallel, much of the bedouin lifestyle became subject to considerable transformation. Some of the nomads developed a nucleus, of more or less stable population settlements, where cultivation was extended further into the drier areas and formed a sort of enclosure adjacent to the steppe. This became an important element of their transformation. Many of the bedouins

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[11] With the rapid rise in demand for meat and livestock products in the past decade, about 58 percent of the country's two million heads (sheep and goats) were raised principally in the range-based/transhumance production system, leaving the rest (42 percent) to be raised in the farm-based system.

[12] The steppe is an area of about one million ha, comprising both shrub and grass-covered areas with an average annual rainfall of between 100-200 mm. Accounting for three-fifths of the steppe (0.6 million ha), the shrub area spans a narrow belt from Ras Al-Nagab in the south to the Mafraq in the north.The rest-the grass covered steppe with 0.4 million ha- is an area that stretches along the Syrian borders from the Mafraq in the west to the Iraqi borders in the east.

became more market oriented, since raising sheep was shifting rapidly away from "subsistence" to commercial production. This was facilitated by the use of tractors and automobiles and benefitted from the improvement of education and health services as well as the restriction of herd movements across international boundaries.

Underlying the availability of feed subsidies, veterinary services and high prices for live animals for export, the market-oriented transformation afforded a greater opportunity for the pastoral economy to flourish. And, with greater incentives for the expansion of sheep flocks, many were able to reap higher incomes.

At present, commercialization of sheep and goat production has become greatly reliant on the availability of supplementary feeding not only for the winter months, but often for the six month period that includes the fall season. In this environment, barley became the most common and important cash crop even though opportunistic cultivation in these marginal areas could only produce a harvestable crop about once every five years. Supplementary feeding is usually required for most of the years, especially during the dry periods when the crops are not harvestable and the fields are leased for direct grazing. Thus, it is clear that these uneconomic grain harvests are promoting a greater soil loss and serious erosion leading to the expansion of desertification and the permanent loss of pastoral lands.

Income from livestock production accounts for about 40 percent of the total agricultural income.[13] It is estimated that in terms of forage production, the rangelands can produce 720 thousand tons of dry matter which is sufficient to provide 30-40 percent of grazing feed requirements. Accordingly, Jordan's sheep husbandry systems support a population of over 100 thousand nomads/semi-nomads and provide over one-third of the feed requirements for grazing animals.

Being the major economic base for rangelands, the "Badia" contains much of the pastoral forage production and supports a high percentage of Jordan's agricultural labor force. The

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[13] Aside from the vast areas of the rangelands which are the basis for Jordan's pastoral economy, a small portion of the cultivated areas (45,000 ha) are under irrigation, out of which 10,000 ha are located in the south-eastern part of Jordan -El-Disi and Mudawara. About one-half of the leased areas are actually utilized in the production of wheat, barley, onions, garlic, potato, water melon, vegetables, legumes, fruit trees and alfalfa.
Mineral: mineral ores and mineral deposits are also contained in much of the rangeland areas: (a) It is reported that an estimated one billion tons of high quality rock phosphate (60-75 percent p.205) are located at a depth of 12-17 m. Exports in 1988 totaled 5.6 million tons. (b) White cement ores can be found in various parts of the rangelands with an estimated production potential of 51 million tons. (c) Pure limestone (97-98 percent) for $CaCO_3$ production, dolomite limestone for glass industry, glass sand (quartz) for glass sheets and containers, clay (naturally pure) for sanitary ware production.
(d) Natural gas, mainly in the north-eastern part of the Badia,with an estimated daily production (two wells) of 18 million cubic feet mcf/a day. Potential reserves are estimated at 700 billion cf out of which 500 billion is recoverable reserves.
(e) Oil, a quantity of 413,00 barrels was produced from the northern Badia in 1988. Oil shale is widely distributed, with potential reserves of up to 50 billion tons.

major question remains, in view of the continuing decline in the carrying capacity of the "Badia", can Jordan through a program of rehabilitation and proper management, attain a viable, sustainable ruminant production systems?

This would certainly require that a forage - livestock balance be achieved in order to curb overstocking and overgrazing in the rangelands. Substantial rangeland rehabilitation and proper management and supervision would have to be realized in the "Badia". This would also require the cooperation of the herders/transhumants in the management of rangeland resources to achieve stability in the "Badia's" pastoral base production.

With the ultimate optimization of the range-based ruminants, grazing in the "Badia" would be augmented by feedstuff, mostly cereal feedgrain. The perception that pastoral production and range management is based upon free forage, would no longer be valid as the beneficiary livestock growers would be contributing to the operation and maintenance of the "Badia" in Jordan.

Greater integration between range-based and farm-based ruminants, and improved rangeland management husbandry practices, would provide opportunities for efficient livestock growers to increase their incomes. Jordan would then reap more income from such development without the burden of subsidizing livestock feed grain.

B. Objectives, Strategies and Policy Development

Synonymous with the low rainfall zone of less than 200 mm, rangelands in Jordan comprise approximately 90 percent of the country's entire land area. Considered to be the main and cheapest source of animal feed, the rangelands, with a pastoral grazing production of about 400 million feed units, contribute more than one-half of the total feed requirements. The rangeland is fundamental to the livelihood of herders in Jordan which numbered 146,000 by the late 1980's and constitute about 5 percent of the country's population. The rangeland is also fundamental to the survival of livestock as it supplies about two-fifths of the country's red meat and most of its milk requirements. It generates nearly one-third of agricultural GDP, amounting to nearly 3 percent of the total national income.

Decades of overgrazing and uncontrolled movements of livestock left much of the rangelands affected by widespread degradation and yielding but a fraction of their original production. Also, extensive new areas within the zone have now been cultivated, ostensibly for barley production, but more likely as a means of laying claim to the land. The extension of barley cultivation into the drier land areas has become a serious threat to the natural pasture of the steppe land. Insensitivity to the agroclimatic suitability resulted in the expansion of barley production which became a serious threat to the natural pasture, including the "Badia". In those areas, the expansion of barley production squeezed out the better grazing areas of the "Badia" and marginal lands where an estimated 50 percent of the areas located between 100-200mm of average rainfall were used for dryland cultivation. Due either to the pressure of rising demand for barley or the desire for establishing historic use of particular tracts, the steppe became

further subjected to loss of its carrying capacity, disturbing the traditional grazing pattern of the flocks due to the dwindling pasture areas.

Expansion of barley production in these areas became more opportunistic, with an increase in the frequency of occasions where no grain harvest was realized.[14] This does not, of course, constitute crop failure in the accepted sense, since both green grazing and the grazing of mature crops that are uneconomic to harvest, do provide some valuable source of feed. Although such cultivation appears to be remunerative for individual farmers, the macro-level practice represents a gross misallocation of the dry land resources which are being gradually destroyed through this aggressive expansion.

Enforcing the existing policy on crop cultivation for areas with less than 200mm of average rainfall is imperative, as it would facilitate the curtailment of such practices. Also, to the extent that feed subsidies appear to provide more inducement for the plowing/cultivation of the marginal/submarginal lands, the proposed policy should discourage their continuation.

There is a strong consensus that Jordan has reached the point where a decision must be made either to commit the necessary investments to reverse the desertification process and move toward sustained productivity of the rangelands, or to maintain the present policies and practices which would ensure further land degradation and the desertification of areas that were once stable and productive.

The productivity of the vast majority of these degraded lands could be improved, and in some cases restored, by an integrated program of rangeland improvement and management and improved livestock management and husbandry. Restored rangelands would contribute not only to improved and sustained forage and livestock production but also to the enhancement of the environment.

It should be emphasized that any serious development objectives for the rangelands in Jordan should be based on the realization that continued overgrazing and the uncontrolled movement of livestock are the root causes of the rangelands utilization problem since they render it nearly impossible to :

1. Delay grazing until the range plants are ready to be grazed.

2. Allow a deferred-rotation grazing system and,

3. Achieve proper stocking. Simultaneous application of these practices would be absolutely imperative in order to achieve a sustainable rangeland development.

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[14] It is estimated that a barley crop is harvestable only twice in every ten year span in the low rainfall areas.

Objectives:

As envisaged, the broad objectives for the low precipitation zone would be:

1. Stop rangeland degradation and reverse the desertification process;

2. Restore rangeland productivity and stabilize range, forage and livestock production;

3. Enhance environmental quality and,

4. Improve the economic welfare of people inhabiting and drawing their sustenance from these lands.

In order to achieve these objectives it is imperative to develop and implement policies to address existing problems of land use, development, management and administration. It will be necessary to modify existing government agencies and their current responsibilities. It is also essential that a professional staff of qualified rangeland managers, scientists and administrators be created in Jordan to implement rangeland policies. And, although the government has the responsibility to stop and reverse the desertification process by implementing rehabilitation projects for the development and management of rangelands, local participation must also be an integral part of any strategy intent upon improving range development and management. As it stands presently, the lack of protection of rangelands from grazing by locally owned livestock is a major constraint to range improvements and sustained production.

Strategies

Given the absence of any serious development strategy, there is much that can be achieved, with relatively small investments, to arrest the desertification process and restore the production capacity of the rangelands of Jordan. A great deal could be accomplished by adoption and implementation of carefully crafted policies aimed specifically at solutions for problems affecting rangelands and related resources. In the development of such policies, full consideration must be given to their economic aspects, social concerns and environmental impact.

Policies

As envisaged, the following policies would, if adopted, stabilize rangeland production, enhance environmental quality, contribute to the economic welfare of rangeland users and increase red meat production:[15]

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[15] Analysis of feed subsidies and their adverse effect on the productivity of the "Badia" is addressed in the subsector on: "Integrated Livestock Production Subsector". Also, the policy dealing with phasing out livestock feed subsidies is detailed in the same subsector.

1. Policies for Land Tenure Reform:

a. The Agricultural Law 20/1973 governing land tenure in Jordan, especially dealing with range law sections, must be enforced to improve rangelands and protect them from uprooting, ploughing and overgrazing.

b. Land use policies must be reformed with clear mechanisms to restore environmental quality and rangeland productivity, prohibit cultivation of marginal lands and provide management that is geared for optimal sustained production.

c. The law should be amended to keep pace with the new proposed policy which is directed towards the cooperative concept- a modern modification of the old traditional grazing system, "El-Hema" which was adopted by the local herders centuries ago and proved effective in protecting and maintaining rangelands.

d. The new policy for rangeland tenure must also include a mechanism for the government to reinstate jurisdiction over unregistered submarginal lands that have been cultivated for barley production. These submarginal lands must then be managed properly to assure sustained productivity and arrest soil erosion.

e. Tribal rights should be formally respected and protected along with customary relations that exist among tribes.

2. Policy for the Establishment of a Department of Rangeland Resources:

Successful management of the rangeland based on a greater understanding of its ecological complexity as well as its limitations and potential, would best be accomplished through the establishment of a Department of Rangeland Resource (DRR) within the Ministry of Agriculture (MOA), and with the following functions:

a. The DRR would have the responsibility for promulgating the rules and regulations that would encompass all aspects of rangeland development, use and management. The rules and regulations would also address and provide solutions to current problems of rangeland abuse and mismanagement which have resulted in land deterioration and reduced productivity.

b. The DRR would interact and cooperate with other government agencies and institutions to resolve common problems appropriately. The DRR would be headed by a Director, and would have four divisions: administrative, research, extension and range improvement management.

3. Policy to Optimize the Range-based Livestock Production by Improving Rangeland Fodder Production and Livestock Genetics:

It is estimated that production of livestock commodities from rangelands could be doubled within a five year period through the judicious application of known and accepted rangeland management and animal husbandry practices. Close cooperation should be required among livestock producers, governmental agencies and institutions with rangeland responsibilities and interests.

4. Policy to Halt and Reverse the Rangelands Desertification Process in Jordan:

It is estimated that over 90 percent of Jordanian rangelands are degraded to some extent and that present productivity is significantly less than its potential yield. A policy to halt and reverse the desertification process would be carried out through a committee selected from existing departments in the Ministry of Agriculture and the Higher Council for Science and Technology. The committee would coordinate anti-desertification activities at all levels of government, promulgate rules and regulations to halt the desertification, evaluate programs and activities and recommend funding for anti-desertification activities.

5. Policy Regulating Border Crossing by Nomads and Livestock:

The decline of forage production on local rangelands forces livestock owners to overgraze rangelands and seek other feed sources outside the country to sustain their herds. This policy would promote cooperation and agreement with the neighboring countries of Jordan concerning crossing by nomads and livestock and grazing rights. It would also place renewed emphasis on the El-Hammad project which was established to organize and control regional grazing and improve rangeland management practices.

6. Policy to Establish Rangeland Resources Curriculum at the Universities of Jordan for the BS and MS Degree:

The long term success and sustainability of a program for proper development, use and management is dependent upon an educated, professional staff and its understanding of rangeland users. To accomplish this educational goal, an academic program providing professional level training in rangeland resources disciplines is essential. This will require a competent and professional staff at the universities to provide academic training to interested students, at the BS and MS degree levels.

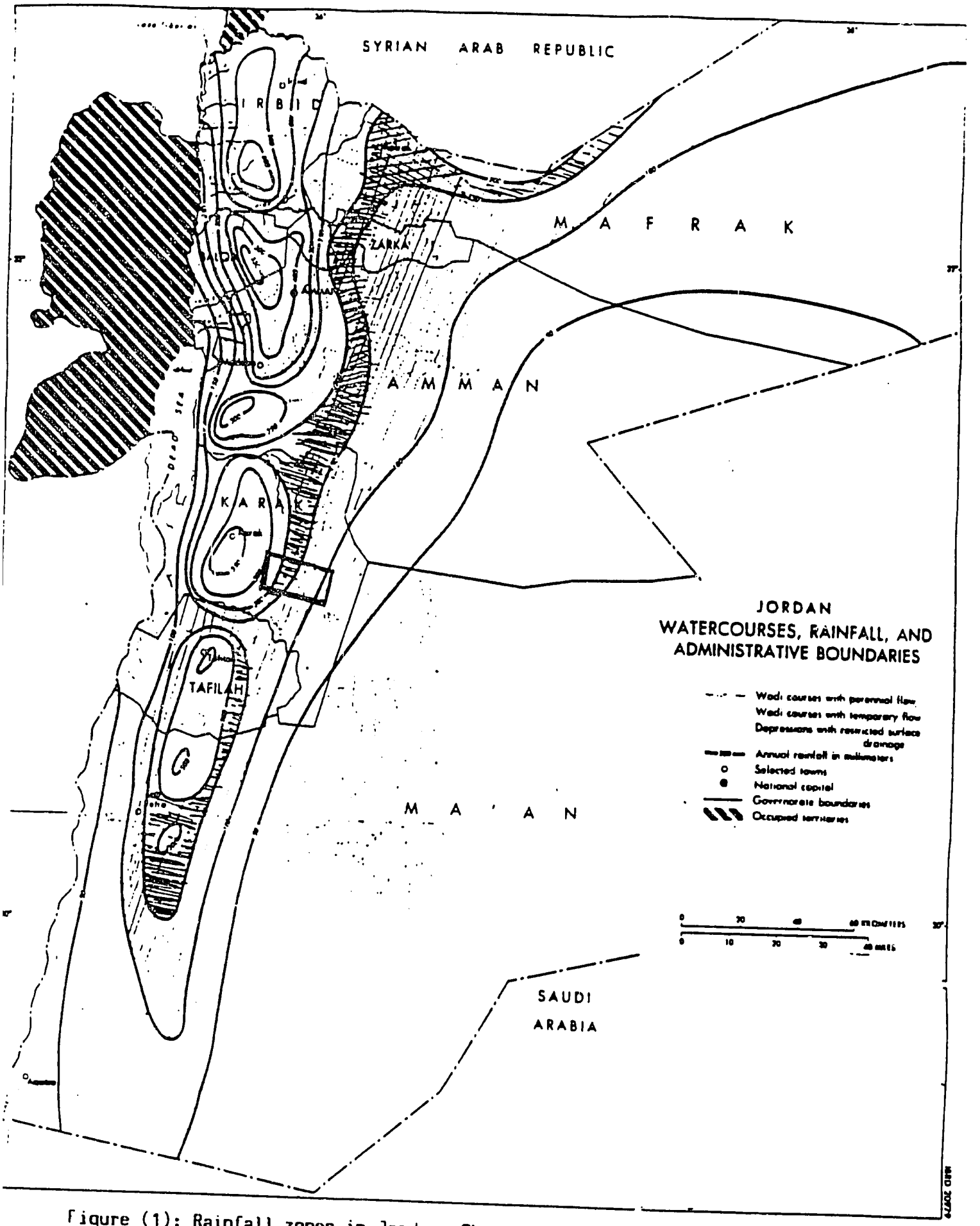


Figure (1): Rainfall zones in Jordan. Shaded area (one million ha) is the rangeland and receives 100 - 200 mm of annual rainfall.Dark shade, areas where barley culitvation is practiced. Square is the Lajoun study site.

IV. INTEGRATED LIVESTOCK PRODUCTION SUBSECTOR

A. Introduction and Background

High population growth combined with ir eases in per capita incomes and the consequent urbanization and labor migration have led to the increased demand for major food commodities, especially in the consumption of livestock products. Consumption increased substantially in meat during the past decade, particularly in poultry which rose at a high rate of 10 percent annually. By the late 1980's, the per capita consumption of livestock commodities became relatively high even compared to other countries with similar incomes; with an estimated 17 kg of red meat, 29.5 kg of poultry, 113 eggs and the equivalent of 54.5 kg milk. This necessitated the rapid expansion of imports in livestock products, rising to 73 percent of the consumption of red meat, and 60 percent of milk and dairy products.

Poultry, however, remains the major successful enterprise of Jordan's livestock production system. In contrast to the production of red meat, poultry production increased sufficiently (at 75,300 tons of broiler meat in 1988) to meet the rapidly rising demand. Throughout the past decade Jordan remained near self-sufficiency with respect to poultry meat while creating a surplus for egg exports.

In response to the great surge in demand for food commodities, especially poultry, which was introduced to Jordan by the private sector in the early 1960's, expansion was considerable between the late 1970's and the late 1980's. During that period, the industry experienced a two-fold increase of egg production (542 million eggs in 1988) and a three-fold increase of broiler production. Due to the ease of production technology, building up a greater capacity for the poultry industry was possible. With a broiler farm capacity of 5.4 million birds and an effective production of 14.6 million (2.7 batches a year) in 1979, average batches increased by more than 50 percent by 1988.

Until the mid 1970's, most dairy farmers were settled in the Jordan Valley, well integrated with agricultural activities- using weeds, vegetable tops, and forage cultivation. From 1975 to 1977, government policy transferred dairy farms (which were considered to pollute the area) towards non-irrigated areas, east of the Jordan Valley. This policy resulted in highly concentrated, and specialized operations, which simultaneously lost their integration with agricultural activities. This included "in stall" feeding and the need for some green roughage which had to be transported from the Jordan Valley. Also, manure to be used for horticulture had to be transported back to the Jordan Valley.

These changes in the cattle production system have not been entirely detrimental to the development growth of dairy production. Actually, the contribution of cattle to diary production increased substantially (about 57 percent) over the period between the late 1970's and the late 1980's at a growth rate of 5 percent annually and reaching 33 thousand tons in 1988, which accounted for one half of Jordan's dairy production.

Along with the production of dairy cows, sheep and goats, dairy products accounted for half of Jordan's total production. Considered to have a low productivity level, the dairy sheep production, mainly in the form of cheese, ghee and dried laban accounted for less than one third of the country's dairy production, at nearly 21 thousand tons in 1988. The productivity of goat dairy production also remained considerably lower due largely to the poor feed availability in the rangelands. Thus, despite the large number of flocks, dairy goat production, which reached nearly 12 thousand tons in 1988, was maintained at about 18 percent of the country's total production.

Despite the efforts expended in dairy production (with increases of 60 percent between 1981 and 1988) rising demand, due partly to population increase, necessitated higher amounts of imports. Among these imports, skimmed milk processed by the domestic industry into dairy products, comprised more than one-half of the total imports- 57 thousand tons in fresh milk equivalents in 1986, followed by cheese which accounted for one-third of the country's total imports.

Of the production systems covering livestock, those governing sheep husbandry are undoubtedly the most complex and the least understood. The "nomadic system" involves an estimated 500 households, less than 5 percent of the country's herders, and comprises 10 percent of the sheep and goats in Jordan- reported at 2.6 million sheep and 1.0 million goats, according to the 1991 Census.

The entire family lives permanently in tents. Livestock being their exclusive activity as they traverse the eastern part of the Badia, including the neighboring countries, seeking spring grazing and stable grazing as well as crop residues in the marginal land in summer. In the fall, they rely on residues of the western Badia and concentrate feed, and survive almost exclusively on grain and purchased roughage (hay and straw) in winter.

The "transhumance system" is estimated to cover 70 percent of sheep and goats, where the flocks are usually kept in the villages during the winter (which is also the lambing season) when they are provided with purchased feed- barley, bran and straw. During spring, the flocks are taken to the surrounding Badia (within a radius of 100 km) and returned to the villages in the summer when crop residue are available, or to the western rainfed agriculture when not available. According to this system, livestock is not the only source of income as it includes other agricultural activities (especially if irrigation is available) as well as non-agricultural activities which generate incomes. It is estimated that the transhumance system comprises most of the large flocks belonging to almost 2,000 landless breeders and over 500 landowners with large flocks.

In contrast to the transhumance system, the "Mixed Farming" system comprises the agriculturists in the relatively high rainfall areas or irrigated areas for whom sheep and goats are mainly for home consumption rather than being a source of cash income. Feeding patterns are highly integrated with agriculture through crop residues and with much use of forage feed (which

would be utilized more if subsidized grain was not available) and a limited use of collective grazing at a walking distance from the village, when available.

"Stall Feeding Fattening Operations" which were carried out in the past by merchants have recently been joined by the fattening landless who also are benefitting from the availability of feed subsidy as well as from the EEC sponsored project which set up 6 units in 1989, each with the capacity of 3,600 heads.

Despite the relative neglect affecting agriculture in the rainfed regions, incomes derived from small ruminant enterprises (sheep and goats) appear to have fared well. Much of the preferred Awassi Lambs (about a quarter of a million sheep) continue to be exported in large numbers and at lucrative prices, to Saudi Arabia and the rest of the Gulf States. However, as sheep growers responded to the rising demand in the 1970's and the 1980's, pastoral production became deficient in providing (almost free) winter and spring grazing. Therefore, as a result of higher demand, sheep flocks increased, which in turn, intensified the problems of overgrazing and overstocking.

Meanwhile, because of increased demand, supplementary feed concentrate, mainly barley, became a major source of animal feed. Rising, demand for feed also encouraged its production expansion further into the marginal and submarginal lands. At present, much of the feed grain, including barley and sorghum, as well as wheat bran is subsidized. The barley subsidy is divided between barley producers and livestock producers who use barley in their feed rations. Feed subsidies have been rising in recent years, reaching 15 million JD with the highest proportion being provided to small ruminants.

It is clear that the negative effects of subsidies overweighs the rationale for providing the sheep growers and/or the barley- sheep grower with cheaper feed. Subsidies should be thought of as added cost to the Jordanian public, since the additional cost is incurred by the government budgetary allocations. Also, with substantial portions of the sheep being exported, it appears that much of the feed subsidies provide disproportionate benefits to the sheep exporters. Perhaps even more costly is the additional negative effect of subsides, which permits increasing sheep flocks, thus further aggravating the problems of overstocking and overgrazing which leads to further deterioration of the "Badia". Consequently, the negative effect of feed subsidies must be thought of as an added obstacle to effecting a policy of sheep optimization, as well as the rehabilitation of the rangelands and the contraction of barley plowing practices in the marginal and submarginal lands.

In contrast to the modern production systems of poultry, dairy and fattening, the knowledge of small ruminants, livestock and pastoral production remained poor. It was also further aggravated by the lack of agreement about the number of small ruminants, as flocks size are difficult to accurately estimate. Also, policies dealing with trade, farm- gate prices and input subsidies are generally planned in a piece meal fashion without always assessing their overall technical and economic impact on the subsector. The inadequate subsector monitoring of the distribution of subsidized feedstuffs is a good illustration, especially in view of the recent

revision of national livestock numbers resulting from the recent livestock survey in Jordan. Accordingly, a policy objective geared to carrying out an "institution building" program will be needed (see the Policy Section) for the planning, implementation and monitoring of the development of the livestock ruminants.

Of the complexity surrounding the production and marketing of small ruminant livestock, those problems concerning meat slaughtering control and output production appear to be most considerable. While it is extremely difficult to gauge the extent of annual fluctuations of numbers and weight of the animals slaughtered, it is likely that such fluctuations can be related as much to pricing polices as to climatic conditions. Accordingly, there is a presumption that ruminant meat slaughtered by municipal abattoirs would represent only a portion of the national meat production. Thus, for the year 1988, tentative estimates suggest that sheep production would include controlled slaughter of 5,000 tons plus 204,000 heads exported (3,700 tons), as well as an estimated 100,000 heads (18,000 tons) for family consumption and uncontrolled slaughters. Also, it is estimated that in addition to the 70,000 goats marketed through controlled abattoirs and exports, 18,00 heads (2,700 tons) will have been slaughtered for family and village consumption. Therefore, with a total of 15,200 tons of small ruminant meat (carcass weight), only about 7,100 tons are marketed through controlled abattoirs.

According to World Bank estimates, with 1.3 million heads in the national sheep flock and about 0.75 million ewes available in 1988, roughly 580,000 lambs could have been produced in Jordan. Of the lambs produced, 280,000 would have been processed in controlled slaughterhouses, leaving 200,000 to be exported to Saudi Arabia, and about 100,000 to be slaughtered at the family and the village level. The proportion of goat production processed at the family level is even higher. With a population of 0.50 million in 1988 of which .30 million female goats would have produced 0.25 million kids. Of the kids produced, 60,000 were processed in controlled slaughterhouses, less than 10,000 were exported and 180,000 were consumed or sold at the village level.

B. Objectives, Strategies and Policy Development

Parallel to the moderate increases of agricultural GDP which rose from JD 115 million to JD 157 million over the period between 1980 and 1985, the contribution of the livestock subsector increased from approximately one-third in 1980, to almost one-half by 1985. Much of the contribution was due to the superior performance of poultry and egg production which expanded rapidly between the late 1970's and 1980's at an annual rate of 10 and 15 percent, respectively. The contribution of poultry and eggs rose from nearly 21 percent in 1980 to over 29 percent in 1985, compared to 11 and 17 percent for red meat and milk.

Jordan's red meat and milk production, dominated by sheep and goats account for about 78 percent of the red meat production and about 42 percent of the country's milk supply. However, many of the country's small ruminants (sheep and goats) are raised in the "Badia" where large portions of the areas are now being degraded. Overgrazing is diminishing the carrying capacity of the pasture and jeopardizing the production of ruminant livestock in Jordan.

As the traditional grazing pattern of the flocks is being upset by the requirement for greater pasture areas, the ewes are suffering from lower productivity, reduced fertility and milk producing capacity. Consequently, the ewes are bearing reduced lambs which are smaller and weaker than normal and the lambs are, in turn, growing to maturity at a slower rate and competing longer with adult animals for the natural forage that is already in short supply.

Therefore, it is becoming increasingly clear that allowing the present policies and practices to continue, would depress the rangeland resources, resulting in lower productivity and increased deficiency in grazing capacity, and intensify the trend toward greater meat imports.

Objectives

A positive development strategy for the integrated livestock production subsector would be to improve the natural resources, as well as to promote economic efficiency leading to the improvement of farmer's incomes. The two major policy objectives should be:

1. Optimization of livestock production.

2. Optimization of feed production.

More specific policy objectives would also include:

3. Increasing the feed productivity of the rangeland, the agricultural by-products, roughages and forage crops.

4. Promoting feeding and husbandry management systems with special attention to balanced rations and production cycles.

5. Promoting health care of livestock (preventive and curative) with special emphasis on common diseases between humans and livestock.

6. Promoting the efficiency of processing and marketing of livestock.

Strategies

In order to achieve the specific policy objectives where the efficient employment of the inputs will result in the highest returns and the least cost possible, the following strategies should be instituted:

1. Rehabilitation and management of the rangeland to achieve a high level of sustained productivity by encouraging the formation of small ruminants cooperatives. Camels may also be included under these cooperative activities. In addition, irrigated forage production should be investigated within the frame work of crop rotation and resource allocation, including sewage water.

2. Livestock management systems are in a state of change. The traditional pastoral system for ruminants (sheep and goats and cattle) has undergone a great deal of shifting away from the traditional ruminant system into semi extensive/semi intensive or pure intensive. In parallel, feeding systems along with feeding balance and cycle have all been changing. Consequently, there is a need to establish new feeding regimes and balances in which feeding requirements of local and imported breeds would be adjusted to the new conditions.

3. Livestock health care (preventive and curative) is another aspect of vital importance since it plays a pivotal role in raising production efficiency. By expending a minimum of costs and efforts, substantial payoffs can be realized. Apart from the vaccination services which are provided by the Veterinary Department in the Ministry of Agriculture, there is need for involving the private sector in such activities.

4. Processing and marketing of livestock products need ample efforts both from the public and the private sector. Some products are processed properly, like laban and labaneh, and others are not. The latter include cheese, chicken, eggs and even red meat.

5. Productivity improvement must include the genetic and the environmental factors. With the genetic we must upgrade the ruminant local breeds through selection, and conduct research on commercial cross breeding of imported exotic breeds with local acclimated breeds. On the other hand, management of feeding, health and reproduction must be consistent and synchronized.

Policies

There is substantial scope for instituting policies which could boost grazing forage productivity as well as the production efficiency of the ruminant livestock. This would transform the rangeland resources by initiating sustainable production activities. Cultivating the potential of the vast misused areas of the rangelands, reversing the desertification process and restoring the rangelands productivity, as well as stabilizing grazing forage and ruminant livestock production would depend on carrying out the following measures:

1. Addressing the existing problems of land use and development as well as management and administration.

2. Modifying existing government agencies and their current responsibilities.

3. Providing a professional staff of qualified rangeland managers, scientists and administrators for policy implementation.

4. Protecting the rangelands from overgrazing by the locally owned ruminant livestock.

It is also clear that the human resources available to tackle the national challenge of "Badia" development are scarce and poorly allocated. There are less than half a dozen of professionally trained rangeland managers in Jordan and the entire subsector is administered by a small unit of three foresters within the Department of Forestry and Land Conservation. The six main Integrated Livestock Production Subsector development policy recommendations are presented as follows:

1. Policy for the Establishment of a Department of Rangeland Resources:

The establishment of a Department of Rangeland Resources is justified for several reasons: The implementation of the dozen or so projects and programs dealing entirely or partially with rangeland development is scattered between a multitude of institutions: MDA, NCARTT, ICO, Jordan Universities and DFSC with little or no technical efficiency and cooperation within the subsector. There is little knowledge available on pastoralism in Jordan. There is also a lack of a development strategy, as well as a long term developmental program and monitoring capacity.[16]

2. Policy for Phasing Out Feed Subsidies:

Feed subsidies will be phased out gradually (within a clearly defined time period) in order to maximize the positive benefits of the transition and to minimize any negative effects of the change. A compensatory support price will be adopted on forage and red meat production to compensate for the change during the transitory period.

Subsidizing coarse grain and feed concentrate has reached a considerable level in Jordan. World Bank estimates suggest that subsides, following the devaluation of the national currency, represent approximately 20 percent for corn, 30 percent for sorghum and 50 percent for barley and bran (in relation to international prices). While the ratio of the price of lamb (live weight) and barley ranges between 10 and 12 in other countries, it reached 25 and 30 in Jordan where barley is cheaper in feeding values than any other forage available on the market. The cost of these subsidies, at JD 12 million in 1989 for the government, would have been much greater, especially if the implicit subsidies supplied for sorghum granted by bilateral aid and for urban (administered prices) were computed. In addition to the burden on budget resources, the development of subsidies for coarse grains and concentrates has created a long-term distortion/disincentive which should not be overlooked. Thus, the provision of low-priced grain to herders during the extended dry season is a disincentive to the rational utilization of the rangeland, thus leading to further deterioration and desertification.

[16] As envisaged, justification for the proposed policy of establishing a Department of Rangeland Resources include its being a necessary institution for improving pastoralism in Jordan (for details see Rangeland Subsector section).

Therefore, a carefully planned phase out of animal feed subsidies according to a gradual schedule with an aim toward lessening the short-term impacts of this policy change is recommended.

3. Policy on Natural Grazing Resource:

Natural grazing resources should be rehabilitated and managed in order to achieve a high level of sustainable livestock production and productivity within the potential capacity of those feed resources.

It is estimated that the rangelands of Jordan produce approximately 400 million feed units annually, which satisfies about 50 percent of the feed grazing requirement in Jordan. Under present levels of management, rangelands are being degraded and productivity is declining. It is estimated, however, that production of livestock products from rangelands could be doubled within a five year period through the judicious application of known and accepted rangeland management and animal husbandry practices. Sustained production at this level would require the close cooperation of livestock producers and governmental agencies and institutions with rangelands responsibilities or interests. Known as a type of "Hema", the government would allocate areas in the form of a grant (instead of land appropriation) for the improved sustainability of the areas through communal grazing practices.

The main institutions which would be involved in implementing this policy include Jordan Cooperative Organization (JCO), MOA and MOI.

4. Policy on Research, Extension Education and Farmer Training:

Steps should be taken in order to establish economically feasible and justifiable livestock management systems and husbandry practices and to utilize national feed resources more efficiently.

The recent increases in per capita consumption of red meat not only increased the pressure on pastureland, but resulted also in the higher demand for forage and feed grain, especially barley. The rapid growth in sheep production exerted substantial pressure on domestic feed supply and strained the carrying capacity, leading to deterioration of range conditions. The proliferation of sheep flocks, coupled with the pressure of overgrazing, increased the demand for feed supplements, (mostly barley) which emerged as a major source of animal feed. MOA and NCARTT along with the Faculty of Agriculture at the University of Jordan and ICARDA are involved in implementing this policy.

Elements of this policy would provide technical assistance to examine (through Livestock Policy Development Project) resource allocation issues based on comparative advantage and other economic criteria such as impact on input use, production, farmer income and government expenditures. A project has already been initiated to investigate the economic justification for allocating irrigation water for forage crops, including sewage recycled water.

Another project (Integrated Crop Livestock Dryland Farming Systems Extension Project) was initiated to extend or transfer the technology to farmers. The project also provides to farmers the conclusions from the current ICARDA managed "Mashreq Project" on increased productivity of barley, pasture and sheep production in the drylands.

Other projects include:

• **The Livestock Nutrition Research Project** — which would identify technically and financially feasible ruminant livestock and poultry feeding systems to increase productivity and utilization of domestic feed resource.

5. Policy for Animal Health Care Services:

Animal health care services for livestock and poultry will be improved both by strengthening government services and by supporting private veterinary practices. The system of public quality standards control of commercial veterinary products will be improved.

Health is an important aspect of livestock production. It is a vital service in management and has a bearing on the profit/loss profile. MOA, through its Animal Health Department, is taking the responsibility for dealing with vaccination for contagious diseases. This includes diagnosing the diseases and providing some medicines nationally, as well as safeguarding the general health of the national flocks, including inspection of and quarantine measures imposed on imported livestock.

The private sector is now heavily involved in poultry health, but to a lesser extent in cattle, sheep and goats. Animal health is critically lacking in human resources, facilities, finance and management. New, developing systems for sheep and goats in particular, are creating imbalances in the diets of the livestock. This situation necessitates a special effort to cope with the constraints resulting from the human/physical, financial and administrative deficiencies. This policy aims at strengthening government services and supporting private veterinary practices. The policy also aims at improving the public quality standards control of commercial veterinary products.

In addition to the involvement of the Directorate of Animal Production and Health and the Veterinary Department in implementing this policy, the following institutions should also be included: Jordan Veterinary Association, Jordan Center for Veterinary Vaccines, Jordan University of Science and Technology, the Chamber of Commerce as well as the Chamber of Industry (both representing manufacturers of veterinary products).

6. Policy for Animal Genetic Resources:

Animal genetic resources will be conserved and improved by carrying out livestock breeding programs, including but not limited to selection and crossbreeding and related applied

research. The main institutions which would be involved in implementation are MOA and NCARTT.

Elements of this policy would include:

- Upgrading of local breeds of sheep and other ruminants through selection and,

- Conducting research on the commercial feasibility of crossbreeding the local acclimatized breeds of sheep with imported breeds.

The six main Integrated Livestock Production Subsector development policies will be supported by secondary priority policies, as follows:

1. The roles, responsibilities and authorities of the institutions involved in agricultural sector development will be clarified to improve their effectiveness.

2. The role of the private sector in providing livestock production, processing and marketing support services will be increased relative to the role of government.

3. A national farmers' union will be established to strengthen the representation and participation of farmers and livestock producers in the formulation and implementation of agricultural sector development policy.

4. Dairy. The systems of milk processing and marketing will be improved through the establishment of a national dairy development association.

5. Red meat. The systems of live animal marketing, slaughtering and processing, and meat marketing will be improved through the establishment of a national red meat development association. This will include meat, hides and skins, fiber, by-products.

6. Poultry. The systems of processing and marketing poultry products will be improved through the establishment of a national poultry development association.

7. Price regulation of livestock and poultry products will be phased out gradually in order to maximize the positive benefits of the transition and to minimize any negative effects of the change.

8. Export import trade policy: An open export/import policy will be followed, so that any support will be maximized for livestock subsector development policy instruments and projects.

9. Women in livestock development. The participation of men and women in livestock husbandry practices, and the actual tasks carried out by them, and the role of each in improving livestock productivity, will be taken into account in the provision of extension

education and training services. The implications of this policy include but are not limited to employing female extension officers to provide extension services to female livestock farmers.

10. Government will apply aggressively the principle of cost recovery for supplying inputs and services.

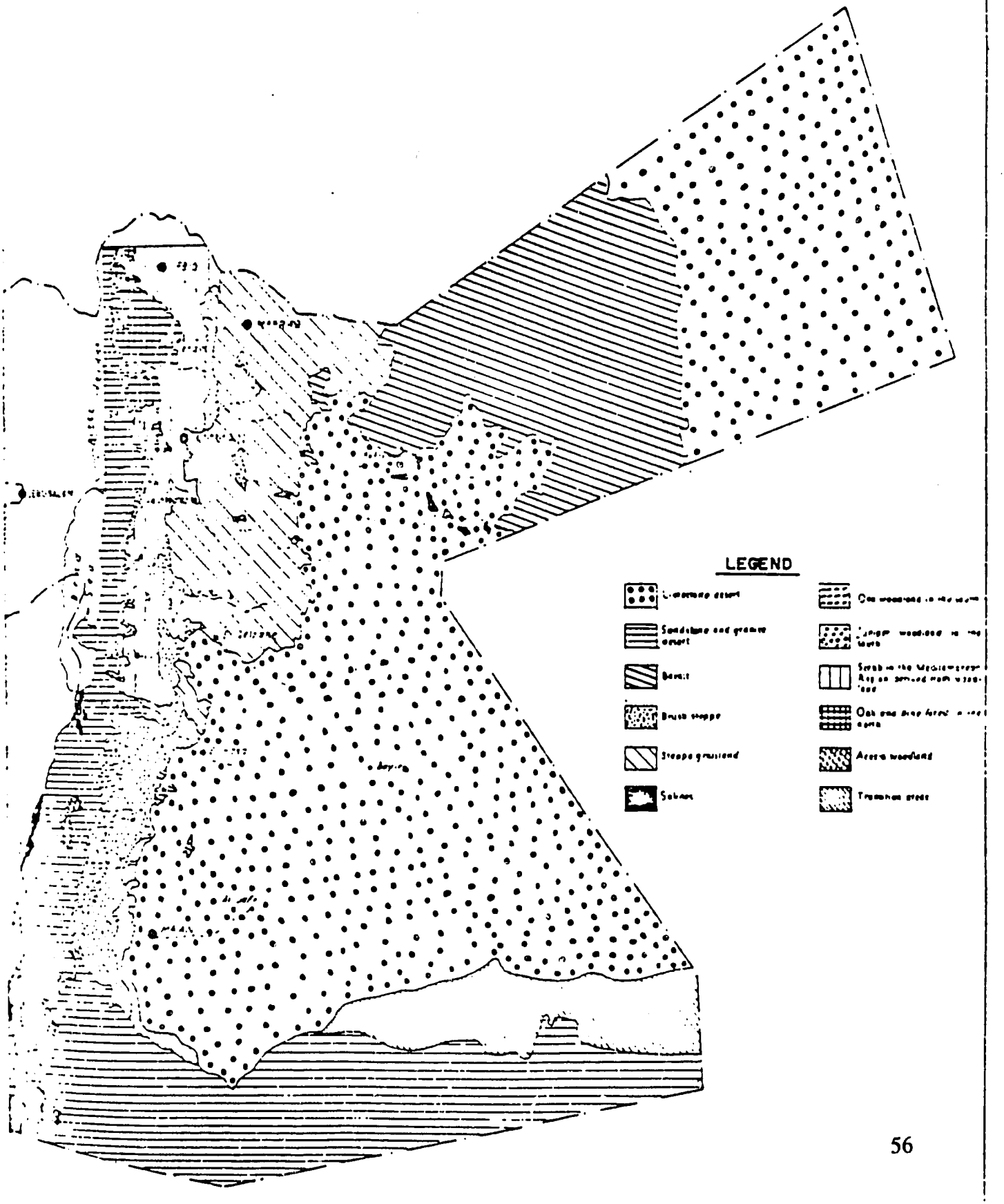
11. Credit policy. The provision of credit for livestock and poultry production, processing and marketing enterprises will be supported, commensurate with their contribution to the national economy and potential increase in productivity.

12. Feed industry development policy. The provision of livestock and poultry compound feed and feedstuffs by the private sector will be supported. The system of public quality standards control of commercial feed and feed products will be improved.

THE MINISTRY OF AGRICULTURE

JORDAN

VEGETATION MAP



V. Forestry Subsector

A. Introduction and Background

Jordan's forest vegetation is quite limited with about 76,000 hectares predominately found in portions of the mountain height region, extending from the Yarmouk River in the north to the Ras Al-Naqab in the south (see Map-figure 1). Beyond the mountain heights, trees are either planted or rather small and shrub like, (although the latter make up important parts of the natural vegetation in both the marginal steppe region and the eastern desert or Badia). Barely comprising one percent of total area (88.9 million ha), Jordan's forest vegetation rises from 100 mm above sea level in the AL-Alouk area, to over 1,0000 m near Ajloun and Balqa and rises again to exceed 1,200 - 1,500 m in the Tafila and Shoubak areas. Due to the harsh environmental conditions of present sites as well as generations of misuse and exploitation, the natural forests of Jordan, comprising an area of about 46,0000 ha, contain vegetation of relatively poor quality and slow growth. An additional area of man-made forests, estimated at 34,000 ha, has been established by plantation over the last 40 years.

Since 1922, when the Emirate of Jordan was established and continuing until 1960, forest policies were contained and implemented through various sector related laws and regulations. These policies, however, were changed arbitrarily on several occasions, leaving forest development and management at times without the benefit of a coherent and regularized policy. Thus, in spite of the early enactment of the first forest law in 1923, the forests of Jordan have been subjected to excessive and uncontrolled use, causing deterioration of government forests, and the concomitant disappearance of most of the private forests.

Although some positive changes have occurred in forest policy since 1960, the pattern of land use in Jordan remains one of a steady and continuous degradation, particularly of the forest cover. The principal agents of this degradation have been the repeated cultivation of every patch of soil and the uncontrolled cutting and uprooting of all woody growth, trees and shrubs for fuel and other domestic purposes. In addition, the forest areas were subjected to excessive and unregulated grazing of every accessible patch of land by goats, sheep and camels, with little regard for the carrying capacity, or resource maintenance and improvement. This misuse is still occurring, perhaps even at an accelerated rate and the soil quality is rapidly and progressively deteriorating.

From a fiscal point of view, forestry in Jordan is a subsidized entity which can barely provide a net return to the government. Although their productive potential may be relatively limited, the forests of Jordan are an extremely important part of the national patrimony contributing in essential ways to the overall well-being of the Jordanian society. Of all the benefits and services, the forestry subsector provides, those benefits and services pertaining to the socio-economic conditions, including employment, revenue generation for government, and forest products trade, are more easily quantifiable. However, since Jordan's forests are utilized primarily for their environmental and social values, obtaining direct financial benefits from the

subsector is not a priority of the government. Therefore, cost benefit concepts are not rigorously applied in considering the financial return. While perhaps difficult to quantify, the forests of Jordan do contribute directly and tangibly to both environmental stability and the socio-economic conditions of the country. These include:

1. Contribution to the hydrological regime through the maintenance of watershed stability, ground water recharge and stream flow.

2. Protection of soils, particularly in sloping and sandy areas, against wind and water erosion and nutrient loss.

3. Climate amelioration through micro-climatic impacts on temperature, humidity, shade and windspeed for both agricultural purposes and for human settlements.

4. Habitat for the conservation and protection of important genetic resources of national flora and fauna.

5. Protection for critical areas such as the margins of water courses or bodies, and irrigation and transportation infrastructure.

Although the likelihood is that financial returns are frequently underestimated, Jordan's financial returns from forests, including timber, charcoal fuelwood, license fees and fines are estimated at a range of between 150,000 to 200,000 Jordanian Dinars annually. The estimated revenue, therefore, is not entirely inconsequential since it covers 5 to 10 percent of government expenditures in the subsector. In addition, there would appear to be other opportunities for generating sustainable revenue, for example, by selling seedlings at production cost as well as other products such as seed, grass, medicinal plants and fruits.

The forestry subsector provides about 1,000 permanent and 10,000 seasonal job opportunities in the administration, management and protection of forests, as well as in plantation and seedling protection activities.

B. Objectives, Strategies and Policy Development

Notwithstanding the less pervasive economic value of forestry, the need to harness its unrealized potential and create a sustainable base for this subsector is of the utmost importance. Motivating Jordanians to intensify their participation, maintenance and expansion of this important but highly limited entity should be a foremost sector priority.

As the farming community becomes more aware of the role of forests and trees on agricultural productivity, real progress can be made in improving watershed management, controlling soil erosion and maintaining soil fertility; thus enhancing the stability of the environment on which sustainable food production depends. The rest of the population must

continue to be made aware of the influence of forests and trees for ameliorating the harsh and extreme climatic conditions (at both the macro and micro levels) as well as the need for providing shelter, amenities and recreational opportunities. Also, urban planners and developers must be further encouraged regarding the need for the establishment of parks and recreational and wildlife areas such as exist in Amman, Aqaba and Irbid.

Embracing this emerging realization of the fundamental importance of the service and protection functions of forests and trees to environmental protection, agricultural productivity, and social well being constitutes one of the basic rationales for revitalizing the forestry subsector and allowing it to take its rightful place as part of the national development strategy. It would also provide the impetus for increasing the new relatively modest area of man-made forests (34,000 ha) so as to ensure that future generations of an increasingly urbanized population would be able to find respite from life in a harsh, arid environment.

In his speech to the Comprehensive Development Conference in 1988, His Majesty, King Hussein drew the attention of all Jordanians to several aspects of the forestry sector fundamental to the long-term development of the country.

Some of the most relevant of these aspects to consider for the forestry Subsector are:

1. The limitation of the natural resource base which highlights the importance of the human element and its impact on them.

2. The national objective of transforming the countryside, wherever and whenever feasible, so as to move towards the creation of a "Green Jordan."

3. The need to utilize the eagerness of the citizenry to play a role in protecting and nurturing the natural resource base.

Despite the emerging concerns regarding the importance of forests and the efforts expended over recent decades on forestry in Jordan, the growth of the susbsector remains stifled. Although present policies contain important elements, the strategies and the activities applied to achieve these policy objectives are not sufficiently stable to produce the desired result. In addition, a series of parallel activities and their impacts have adversely affected forests in Jordan; these include:

- The allowance of uncontrolled grazing within the forests.
- Permission for forest cutting to construct roads.
- Planting other agricultural crops on forest lands, and
- Plowing the marginal areas.

As a result, many of these activities emerged over the years as forms of constraints that left the subsector's contribution and growth potential stalled in Jordan. The subsector has been also plagued by the lack of institutional capabilities and budgetary constraints as well as by the

shortage of trained personnel and the insufficiency of baseline data. These circumstances have hampered efforts to support cost effective forestry planning and implementable programs in revegetation and forestry management practices.

Policy Objectives and Strategies

There is now a greater realization that apart from the removal of constraints, the opportunity for a more viable forestry subsector in Jordan must significantly hinge on creative and well thought out policy objectives. These policies must contribute to achieving the maximum sustainable productivity of the renewable natural resource base. Within the context of forestry development in Jordan, the following are the major policy objectives:

A. Increasing the area under forest cover.

Options available for achieving this policy objective should be based on the following strategies:

1. Definition of forestry resources: Clarifying what constitutes forest resources, and more precise information related to vegetation type, area coverage, special features and legal status of the land, would be useful in understanding the exact coverage of forestry resources in Jordan.

2. Solution of the unoccupied land situation and acquisition of potential forest land: There is much confusion about the issue of unsettled lands, particularly in the south where much of the area should be designated as forest land because of the site limitations which restrict its land-use to forestry.

3. Consolidation of forest land: Refers to the formation of contiguous forest units by legal means. Contiguous units of forests are areas where private land holdings inhibit the practice of forestry management. There is presently legal precedent for trading privately held land found within high potential forest areas for other lands held by the government in areas of agricultural potential.

4. Expansion of forest cover: Expansion of the area covered by forests is a controversial issue, especially in forest areas adjacent to grazing grounds. Opportunities for the expansion of forest cover will be dependent on parallel activities aimed at acquiring unsettled lands, for resolving land-use prescriptions on other areas in general and on the capability of the government forestry institutions to carry out such activities.

5. Established principles restricting conversion of forest lands: Under Jordanian conditions, any attempt to raise the stability and productivity of a given forested site must be carefully considered. Any such conversion must be carried out under strict guidelines which ensure that the protective functions of the site are safeguarded. For example, the tendency to convert private forest lands into fruit orchards should only be allowed if the

owners are prepared to establish suitable soil and water conservation measures that will guarantee that the watershed function previously served by the trees is maintained. Establishing a clear guideline for conversion of forest land as well as revising and updating the present legislation governing all aspects of forest area management will be necessary.

B. Improving the Management of Existing Forest Areas:

Promoting the expansion of the forest area should be complemented by high level policies aimed at achieving long-term sustained yield management. In Jordan, sustained yield management must clearly take into consideration both the production and protection capabilities of the forest and formulate strategies that are focused on improving the management of the forests which would, in turn, enhance their contribution to development.

1. Forestry as an important land-use option: Must be viewed and acted upon as a viable management option in the overall land-use matrix of the country. Jordan has a great variety of forest resources with different conditions, sites and in different development stages. To achieve a maximum sustainable productivity, it will be necessary to take a much more aggressive approach to forest management throughout the country. With much of the basic "know-how" being already available in the country, it will be necessary to combine these experiences, prepare prescriptions for different conditions, legalize them, and finally apply them in managing the forest resources throughout the country.

2. Protection strategies for forest resources: Protection of forest resources involves the creation of conditions that assure the natural development and sustained yield management of specific forest areas. It also involves much more than the mere physical protection against damage, as it requires the safeguarding of the forest resources on the basis of a commonly understood social contract, whether by those living adjacent to the forest or by other members of the society using them less frequently. Without an affirmative action program aimed at protecting the existing forest resources, it will be difficult, if not impossible, to achieve sector policy objectives.

3. Extending the knowledge of forest resources: Development of the subsector must rely on a sound scientific base, including the identification of research needs and prioritized research plans.

C. Improving National Capability for Forestry Development:

Widening the spectrum of public and popular understanding of and support for forestry would be enhanced by the following strategies:

1. Establishment of forest management capabilities: Foresters should be more than custodians, as management responsibilities would include seeing that all the necessary

forestry management activities be implemented, including the legislative framework, and the responsible public administration entity as well as the specialized staff and a regular budget.

2. Institutional coordination among relevant parties: Concentrated actions, undertaken to maximize impact and avoid needless duplication of efforts or institutional confrontations should be part of such a strategy:

(a) Identify the institutions involved in environmental issues.

(b) Elaborate on internal strategies and agreements to avoid overlaps between the institutions.

(c) Develop a mechanism to communicate and cooperate between institutions.

3. Public awareness and involvement in forest and environmental issues: The best environmental strategy is the one that seeks to intensify national awareness and environmental involvement beginning within the educational system. Consequently, teaching curricula from the primary through secondary schools should be reviewed to include environmental sensibilization and engagement.

4. Direct public involvement and funding: Given the problems and goals for the management of the forestry and natural resources in Jordan, it is unlikely that government funding and programs through its regular budget will be adequate to reach the level of impact necessary. Therefore, non-governmental organizations, government public relations services and local politicians have to become involved. For such an approach to expand and flourish, a chain of steps must be followed:

(a) Design and establishment of the legal basis for recognition of non-governmental and/or private voluntary organizations (NGOs and PVOs), including the nature of cooperation anticipated between the public and private sectors;

(b) Identification and promotion of interested responsible institutions to participate in these activities;

(c) Fund raising; and

(d) Coordinating operations of such private sector organizations with their public sector counterparts.

Even with the enactment of the first forest law in 1923 (one year after the Emirate of Jordan was established), the forests of Jordan have still been under excessive and uncontrolled use. Enforcement of the law was apparently not effective, mostly due to the absence of a proper organization of the various types of forest areas. Notwithstanding the successive drafts of forest

policy statements in 1955, 1963 and 1967, the history of land use in Jordan continued to reflect a steady and continuous destruction of many forms of plant life, particularly the forest cover. As stated previously, these problems are still escalating, as the soils of Jordan continue to rapidly and progressively disappear or deteriorate beyond hope of recovery.

Although present policy reflected in the forest legislation provides the basis for the protection of forest land and trees, there is no well defined and officially announced or adopted forest policy in Jordan. However, since the forests of Jordan remain highly subsidized, (net revenue comprises about 10 percent of the government expenditures) and will most likely play only a modest role in meeting society's basic needs for wood products, policies governing their direct and tangible contribution to the environmental stability and socio-economic well-being should be of primary importance.

Therefore, it behooves Jordan to develop a comprehensive forest policy statement to circumvent the steady loss of forest lands and uncontrolled grazing in forest areas. Consideration should be given also to the extension of forest cover, improvement of forest productivity, development of forestry institutions and their public administration, as well as the need for revenue generating activities and general forestry education. Based on a well thought out and comprehensive policy, the GOJ should create legislation suitable for the administration and management of forestry resources. It should include a budgetary provision to meet actual requirements which would provide for the development of a well trained staff and the background support work on forestry research in Jordan.

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