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DESERT LAND UTILIZATION

ADVANCE TEAM REPORT

Prepared for

USAID/Jordan

by

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DESERT LAND UTILIZATION ADVANCE TEAM REPORT

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EXECUTIVE SUMMARY

The Government of Jordan (GOJ) has given a high priority to developing a plan for utilizing the desert areas of Eastern Jordan for agriculture to enhance the economic return from the largely unpopulated region. AID has indicated a willingness to provide the GOJ with a prefeasibility study that will assess the agricultural potential of these desert lands.

To facilitate the functions of the prefeasibility team the contractor, the Office of International Cooperation and Development of the U.S. Department of Agriculture (USDA) has organized and sent to Jordan an Advance Team for the purpose of gathering information, defining the scopes of work and working out the logistical arrangements for the prefeasibility team. This report summarizes the activities of the Advance Team which was composed of Martin M. Fogel, Hydrologist from the University of Arizona, Donald W. Gohmert, Soil Conservationist with the Soil Conservation Service of the USDA and Steven H. Sharrow, Range Management Scientist from Oregon State University.

The Advance Team worked with the Jordanian National Planning Council and with counterparts from the Ministry of Agriculture and the National Water Authority. The counterparts and the team made several field visits to range nurseries, range protected areas, dam sites, and irrigated areas in the desert lands. Range sites included those in the vicinity of Mafraq, Shoubak, Tafila and Karak while the irrigated areas included Azraq, Jafr and Disi.

In addition to field visits, the team reviewed related studies including the Park report of 1955, the National Water Master Plan of 1977, the Zarqa Project report of 1981, the Child - Saunier report of 1984 and the Post report of 1984.

The field visits and discussions with counterparts and others brought out some critical issues that the GOJ will have to face prior to implementing plans for developing desert lands. For one, much of the desert lands with less than 150 mm of total annual precipitation, perhaps as much as 70 percent of the total land area of Jordan, have little or no development potential. The exception to this are those limited areas where water is available either from underground or surface sources. Major sources of groundwater appear to exist in the Azraq and Jafr areas while known techniques such as water harvesting and water spreading can be used to a limited extent to enhance forage production and supply water for livestock. The remainder of the land, that with an annual rainfall below 150 mm, will be extremely difficult to improve.

Another issue confronting the GOJ is the lack of trained personnel at all levels in the field of range management. The Advance Team was able to locate only one such individual with a technical knowledge of range management.

Other issues facing the GOJ include the current land tenure and water rights situation. It is the team's understanding that much of the rangeland in the 150 to 250 mm zone has been plowed and converted to intermittent cereal production as a means by which individuals may establish a laim to crown lands.

The Advance Team identified six areas that should be studied in further detail to establish the potential for agricultural development in the rainfed areas. These are called Desert Land Utilization Areas and consist of four areas where there is apparent potential for rangeland improvement and two areas where groundwater may be utilized for irrigation of crops and forages.

The Advance Team recommends that the Prefeasibility Team be organized with two field groups and one core group to provide support to the field groups and to complete the analysis required by the study. It is suggested that the field groups be selected from U.S. Soil Conservation Service personnel and include a soil scientist, a range conservationist, and an agricultural engineer. At the least, the core group should include an agronomist, a social scientist, a hydrologist, an agricultural economist, a plant materials specialist, a range management scientist, a training and information specialist and an overall team leader to coordinate and facilitate team member activities.

The Prefeasibility Team should begin their study no later than early March, 1986. This is the best time of year for the field groups to complete their resource inventories of the six desert land utilization areas identified by the Advance Team.

DESERT LAND UTILIZATION ADVANCED TEAM REPORT

INTRODUCTION

The Government of Jordan (GOJ) has placed a high priority on developing a master plan for the utilization for agriculture of desert areas of eastern Jordan to enhance the economic return from this largely unpopulated region. The 1986-1990 Five-Year plan states that both crop and livestock production will be increased. Livestock, a commodity that Jordan previously produced in sufficient quantity to meet its needs now requires importation of up to 50 percent of current demands. Similarly, the total production of wheat in Jordan is considerably less than what it consumes.

The United States Agency for International Development (USAID) has indicated a willingness to provide short-term technical assistance for the prefeasibility stage of the master plan development. This stage is expected to follow the recommendations given by this Advance Team (AT). Thus, the objectives of the Advance Team are:

(1) Gather information and documents relevant to the efforts of the Pre-Feasibility Study.

(2) Further define and/or refine scopes of work for each member of the Pre-Feasibility Team (PFT).

(3) Reconsider mix of expertise to be represented on PFT.

(4) Work out logistical arrangements for PFT.

PREVIOUS STUDIES OF JORDAN'S DESERT AREAS

One of the earliest, if not the first study relative to the improvement of Jordan's range areas, was the "Technical Report on Range Improvement, Development and Management for the Hashemite Kingdom of Jordan" dated November 1955. The material for this report was gathered over a 2 year period by the author, Barry C. Park, Range Manager, International Cooperative Administration (ICA). Essentially this report recommended a range program for Jordan and delineated certain areas for this development.

A four-year range improvement study was recently completed for the Al Hammad Catchment, a large area in northeastern Jordan and extending into three other Arab Countries, namely, Iraq, Saudi Arabia and Syria. This study, sponsored by ACSAD and the Arab Fund for Socioeconomic Development, evaluated the available physical resources and the socioeconomic conditions of the area. A report is available written in Arabic with English summaries. A copy of the report is available in the Ministry of Agriculture (MOA).

In 1984, at the request of the Jordanian National Planning Council, a USAID team visited the Kingdom for a three-week period in June and early July. A report, commonly known as the Child and Saunier Report, presented the team's finding which attempted to emphasize the implementation phase of a number of projects. The report is also useful in that it summarizes related project activities currently underway and, in addition to the Al Hammad project, mentions the following range-related projects:

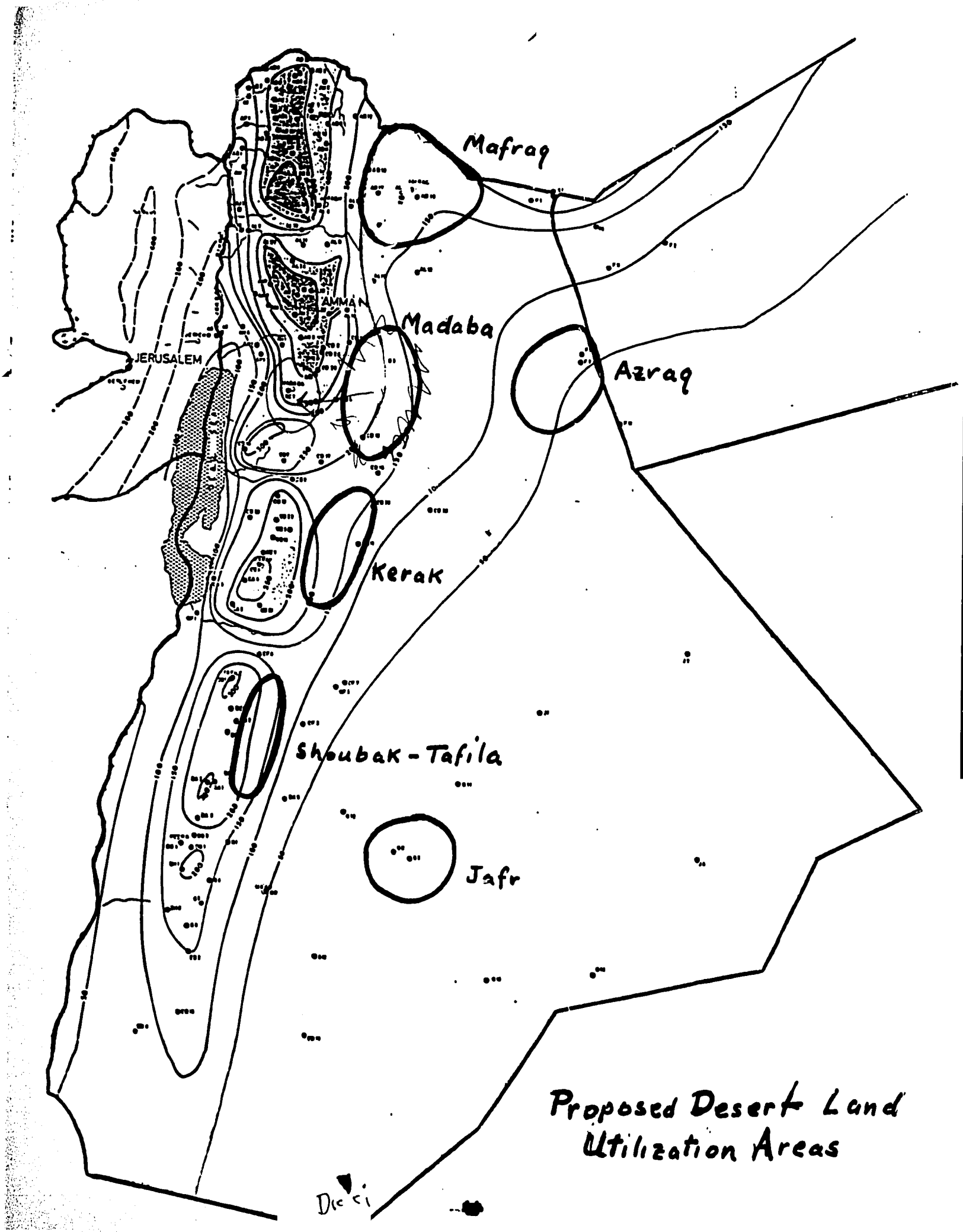
- The Zarqa Project being conducted by the Ministry of Agriculture (MOA) and the German Agency for Technical Cooperation (GTZ);

- The Highlands Development Project being undertaken by MOA, the World Food Program (WFP) and USAID;

- Lajjun Range Rahabilitation Project developed by a United Nations Environmental Program (UNEP) mission;

- Land Capability Study conducted by the Australians; and

- Forage Legume work being conducted by the Australians.


Mafraq
AMMAN
Madaba
JERUSALEM
Azraq
Kerak
Shoubak - Tafila
Jafr
Proposed Desert Land
Utilization Areas

CRITICAL ISSUES

Land and Water Resources

Desert lands in Jordan are generally considered to include those lands which receive 200 mm or less of total annual precipitation. Under this definition, approximately 8.5 million hectares or 91% of Jordan's total land area is classified as desert (Table 1). Although some desert land has been developed for irrigated agriculture, principally in the Jordan Valley area, livestock grazing remains the principal use of the desert area. It is important to recognize in considering the desert in Jordan that this definition is somewhat broad in that it includes several recognizable climatic zones which differ substantially in their current resource state, current agricultural use, and potential for enhanced productivity. In addition, delineation of resource zones in Jordan based upon long-term average annual precipitation can be misleading because rainfall varies tremendously from year to year with the number of below-average precipitation years exceeding those of above-average precipitation. Limitation of "desert development" to areas below 200 mm of annual precipitation presents a problem in this regard as crop production in the 200 mm to 300 mm precipitation zone is often dependent upon the occurrence of average to above average annual precipitation. In the 200-300 mm zone, cereal crop yields are so low that one year in two the crop is sold for forage without harvesting grain from it (Harvey, 1984). Although land in the 200-300 mm zone is commonly classified as "rain-fed" agricultural land, it is functionally desert land in that a rain-fed crop can not be

Table 1

RAINFALL ZONES OF JORDAN

(from: Regional Study on Rainfed Agriculture and Agro-Climatic Inventory of Eleven Countries in the Near East Region. FAO. 1982)

Rainfall (mm)	Area (ha.)	Percent of Total Area
Less than 50	5,932,700	64.1
50 - 100	1,385,100	15.0
100 - 200	1,139,500	12.4 8±
200 - 300	394,800	4.3
300 - 400	178,800	1.9
400 - 500	125,300	1.3
500	98,900	1.0

< 150 mm Precipitation Zone

From a development standpoint, areas receiving less than 150 mm of precipitation may be considered to have a low potential for several reasons. First, the biological potential of the site for non-irrigated agriculture is severly limited by lack of moisture to support plant growth. Water harvesting, water spreading, etc may allow increased plant production on limited areas. However, the ratio of watershed/productive area would need to be high, somewhere in the range of 10-20/1 (i.e. 10-20 hectares of watershed runoff concentrated onto one hectare of desert forage). The cost of such a program would likely be exceedingly high per ton of forage produced in this manner. An exception to this problem may occur for small areas in wadi bottoms where water is concentrated naturally. The current vegetative cover of these lands is predominantly cool-season annual grasses and forbs. Relatively, little is known about the original natural vegetation of this zone, although Park (1955) speculates that some perennial grasses may have originally existed there. Experience in many areas of the world suggests that establishment of perennial forage vegetation is difficult if not impossible where annual precipitation is less than 150 mm. Establishment of native perennial vegetation on desert sites frequently relies upon long-lived "mother plants" which provide a continuous seed source. Actual establishment of young plants may only occur infrequently when growing conditions are abnormally good. Reproduction of large cactus species in the American Southwest, for example, may occur only once every 50-100 years. This reproductive strategy is difficult to imitate in range improvement projects.

Second, although the 150 mm precipitation zone is large in size, its low biological potential has resulted in relatively low density of use by humans and their livestock. This makes delivery of extension services and other inputs difficult logistically, especially in light of a general lack of roads and other infrastructure in the area.

150-250 mm Precipitation Zone

Sufficient experience exists within Jordan to suggests that shrubs such as Atriplex and Salsola may be successfully established within the 150-250 mm precipitation zone where soils are deep. Best success with shrubs has been achieved in areas where annual precipitation is approximately 200 mm or greater. Relatively little work has been done in establishing perennial grasses in this zone. The native vegetation probably consisted of shrubs and perennial bunchgrasses with an abundance of annual grasses and forbs in wet years. Presently, most of the areas having moderately deep to deep soils have been plowed for cereal production. Plowing has almost entirely destroyed the desert rangeland vegetation within much of this zone. Vegetation on unplowed rangeland is heavily utilized by livestock. This zone has the highest biological potential of the desert rangelands and probably produces more forage for livestock than the 150 mm precipitation zone which is larger in area.

From a development standpoint, the 150-250 mm precipitation zone is superior to the 150 mm precipitation zone in several ways. First, some plant materials and rangeland improvement technologies which are applicable to

Second, the higher rainfall and more sloping topography of this zone are more suitable for small-scale water management systems. And third, much of this land is near villages and towns with roads, government offices, and other useful elements of infrastructure.

It should be clearly recognized, however, that dryland development of desert lands is inherently risky and potential for improvement of land productivity, while substantial as a percent of current forage production, will not be dramatic when expressed in kg/ha. Rational desert rangeland development is a long-term process with returns on money invested often not realized until many years after improvements are put in place.

Desert land is often used as a seasonal forage resource with livestock spending a portion of the year grazing other areas. It is critical, therefore, that any attempt to develop the desert rangelands be coordinated with other agricultural development efforts such as the proposed Highlands Agricultural Development Project.

Human Resources

Rangeland development and management in Jordan is currently limited by lack of trained Jordanian Range Managers and Range Scientists. It is our understanding that Yarmouk University has plans to establish a range management curriculum in the future. Currently neither Yarmouk or Jordan University offer training in range management. Only one trained Range Manager is now employed by GOJ. Success of rangeland development projects will depend

planning and implementation. Since no cadre of range-trained Jordanian professionals exists at any level (technician, management, scientist, or educator) it is imperative that training of Jordanians in range management at all levels be given high priority by donors and by GOJ.

Cultural and Institutional Factors

It is our understanding that much of the rangeland in the 150-250 mm precipitation zone which has been converted to intermittant cereal production has been plowed both as an immediate economic enterprise and as a mechanism by which the farmer may potentially establish a claim to crown lands. This practice reduces livestock production by destroying some of the most productive range sites while probably not adding significantly to cereal grain production except in years of above average production.

ADVANCE TEAM PROCEDURES

Prior to arrival in Jordan, the team participated in a Team Planning Meeting (TPM) conducted by USDA/OICD. The purpose of the TPM was to build a common understanding of the objectives, tasks and expected outputs. It was also helpful for the team members to develop a comraderie relationship before arriving in country.

The first few days in country were spent meeting with various officials in AID, the Ministries of Planning and Agriculture, National Water Authority (NWA) and various members of the Country Development Strategy Statement (CDSS)

perceive desert land development in the rainfed areas of the country. The team also reviewed several pertinent reports such as the Childs, et al of June 1984, excerpts pertinent to the new five year plan and other information being used or generated by the CDSS team currently working in country.

As a strategy, the Advance Team worked collectively as a unit, rather than independently, throughout the two week period. After the initial interviews and discussions were completed, the team scheduled field trips to review what has been done or proposed and to identify areas with apparent potential for desert land development (see Appendix A).

POTENTIAL AREAS FOR DESERT LAND UTILIZATION

As commonly delineated in Jordan, desert lands are those areas that receive, on the average less than 200 mm annual rainfall. This team, however, suggests that this line of demarcation be increased to 250 mm as previously stated. It is generally recognized that the highest use of desert lands is for irrigated agriculture. However, since sufficient water is not available for either irrigated or rainfed agriculture for the vast majority of Jordan's desert lands, forage production for livestock represents the major focus of this study for those lands receiving less than 250 mm annual rainfall. On the other hand, where available water is known to exist these areas are delineated and general recommendations are made for their development.

Selection Criteria

Prior to selecting and prioritizing desert lands for development, evaluation criteria for their selection are presented as follows:

(1) Benefit-cost ratio to both the private sector and to the GOJ;

(2) Total estimated developmental cost;

(3) Compatibility of development with adjacent dryland crop and range potential; and

(4) Insofar as a particular site within development area is concerned,

Range Areas

Based on the above criteria, the Advance Team has selected four potential areas for consideration for range improvement. All the areas have one important aspect in common, i.e., the long-term average annual rainfall within the area varies from 150 to 250 mm. Also, much of each area is relatively free from rocks and stones and have soils that appear to have good infiltration and water-holding capacities, making them suitable for rangeland use. The following are the areas selected for prefeasibility rangeland development studies ranked from highest to lowest priority:

- Mafraq
- Shaubak - Tafila
- Karak
- Madaba

These areas are shown on the accompanying map.

The distribution of rainfall and the soils of the Mafraq area, as determined by a preliminary examination, appear to offer the greatest opportunity for the development of a successful range operation. The National Water Authority has selected 18 existing dam sites for further study, three of which are in the Mafraq area. This will provide hydrologic information useful in the design of water harvesting, water spreading and livestock watering systems.

namely, the sheep station near Shaubak and the Tawanna range station east of Tafila. Both stations were in the midst of plowed areas indicating a precipitation zone of around 200 mm annual precipitation.

The Karak and Madaba areas are also in the 150 - 250 mm rainfall zones. There appears little to choose between these two areas.

Irrigated Areas

The two main areas within the desert lands that apparently have groundwater available for development are the Azraq and Jafr areas. While there probably is not sufficient water in the Azraq area for large-scale irrigation development, the team felt that it may be possible to tap the shallow groundwater directly with deep-rooted forages. Located in low rainfall areas, grasses and shrubs may have to be established by irrigation until their roots extend to the capillary fringe of the groundwater. Such an operation would not be a heavy burden on the existing underground water. In fact, this operation may make better use of available water by having plants use water before it evaporates from the surface pools which are outcrops of the water table.

As for the Jafr area, the major limitation may be the amount of available water in underground storage and the annual rate of replenishment. Soils appear to be suitable for irrigation of fairly extensive desert lands.

PRE-FEASIBILITY STUDY TEAM

ORGANIZATION

The GOJ and USAID are particularly interested in assessing the potential for developing a more stable and productive agricultural economy on the rainfed areas. The Advance Team has initially identified four areas where the potential for rangeland development appears to be good. In addition, two areas that have potential for irrigation development have also been identified.

To more fully assess the potential and feasibility of developing these areas, more specific resource information is needed about each area. A general inventory of soils, vegetation and hydrologic characteristics of surface and ground water is needed. Cost-benefit analysis of alternative land uses is needed to compare dryland wheat farming to rangeland grazing and irrigation. To do this, input and productivity estimates are needed.

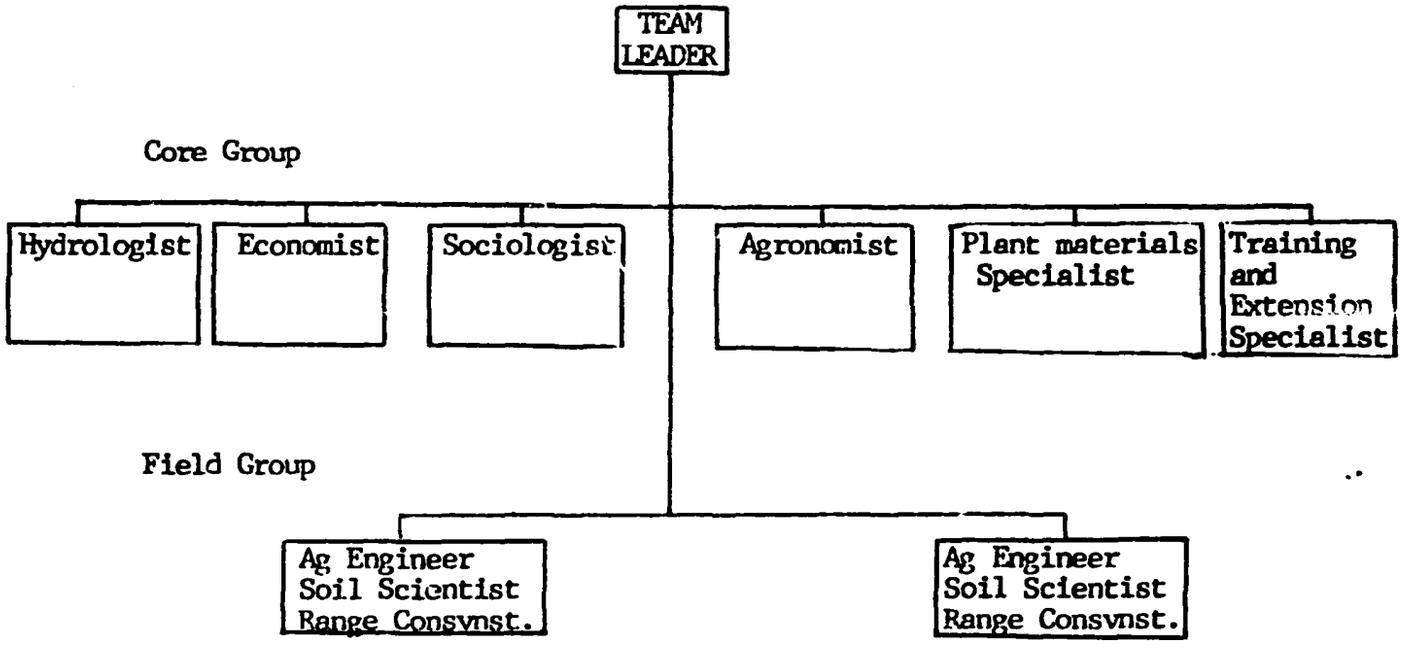
In addition, sociological and institutional constraints and cultural traditions will impact significantly on decisions to make broad land use decisions in some areas. The GOJ must fully be aware of the issues raised by these constraints and be prepared to deal with them early on.

All of these issues must be addressed to some degree in the prefeasibility study on each of the six areas. This necessitates that the

prefeasibility study team be multi-disciplinary in nature and be headed by a team leader with coordinator/facilitator responsibilities to keep the study progressing in an orderly and timely fashion.

The amount of time required to inventory and assess the resources in each area is considerable. Therefore the Advance Team developed an organizational scheme for the prefeasibility study team. The field work will be carried out by two seperate groups, each group having identical disciplines. One group would inventory the three areas in the north region and the other group would inventory the three areas in the south region. The core group individuals would be interfacing with the field groups and counterparts in the GOJ as necessary to complete their respective assessments and analyses.

The organizational concept of the pre-feasibility study team can be illustrated as follows:



It is expected that counterparts in variuos ministries and departments in the GOJ will be involved throughout this study. A list of potential counterparts is in the Appendix B.

PROPOSED SCOPE OF WORK

The objective of the Prefeasibility Team is to determine the agricultural potential the desert land utilization areas identified by the Advance Team.

The tasks necessary to achieve the objective are as follows:

Task 1 (Team Leader):

Provide administrative support for other team members by acting as a liaison between the team and USAID, and ministries with GOJ.

Task 2 (Team Leader):

Facilitate rapid start-up of team activities in Jordan by establishing contact with USAID, and GOJ personnel by collecting needed reference material, and by arranging for provision of logistical items such as office spare, computers, etc. This activity is expected to take place prior to arrival of the main body of the team.

Task 3 (Team leader):

Coordinate efforts of other team members in accomplishing their tasks and preparation of the final team report.

Task 4 (Team leader):

Be responsible for the final report of the team.

Task 5 (Sociologist/Anthropologist):

Describe current system of land tenure and water rights and evaluate their impact of proposed land use practices (PLUP).

Control of land and water resources is generally considered a prerequisite to effective land management. Water rights, as explained to the Advance Team by officials in the National Water Authority, appear to be relatively straight forward. Enforcement of laws relating to water rights are often lax, however. The degree to which current law's regarding ground or surface water use would facilitate or hamper PLUP should be studied. In contrast to water rights the system of ownership and of specific rights to use land is quite complex. Plowing of rangelands is commonly practiced. It's not clear how much of this land is government land and how much is private land. Presumably, much of this land is government land which is being converted to private use. The legal implications of this practice are unclear. In addition, traditional grazing rights to forage need to be clearly defined and their implications considered before PLUP involving establishment and management of forage plants are formulated.

Task 6 (Agricultural Economist):

Compare the costs/benefits of current land use practices to PLUP's

Proposed land use practices are most likely to be adopted by individuals within the private sector if they yield higher returns on invested capital or labor than do current practices since many Jordanian Agriculturalists are risk-adverse. Comparison of costs and returns of specific agricultural enterprises should include an assessment of relative risk. This is an especially important consideration in rain-fed livestock or crop production systems in areas which have extreme variability in yearly total precipitation. Much of the potentially productive desert rangeland in the 150mm to 250mm annual precipitation zone is currently used for rain-fed cereal production. Any proposed rangeland development in this zone will likely have to displace barley production as an economic enterprise.

Task 7 (Agricultural Economist)

1) Evaluate economic feasibility of proposed land use practices (PLUP)

Both the government of Jordan and potential participants from the Jordanian private sector will require information about the costs and benefits of proposed agricultural land use practices before a rational decision can be made concerning their economic merits. GOJ has emphasized the importance of participation of the private sector in future land use and development in Jordan. Therefore an economic analysis should include both an assessment of

statement for a "typical" economic enterprise employing each PLUP package. It is expected that some PLUP (i.e drilling wells, building water-spreading structures, etc) may be capital intensive potential sources and costs of capital should be identified. The ACC and JCO may be useful sources economic information. In addition, an assessment of the availability of venture capital within Jordan was completed by USAID in 1984 as a portion of the planning process for the Highland Agricultural Development Project.

Task 8 (Sociologist/Anthropologist):

Evaluate social soundness of PLUP's

Land use decisions often reflect factors other than purely economic considerations. The sociologist/Anthroplogist will identify these cultural factors and assist other team members to develop PLUP's which are most compatible with existing cultural norms.

Task 9. (Hydrolgist)

Evaluate availability of groundwater in desert lands and consider economic factors for their development.

The amount of water in storage the rate of replenishment and the current pumping conditions (amount and lifts) need to be determined to estimate availability of groundwater for irrigation, ivestock water or for any other

ublished numerous studies of

groundwater basins. Little information exists, however on aquifer replenishment. It is expected that these values will have to be estimated from limited data sources. Limited contact with the NWA has indicated that there at least two major groundwater basins that may have available water, namely, the Azraq and Jafr areas. Economic factors for development of these waters will have to be determined as a function of lift and distribution.

Considerable hydrologic information is available in the National Water Master Plan prepared by the Germans (GTZ, 1977).

Task 10 (Hydrologist)

Characterize spatial and temporal distribution of precipitation regimes in Jordan.

While sufficient information exists on the distribution of annual precipitation (National Water Master Plan of Jordan German Agency for Technical Cooperations Ltd. Frankfurt, July 1977), little analysis has been made on storm precipitation, its intensities, duration, amount, aerial extent and frequency. Such information is useful in designing measures for the control of water as well as for analysing and recommending specific land use practices. Daily precipitation records are published by the Water Resources Dept. of the National water Authority. For example, Technical Paper No 50, "Rainfall in Jordan" is for the water years 1976 to 1980.

Task 11 (Hydrologist)

Assess runoff potential of Jordan's desert lands.

Estimates have been made by the NWA on the availability of surface water for some type of development. It appears, however, these estimates have been based on limited information and, in addition, have not necessarily been site specific. Also, this information is mainly on an annual bases. Storm runoff is desirable for designing flood protection, water harvesting and water spreading systems as well as for crop and forage production systems. Some type of methodology, such as the U.S Soil Conservation Service method for estimating runoff from rainfall, will be required for this purpose.

Task 12 (Agronomist)

Propose appropriate crops and forages for both rainfed and irrigated agricultural areas and recommend management practices.

In as much as there exists in Jordan a potential conflict in land use, primarily on land where either cereal crops or forages can be grown, an economic evaluation will be required. This will necessitate the selection of appropriate crops or forages for a given area and recommended agronomic practices for their production. A similar requirement will be necessary for potentially irrigated areas. That is, where water is available in sufficient quantity and quality for irrigation, recommended crops and/or forages and practices and expected production will have to be estimated for economic consideration.

Task 13 (Agronomist)

Evaluate cropping systems that are currently being practiced in Jordan.

As a basis for comparing PLUP with existing systems, crops and management practices currently in operation by Jordanian farmers within the study areas will have to be determined. This will include all information necessary to make an economic evaluation of the existing cropping system including input (production costs) and yield estimates.

Tasks 14 - 16 (Field Team)

14. Inventory and evaluate soils, vegetation and hydrology on representative sample areas within the study areas.

15. Document current land use practices on each study area.

16. Identify land use and treatment practices required for development and management.

Reliable estimates of potential productivity of the desert land areas can only be made when the inherent properties of their soils are described and analyzed. A soil survey, using the U.S. S.C.S. Soils Handbook procedures, of representative sites within each area is needed to provide this information. Soil Scientists experienced in standard soil survey procedures in desert areas are needed.

Vegetation inventories also provide a basis for estimating the inherent ability of the soil to produce biomass under natural conditions. A vegetation inventory in each of the six areas will identify the species of plants and the frequency in which they occur naturally. The vegetation inventories should be done on the same representative sites as the soils survey and according to the U.S.SCS Range Handbook procedures. This will assure the correlation of the soils data to the vegetation data. Since no reliable data on vegetation by seral stage exists, it will not be possible to establish "range condition" for the representative sites within the areas. Range Conservationists experienced in sampling procedures and plant taxonomy in desert areas will be needed.

Surface hydrology is an important characteristic to assess on the representative sites. The amount of runoff, when it occurs and what happens downstream is important when considering soil or water conservation practices. Agricultural engineers are needed on the field teams to collect this information. They should be experienced the design and installation of conservation practices on desert lands.

A second part of the task will be for the field group to identify any current land treatment or use practices. This could include reservoirs for livestock water, wells, pipelines, shrub plantings and other related practices. Management practices, or the lack of them, should also be documented.

In completing the task, the field group will work with appropriate core group members to identify land use practices needed to develop the area to its potential. This list should include structural, vegetative and management practices.

Range seeding, fencing, water catchments, pipelines, water harvesting, water spreading, range deferment, proper grazing use and planned grazing systems could be the more common practices identified. Where range seeding is determined to be needed, the range conservationists and the plant materials specialist will identify perennial forbs, grasses and shrubs they feel are most suited to the sites within the respective study areas. All such plant materials should be available through commercial sources.

In the potential irrigated areas, the soil scientist and ag engineer will work with the agronomist to identify land use practices needed for developing irrigation systems for cropland, developing alternative cropping systems including forage crops, and irrigation water management practices. The need and feasibility of implementing other support practices as soil moisture monitoring, metering flow and monitoring groundwater levels should be considered as well.

The field teams will also be interfacing with the economist in order for him to complete his task.

Each field team will submit a report on in activities to the team leader prior to leaving the country.

Tasks 17 - 21 (Plant Materials Specialist)

17. Determine the need for a broad plant material program for the introduction, testing and propagation of new range forage species particularly grasses and forbs including data collection, storage and retrieval.

18. Analyze soils and range site information to determine what species may be adaptable.

19. Assess the on-site potential of making range seedings using such water harvesting techniques as water spreading, contour furrows and others soil moisture enhancing practices.

20. Evaluate the available equipment currently on hand and determine what is needed to begin range seedings using soil moisture enhancing cultural treatments.

21. Evaluate the physical plants and infrastructure of the MOA nurseries to determine the suitability and capability for propogating grasses for seed production for large scale plantings, plant testing and production and maintenance of foundation seed supplies.

Range Improvement of the rainfed areas will depend, in part, on the successful establishment of palatable shrubs, forbs, and grasses. The Range and Forestry Department in the Ministry of Agriculture is successfully propagating two saltbush species (A. nummularia and A. halamus) in its nurseries and transplanting them on various sites throughout the country. The gene pool from which the seed are collected is limited to parent stock found on the nursery at Wadia Duleil. Resulting problems noted at the plantings are variations in site adaptability and palatability. These problems are compounded by the fact that all range plantings are made plantation style

usually in rows running up and down the slopes. To date, no work has been attempted to collect and propogate grass or grass-like plants for range improvements.

To increase the productivity of the rangelands, a comprehensive plant materials effort is needed to find, import, test and propogate seed of adaptable perennial grasses forbs and shrubs.

Useful references for the plant materials specialist include the USDA-SCS National Plant Materials Handbook, the latest price lists from commercial seed nurseries, technical notes and technical reports from PMC's in Colorada, New Mexico, California and Arizona.

Task 22 (Range Training Specialist):

Assess the kind and number of range management-trained personnel required in Jordan and suggest a training scheme by which Jordanian may be trained to fill this need.

In contrast to most other sectors of the Jordanian economy, a severe shortage of personnel at all levels trained in modern range management technologies was identified by the advance team. In order for Jordan to adequately develop and manage its desert rangeland resources, training needs to occur throughout involved organizations. The team therefore proposed inclusion of a training specialist to develop an overall strategy for range management training that will cover these organization from top to bottom.

Among the activities that the training specialist will perform are the following:

1) Identify the types and levels of training in range management and related disciplines necessary to address the full range of tasks and issues required to implement desert land development and/or management in Jordan. Specify the tasks required of these personnel and the types of training necessary to equip them to perform these services.

2) Identify the extent to which personnel with specific, appropriate range management training already exist in Jordan.

3) Estimate the "gap" of trained personnel (1-2), and prioritize skills that need to be developed.

4) Specify the preferred mode of training necessary to develop required skills (i.e. formal, non formal or on-the job-training), time period required to accomplish training and location of training (in-country or overseas).

5) Identify in-country on overseas training institutions capable of providing required training.

6) Identify potential donors in funding training.

PROPOSED SCHEDULE FOR PREFEASIBILITY STUDY TEAM

To maximize the efficienty and effectiveness of the Prefeasibility Team, the Advance Team developed a schedule of estimated time in country for each team member. The tasks and functions of the team members are described in the Proposed Scope of Work. The schedule is illustrated as follows:

	WEEKS								
PERSONNEL	1	2	3	4	5	6	7	8	Total
Team Leader	x	x	x	x	x	x	x	x	8
Sociologist	x	x	x	x	x				5
Training Spec.	x	x	x	x					4
Plant Materials Spec.			x	x	x	x			4
Agronomist			x	x	x	x			4
Hydrologist			x	x	x	x			4
Ag Economist				x	x	x	x	x	5
Soil Scientists(2)		x	x	x	x	x	x		12
Range Conservationists (2)		x	x	x	x	x	x		12
Ag. Engineers(2)		x	x	x	x	x	x		12
TOTAL WEEKS									70

There are a total of 70 person weeks in this schedule. The team leader is the only member to be in country for the full eight week period. The team leader and the economist will assemble the final report and submit it prior to leaving the country.

The field group schedule was developed with one week of "start up" time on the front end, four weeks to complete the field work and one week to complete their final reports for submittal to the team leader.

It is desirable for the Prefeasibility Study Team to arrive in country in early March 1986. This will allow the field teams to do a better job of inventorying the soil, water and plant resources, because the winter rains will most likely have germinated the vegetation and softened the soil. It is also likely that surface flow regimes could be observed more readily during March and April than in other times of the year.

EXPECTED PRODUCTS

The prefeasibility team will be expected to complete its final report prior to departure from the Kingdom. The Team Leader with the assistance of the Ag. Economist, will have primary responsibility for drawing together the inputs of the various Team members and review their work to insure consistency and uniformity of methodology.

The final report is envisioned to consist of an Executive Summary synthesizing the Team's conclusions, recommendations, and a listing of areas, ranked on a priority basis for development; six sections containing region specific information gathered in each of the proposed areas; and a report on the need of a plant materials programs.

The six Area Report sections will each contain information collected by the field teams and synthesized by the resource persons of the core group. Each Area Report will include resource data collected, the proposed land use practices (PLUP) recommended by the Team for the area, an economic analysis of the PLUP and any social, legal, or cultural constraints unique to the area. To the degree possible, it is recommended that each area report be sufficiently detailed to be able to "stand alone" appropriate for use by the GOJ and/or interested donors as a basis for further study and subsequent funding.

The plant materials section will include a discussion on the availability of such materials, present plant testing infrastructure, the need for a

The final section would include information that can be generalized across the six areas, and be composed primarily of the individual reports of each core group member. This section may include, but is not be limited to, a methodology used for estimating economic potential, social and legal issues constraining a PLUP, institutional relationships and responsibilities necessary for implementation, nation wide infrastructure and training requirements, recommended management systems, etc.

APPENDIX

APPENDIX A: Site Visits

A five-day schedule of field visits was developed and followed. AID provided a vehicle and driver. Counterparts in the GOJ participated on two days. The schedule was as follows:

First Day: Mafraq-Irbid Area (ppt- 150mm - 250mm)

Counterparts from the MOA and the NWA were present. The team reviewed work being done on the range nursery in the Wadi Duleil area with saltbushes (A. Nummularia and A. Halamus). From there the group traveled to a dam site east of the nursery that is being used primarily to supply runoff for groundwater recharge. Plowed, non-irrigated lands were observed throughout the area. Landowners had apparently prepared the land for wheat in hopes of receiving rain. No apparent soil or water conservation practices are used on this plowed land.

From the nursery the group travelled to Mafrak and met with the Director of the Ministry of Agriculture's Mafraq Agriculture Center. Most of the land in the area was also plowed. No conservations practices were evident. The Director said that good wheat productions of 50 kg per dunum (1/10 hectare) occur only when rains are above normal, which is every fourth or fifth year.

An irrigated apple and vegetable farm was visited in the Umm Jmal area. It utilized a drip irrigation system, receiving its water from a well on the farm.

The Sabha Range Station was visited where the group saw range plantings of saltbushes. Some research using sheep grazing on the saltbush is being conducted as well. Utilization by the sheep was evident on many of the saltbushes. Survival of the saltbushes appear good. No work is being done on range grasses. Water and soil conservation practices were not used on the station.

The catchments at Yarmouk and Serhan were visited. No apparent use is now being made of either reservoir except for livestock water. The irrigation facilities at the Serhan dam have fallen into a severe state of disrepair. No other water harvesting or water conservation measures were observed on adjacent range and cropland.

To get a perspective on the relationship of the Highlands Area to rainfed lands, the group returned to Amman via Jerash and Suweleh.

Second Day: Al Azrak (ppt - 50 mm - 100 mm)

A counterpart from MOA accompanied the team on this day. Stops were made at the Shaumari Wildlife Refuge and several irrigated farms in the Azrak Area. Irrigation water appears to be shallow and of good quality. Irrigation practices and water management appeared to be poor even though drip systems are being used. The team felt there is a need for better hydrologic information. Much of this information probably exists in the NWA. The soils south and west of Azrak appeared to be of good quality, although salt accumulations were noted where water had evaporated from the surface. Any

development of irrigated lands should be considered in the area south of the Shaumari Wildlife Refuge. The wadi bottoms feeding this area from the west and south appear to have limited potential for some range improvement if surface water could be harvested and utilized more effectively.

The team returned to Amman by way of the Aqaba highway. Annual precipitation in this area is approximately 100 mm or less. Those areas where the desert pavement does not exist appear to have good soils. However, because of the limited precipitation, range improvement is considered risky even with water harvesting measures.

Third day: Madaba - Aqaba

There were no counterparts available on this day. Areas in the Madaba, Wadi Walla and Wadi Mujib region west to the Jordan Valley were looked at. The Madaba area has moderately steep slopes. Erosion on the plowed lands is evident, as no soil conservation practices are used. In the steep areas adjacent to the wadis, it appears that most relatively level areas are now being irrigated with water from the wadis or from wells. The Wadi Arraba area was reviewed mainly from the highway. It appears that while this area is in a relatively low rainfall zone, evidence of intense runoff exists. Soils vary from blowing sands to cobbles and boulders to small areas of loamy materials. For these and other reasons, development in this area does not appear very feasible at this time.

Fourth Day: Al Jafr - Disi - Wadi Rum (ppt 50 mm)

No counterparts were present on this day. The team visited Wadi Rum police station. There is a bedouin settlement under development at the station. Bedouins have moved into the area, and officials stated a school is being built there. The water supply comes from a nearby spring.

There is no evidence of cropland agriculture taking place. The soils appear to be deep sand with moderate potential for severe wind and water erosion.

In the Disi area, the team saw some irrigation development taking place. This is the same area that supplies water for the city of Aqaba. Interviews with a private developer in that area indicates that as much as 5000 hectares of land are planned for irrigated cropland using center-pivot systems.

The soil is basically a silt loam silty clay loam material which has been deposited in mud flats. This area appears to have the necessary components for development - good soil and water - but more detailed information is needed on both before definitive value judgements can be made. Also, serious problems can be created if irrigated lands are developed in the mud flats without consideration given to drainage needs and flood protection.

At Al Jafr, the Bedouin Settlement Project (sponsored by the Water Authority and the United Nations) was seen. This project was instituted as an effort to settle the bedouin in the area.

It appears that it was a project based on sound principles and resource information. Crops of alfalfa and vegetables that are being grown look good. However, the whole area appears to be in a downward trend. Wells have been abandoned. Irrigation delivery systems are collapsing out of neglect and poor maintenance. Some fields have been abandoned and windbreaks left to die for lack of water.

It appears that the potential of this area still exists. More effort is needed to establish the limits of the soil and water potentials needed to develop and expand the irrigated land.

The poor condition of this pilot project does not seem to be a function of a lack of funding, poor quality and quantity of soil or water or a lack of interest on part of the people who moved in and settled. It does appear to be strongly related to a lack of on-site technical assistance and educational extension provided to the people. It is probable that this same situation will continue to occur wherever future development is not supported by extension and on-site technical help for those individuals who must manage their own resources.

Fifth day: Shaubak - Karak Area (ppt 150 mm - 200 mm)

The range and dry cropland areas in the Shaubak-Karak areas were viewed. The director of the MOA's Agriculture Center was contacted. The team was taken on a tour of the nursery. Primarily the nursery is forestry-oriented, with some shrubs being propagated for limited range use.

A college of agricultural sciences is also located in Shaubak. No range science courses are being taught at the present time.

A climate station is also located at Shaubak. Climatological data is recorded on a daily or weekly basis and sent to the Meteoroligical Department in the NWA for historical documentation.

The range station, Tawanna, east of Shaubak was visited briefly. It is located on steep, rocky slopes in the 200 mm precipitation zone. Saltbush plantings have been made. The area is protected from grazing.

The sheep station north of Tafila was also visited. It contains 10,000 dunums of land and runs 400 head of sheep. Atriplex plantings have been made, but no soil or water conservation measures were used. Plantings were made up and down the slopes, and adapted grasses were not used.

Grazing use of these rangelands by sheep is not uniform. The atriplex areas are extremely overused while other areas on the station are used very little. The soils appear to be loamy in texture and moderately deep with little erosion, except in furrows of the saltbushes. The saltbushes which were planted here appear to be unpalatable to sheep. Sheep consumed almost all of grasses and forbs without eating much saltbush. Use of saltbushes was very nonuniform with a few bushes heavily browsed while the majority were ungrazed.

This area is in the 200 mm precipitation zone. The nearby areas outside

The potential for range improvement work appears relatively good. Water harvesting through the use of spreaders, terraces and contour levees would be needed. Water catchments would have potential for livestock water.

In the Karak area, the team met with the Director of the MOA Agriculture Center. He related what was said by the other Directors in that the MOA would like to convince the people in the area not to plow the lands with limited (less than 200 mm) rainfall.

A tour was made of the range station east of Karak. It was fenced in 1981 and about half of it was planted to atriplex. Soil erosion practices were generally not used. The area does show a "fence line" contrast to the grazed area outside the station.

The western part of the station is apparently in a higher precipitation zone than the eastern part. The vegetation in the eastern part is more sparse and drier than in the western part. Also, the lands around the western part of the station are being plowed, but further east they are not.

The soils appear to be loamy in texture and shallow to moderately deep with some natural fertility. Plowing is quite extensive on the gentle slopes to as far north as Al Simakiya.

The Jordanian Cooperative Organization (JCO) is working in the area north of the station in the drier eastern side to get the local people to plant atriplex. These plantings appear weak with only moderate survival.

The United Nations Environmental Program (UNEP) has proposed a project similar to the JCO, but still further east in the drier 100 mm precipitation zone. No plowing is being done in this area, so there appears to be little need to convince farmers that range is the proper land use.

With the field trips and interviews completed, the advance team then prepared an outline by which to develop a report. The findings, observations, and scope of work with recommendations were discussed with USAID officials and the counterparts in the Ministries and the NWA prior to finalizing the report.

APPENDIX B: Suggested Useful Contacts

Kamal Tadros, Head, Range Division, Forests and Soil Conservation Dept., Ministry of Agriculture.

Musa S. Nasir, Irrigation Engineer, National Water Authority.

M. Mahir Iskandar, Civil Engineer, Study and Water Research Dept., National Water Authority.

Munther Azer, Ministry of Planning.

Dr. Omar M. Joudeh, Director, Study and Water Research Dept., National Water Authority.

A. M. Hemnd, Geologist, Study and Water Research Dept., National Water Authority.

Walid Abed Rabbo, Evaluation Division, Ministry of Agriculture.

Mr. George Goddard, Livestock Advisor, Jordanian Cooperative Organization.

Dr. Mohamed Harb, Animal Scientist, Faculty of Agriculture, University of Jordan.

Mr. Ted Hendricksen, Zarqa Project, GTZ

Dr. Shatanawi, Irrigation Engineer, Faculty of Agriculture, University of Jordan.

Elias Baydoun, Ph.D., Assistant to the President, Yarmouk University, Irbid, Jordan, Phone: 71100-71115

Ghaleb Abu Arabi, Director General of Forest and Watershed Management, Amman.

Marwan M. Muwalla, Ph.D., Dept. of Biology, Yarmouk University.

Murad J. Bina, Ph.D., Director of Industrial Chemistry Department, Royal Scientific Society, Amman.

Ahmad Kilani, Consultant, National Water Authority, Amman. Phone: 666111/9.

Mohammad L. Kilani, President, Water Authority, Jordan Amman. Phone: 666111 - 666117.

APPENDIX C: Relevant References

List of References

for the

Prefeasibility Study Team

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6. Jordan Highlands Agricultural Development Project. Prepared for USAID/Jordan by Post et al, 1984.

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9. Jordanian National Planning Council Australian Development Assistance Bureau - Land Use Capability Planning Study - Jordan. March, 1983.

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15. Technical Report on Range Improvement, Development and Management for the Hashemite Kingdom of Jordan, Barry C. Park, Range Manager, I.C.A., November, 1955.

16. Additional References can be found in the Bibliography of A National Rangeland and Rainfed Watershed Program, by Childs et al, July 1984.

APPENDIX D: Materials and Equipment Needed

Materials & Equipment Needs

for the

Prefeasibility Study Team

1. Aerial photos and maps of the six study areas,

   Possible Sources: Ministry of Agriculture, Jordan

   National Geographic Center, Jordan

   U.S. AID, Washington, D.C.

2. Micro-computer and software for word processing and economic analysis.

   Possible Sources: U.S.AID Mission, Jordan

   Private Contractor, Jordan

   (Economic Analysis Software may have to be provided by the Economist)

3. Equipment for Field Team - Soils augers, shovels, pH kits, taxonomy guides, inventory sheets, color charts, etc.

   Possible Sources: Individual Team Members

   bring from the states

4. Vehicles and drivers for Field Teams.

   Possible Sources: U.S.AID Mission, Jordan

   Jordan MOA

5. References:

   Possible Sources: U.S.AID , Jordan

   U.S.AID, Washington, D.C.

6. Office space or work area for team headquarters,

Possible Source: U.S. AID Mission Headquarters

Motel

APPENDIX E

Natural Rangeland in Jordan

The natural rangeland in Jordan are these areas where the annual rainfall is less than 200 mm and comprise 91% of the total area of Jordan i.e. more than 85 million dunums.

The development of the rangeland depends on the following:

1. Protection methods: This is achieved by barbed wire and guarding. Consequently, this will protect rangeland from grazing, cutting and plowing and let plants grow and increase naturally.

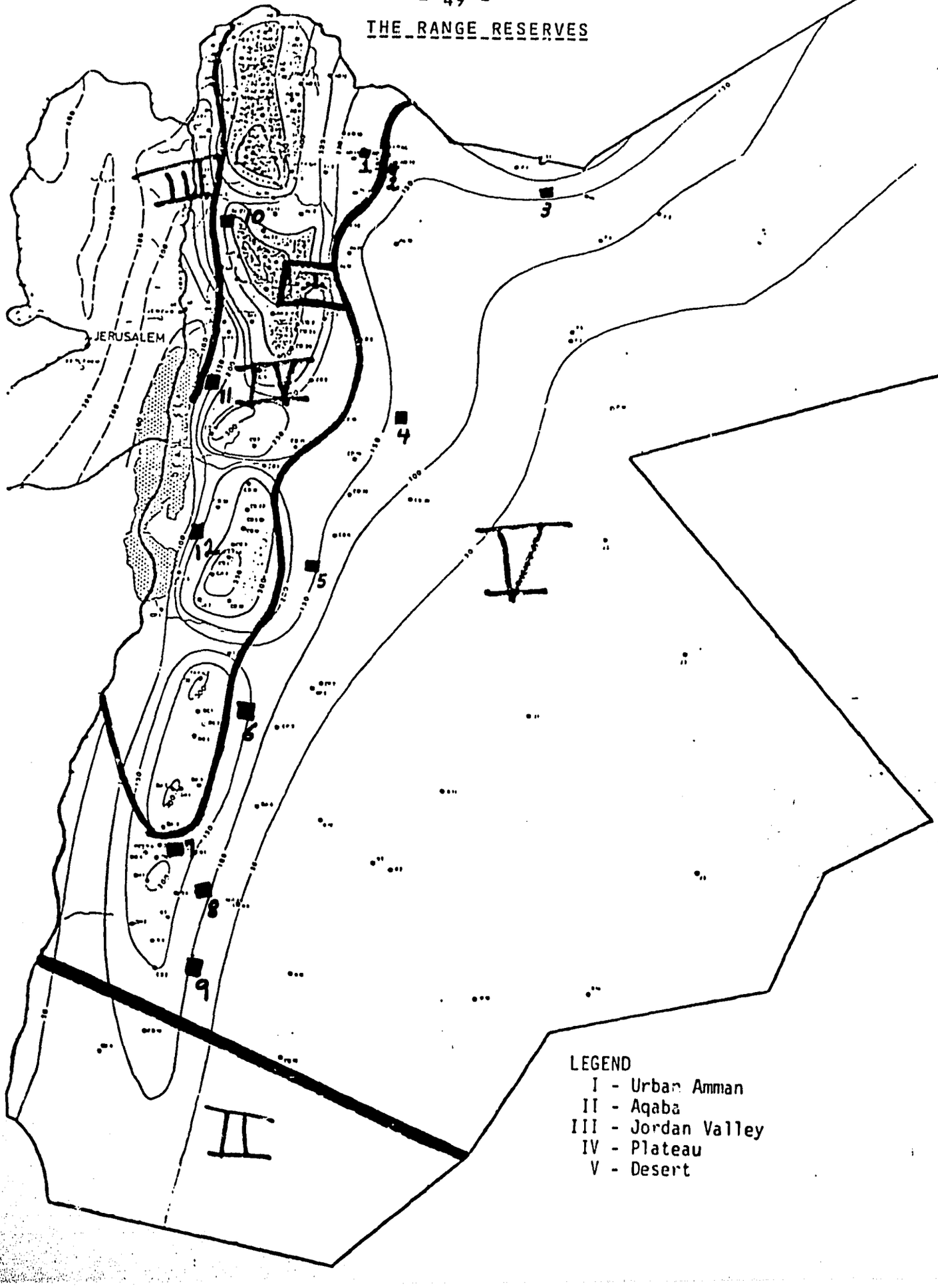
2. Improvement methods: This is achieved by:
   1. Soil conservation.
   2. Keeping water in furrows and stoney dams.
   3. Direct cultivation of seeds and trees to resist dryness.

3. Management of the Rangeland: This is achieved by utilization of rangeland through sheep depending on the grazing efficiency of each site to keep balance between the plant production and animal production. Khanaseri and Fujij rangeland stations are being utilized through sheep from the Ministry of Agriculture.

THE RANGE RESERVES

A number of range reserves have been established in different areas in the rangeland in Jordan to study the effect protection in the development of the natural rangeland , to keep water and to improve it by planting the suitable trees like atriplex and salsola. The range reserves are the following:

strict	No.	Name of Reserves	Year of Est.	Area/dunum	Average Rainfall (mm)	Notes
id	1	Khanaseri	1946	4545	250	Guided and fenced, it contains: 700 sheeps, rooms for the employees, and stable for the sheeps.
a	2	Surah	1946	3961	180-200	Guided and fenced, it contains: office and room for the guide.
	3	Sabha	1979	10539	150	Guided and Fenced
	4	Daba'a	1968	3000	120	Guided and fenced, with two rooms for the guide.
	5	Lajjun	1980	11,000	150	Guided and fenced, with two rooms for the guide.
la	6	Tawanneh	1981	20,000	150-180	Guided and fenced, and it contains two rooms under establishment.
an	7	Fujij	1958	10,000	200	Guided and fenced, it contains: 450 sheeps, rooms for the employees, and stable for sheeps.
an	8	Manshieh	1968	3000	150	Guided and fenced, and it contains two rooms under establishment.
an	9	A'ishieh	1981	10,000	100	Guided and fenced, and it contains three rooms.
e	12	Maein	1983	20,000	200	Fences will be finished in 1985 and two rooms under establishment.
	11	Adasieh	1983	20,000	200	Fences will be finished in 1985.
	10	Rajeb	1983	20,000	200	Fences will be finished in 1985.

urces: Range reserves in Jordan, unpublished report, Kamal Tadros, Range Division, Ministry of Agriculture

THE RANGE RESERVES