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DRAFT ENVIRONMENTAL REPORT
ON
JORDAN

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DEPARTMENT OF STATE
WASHINGTON, D.C.

AUGUST 1979

DRAFT ENVIRONMENTAL REPORT ON JORDAN

Table of contents

Prepared by Fred Bauman, Library of Congress

0.0 INTRODUCTION AND SUMMARY

Situated in the Middle East with its major areas of population and economy activity within a 50 kilometer-wide strip of land directly east of the Jordan River, the Hashemite Kingdom of Jordan is a country approximately the size of the state of Indiana with a present population of about 2.2 million that is growing at an annual rate that may be as high as 3.6% annually.*

A constitutional monarchy under which the King and his cabinet play the most important role, the modern state of Jordan has been subject to many shocks since its formation in 1950, perhaps the most severe of which was the loss of the some 6% of its territory lying west of the River Jordan in the 1967 Arab-Israeli War. As a consequence of this and other conflicts in the Middle East, Jordan has been flooded with refugees, chiefly Palestinians, who now comprise as much as half of the population and whose presence has considerably altered the nature of Jordanian society.

As a land, Jordan is poor in nature resources. By far the greatest part of its territory is desert. Only about nine percent of its land is cultivable, and forests cover less than one percent of the country. Water resources are few, and frequent periods of drought make agricultural production uncertain. Wildlife, once plentiful in the area, has been decimated by overhunting. Mineral resources, appear to be scanty, although phosphates now play an increasingly important role in the economy and the exploration and development of mineral resources have become the chief government development priority.

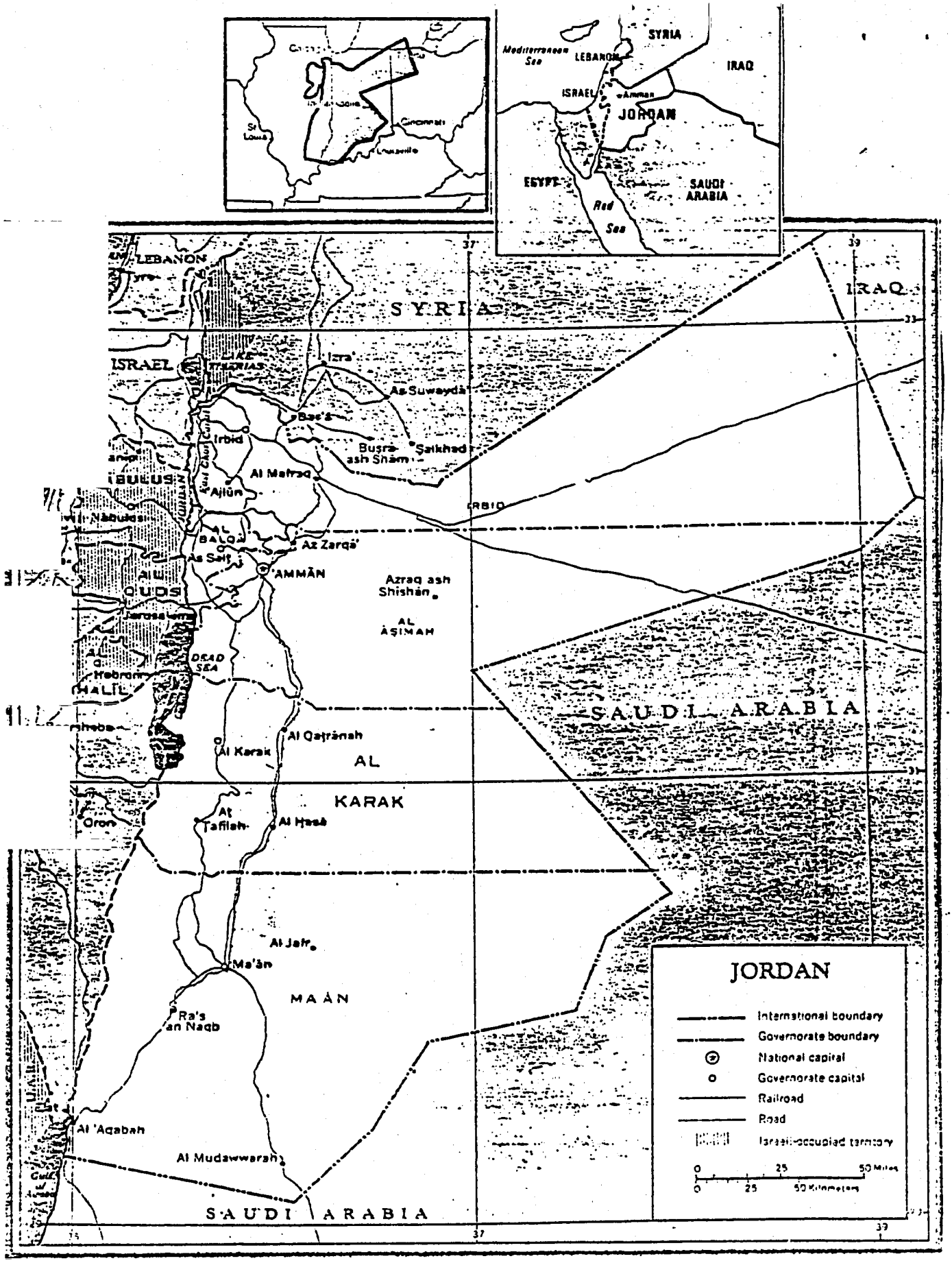
Jordan's environment and resource problems are numerous: lack of water resources; deterioration of agricultural land; deforestation. With regard to its human resources, the level of health is low, with malnutrition and illness affecting particularly children and women in the child-bearing years.

Jordan's major problem is insufficient water resources to meet both the domestic needs of its growing population and the demands of the farmer for irrigation water to produce the crops necessary to feed its people and produce crops for the export market. Large segments of the population do not receive adequate daily supplies of water, and much of the water used for domestic purposes is contaminated by human wastes. In the crowded urban area of Amman-Zarqa, pollution of water resources resulting from the heavy concentration of industry is also a problem.

Degradation of soil resources through erosion is also a problem, particularly in upland areas, where wheat, the nation's single most important crop is grown. Erosion resulting from overgrazing of goats and sheep, which strip the land of its protective vegetative cover, is also of serious concern. The use of modern machinery on land unsuited for deep ploughing has also contributed to erosion problems.

*These figures apply only to East Bank Jordan, that area of Jordan actually under the jurisdiction of the government in Amman.

Although extensive areas of upland Jordan were once covered by forest, most of this forest cover has been lost, much of it during the present century, as trees have been cut for firewood or lumber or to clear areas for cultivation. Overgrazing has also been an important contributor to deforestation, and the grazing habits of Jordan's numerous and ubiquitous goats have prevented the regeneration of forest land.


Mediterranean Sea
LEBANON
SYRIA
IRAQ
ISRAEL
Amman
JORDAN
EGYPT
SAUDI ARABIA
Red Sea
St Louis
Cincinnati
Louisville
LEBANON
SYRIA
IRAQ
ISRAEL
LAKE TIBERIAS
Irbid
Jarash
As Suwaydā'
Bae's
Buṣrā ash Shām
Salkhad
Al Mafraq
IRBID
Ajlūn
BULUS
Nābulus
AL BALQA'
Az Zarqā'
As Salt
'AMMĀN
Azraq ash Shīshān
AL 'AṢIMAH
AL QUDS
Jerusalem
DEAD SEA
Hebron
AL KHALIL
SAUDI ARABIA
Al Karak
Al Qaṭrānah
AL KARAK
Oron
At Tafilah
Al Hasā
Al Jafr
Ma'ān
MA'ĀN
Ra's an Naqb
Al 'Aqabah
Al Mudawwarah
SAUDI ARABIA
JORDAN
International boundary
Governorate boundary
National capital
Governorate capital
Railroad
Road
Israeli-occupied territory
0 25 50 Miles
0 25 50 Kilometers

1.0 POPULATION CHARACTERISTICS

Population statistics for Jordan are of questionable reliability. The gathering of accurate statistics has been severely hampered by the disruption which has been a prominent feature of Jordan since it gained independence in 1947, displacing civilian settlements and bringing thousands of refugees into the country. Although interim counts of population have been made since that time, the last official Jordanian census was conducted in 1961. Total population figures for Jordan generally include the West Bank, which has been under Israeli jurisdiction since the 1967 war. Population of the East Bank (the area actually under Jordanian control and consequently the major focus of this profile) doubled between 1961 and 1977, not only because of high rates of natural population growth (some estimates place it as high as 4.2%) but also because of the influx of Palestinian Arabs. Greatest increases in population were in Amman and Irbid (Arthur D. Little 1979:I:3-43).

An important factor in the consideration of Jordan's population is the large number of Jordanians living and working abroad, an estimated 22.6% of the population in 1975 (Birks and Sinclair 1979: 72).

1.1 General Population Statistics

Total population: 3.0 million*
- East Bank: 2,224,000 (National Basic Intelligence 1979:108).
- West Bank: 784,000.

Rate of natural increase: 3.3*

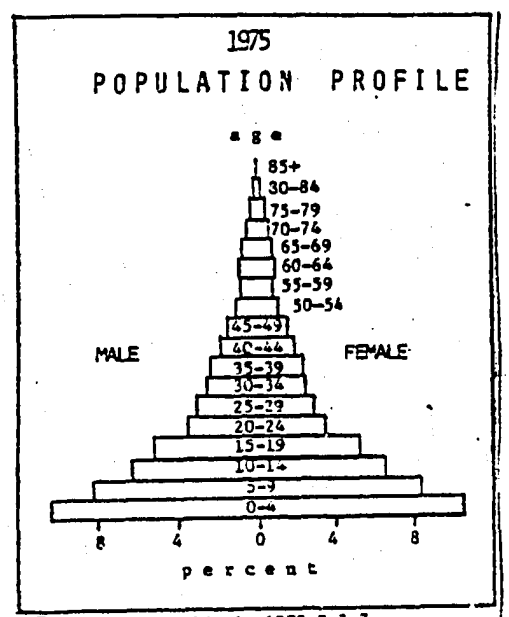
Amount of time to double population: 21 years*

Population in the year 2000: 5.8*

Population under 15: 47%*

Population over 64: 3%*

Urban population: 42%*



FROM:Arthur D. Little 1979:I,3-7.

*WPDS 1979

1.2 Population density (see map, page 2a)

The population of East Bank Jordan, as indicated by the map on page 2a, is concentrated in the governorates in the northern section of the country, with highest densities in the areas of Amman and Irbid.

1.3 Urban-Rural Population Distribution

According to the most recent estimate of the Population Reference Bureau (WPDS 1979), 42% of Jordan's population is in urban locations. The major concentrations of this urban population and the center of Jordan's population in general is the complex formed by the capital city of Amman and the nearby city of Zarqa. This area has experienced phenonemal growth within the past fifty years: in 1921 its population was around 5,000; by 1947 it was 30,000; by a 1975 estimate the population had swelled to 958,000, with an estimated 652,000 in the city of Amman itself. One reason for the growth of Amman is its attraction as an employment center for landless Palestinian refugees. In the North, the major urban population concentration is Irbid, with an estimated 1975 population of 128,000. Throughout the country urbanization has been dependent on the increase in water supplies made possible by more sophisticated technology; however, increasing burdens are placed on limited supplies as urban populations continue to expand; demand is already ahead of the ability of public water systems to supply safe piped water in Amman (Arthur D. Little 1979:1,3-41).

1.4 Ethnic characterstics of population

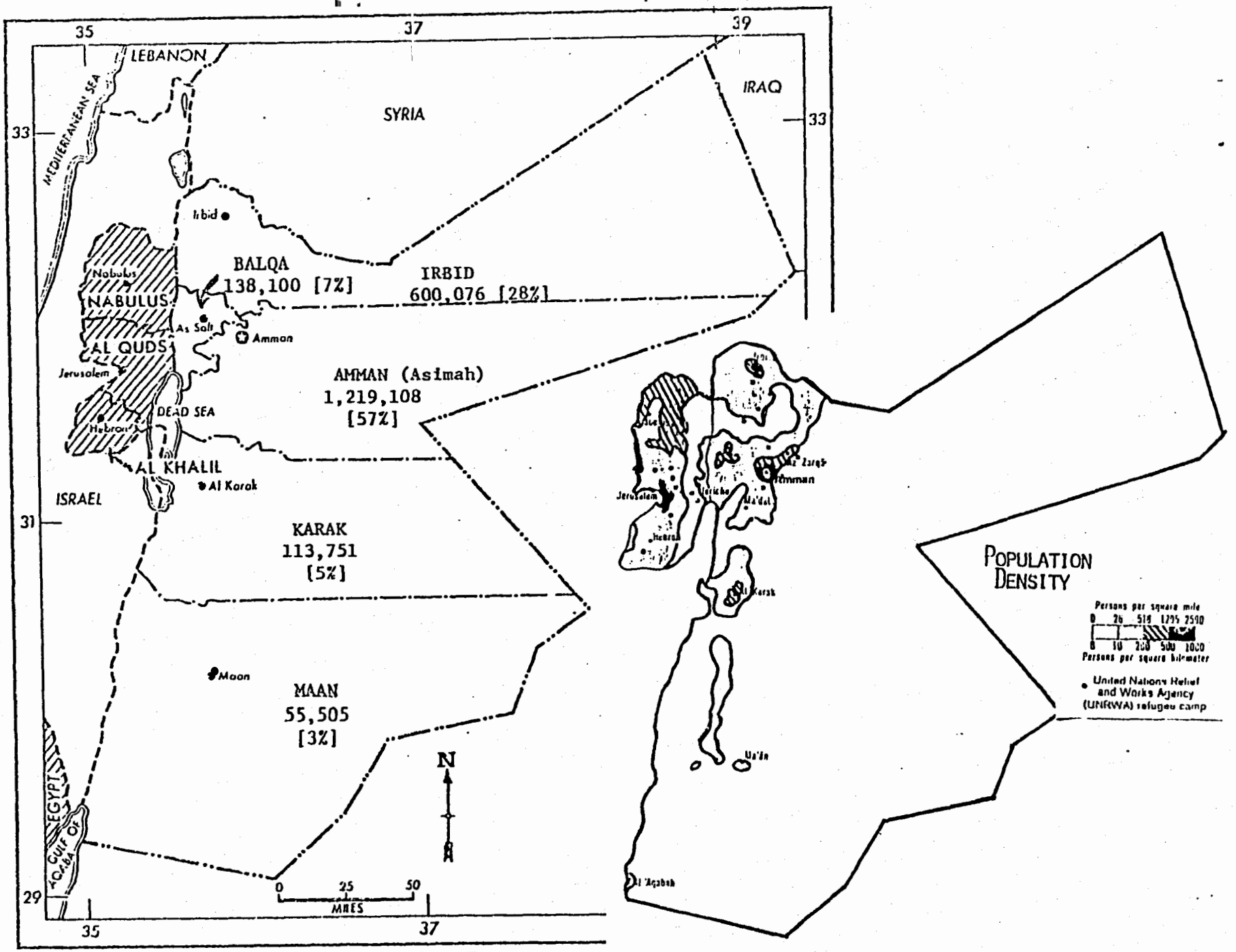
Jordan is a predominantly Arab Islamic society, with less than 10% of the population comprised of minority groups of Circassians, Armenians, and Kurds. However, there is an important distinction to be made between the Transjordanian and Bedouin populations constituting the "native Jordanians" and the Palestinian Arabs who, entering the country in large numbers since 1948, now constitute at least 50% of the population of the East Bank. Whereas the Palestinians, who now dominate much of the cultural and social life of Jordan, tend to be sedentary and urban, the Transjordanians are basically tribal and rural, the true Bedouin tribe being a fully nomadic group based on camel herding. Therefore, despite the unifying force of Islam, the very deep-lying distinctions between these two groups in Jordanian society makes national unity difficult to maintain (Nyrop 1974:2,78).

1.5 Educational characteristics of population

Literacy: about 50-55% in East Jordan
somewhat less than 60% in West Jordan

Educational system (see also 2.5.0)

Education is free and compulsory for the first nine grades of the educational ladder in Jordan, and is free for both general and vocational



EAST BANK POPULATION BY GOVERNORATE
[ ] Percent of 1977 East Bank Population
(Arthur D. Little 1979)

secondary education as well as for teacher training institutes and the Higher Institute of Agriculture (see 2.5.0). Textbooks are provided free of charge in elementary and preparatory (middle) schools, while a nominal charge is required for textbooks in secondary schools. While the Jordanian Ministry of Education pays the bill for education of its own people, the responsibility for the education of the numerous Palestinian refugees within Jordan has been assumed by the United Nations Relief and Works Agency for Palestinian Refugees (UNWRA) and UNESCO. In 1977 there were 192 UNWRA schools, and five UNRWA vocational training centers; these schools follow the same curriculum and use the same textbooks as do the schools under the Ministry of Education. (Jordan...Ministry of Information 1978:97-98).

SCHOOL ENROLLMENT: 1977 -East Bank (from Jordan...Ministry of Information 1978:97-98)

	no. of schools	no. of students	no. of teachers
Elementary	1,123	402,401	11,636
Preparatory(7-9)	959	124,982	6,023
Secondary(10-12)	273	60,718	2,492

Although the Jordanian educational system offers both academic and vocational programs to the secondary student, there has tended to be a very heavy concentration of students in academic programs, while vocational programs have not attracted enough students to meet the national demand for mid-level technicians and skilled workers. The graduates of academic programs have the worst unemployment rate of any educational group, while many Jordanian university graduates, finding little demand for their skills in their native country (scientific personnel, for example, are often too specialized to be of use to Jordanian industry), must seek employment abroad, especially in oil-rich Arab nations. The money sent home by such workers has had a significant effect on Jordan's foreign exchange position (Nyrop 1974:104).

University education (see 2.5.0)

Brain drain

Jordan has a long history of broader education, its modern educational system dating back to before World War I. Considerable investments in education have made the present Jordanian people an educational elite in the Near East region, where they serve as teachers, doctors, statisticians, bankers, and technocrats (Birks and Sinclair 1979: 75). Because large numbers of this educated population works abroad, Jordan is often said to suffer from a brain drain. Jordan is seen as investing large sums of money in providing education for people who then take their skills abroad where they can earn more money than at home. A survey taken in 1975 indicated that nearly 70% of

those Jordanian abroad in 1975 had a secondary school certificate or higher as opposed to only 8.4% of the domestic population as as recorded in 1976 (Birks and Sinclair 1979:76). However, it should also be noted that jobs for persons with higher education in Jordan are limited; many educated Jordanians have not gained their education at government expense but rather at their own expense or by attending free institutions in countries such as Kuwait, the U.A.E., Qatar, and Saudi Arabia; and Jordan receives considerable aid from those very Arab countries in which most of its educated foreign workers are employed (Birks and Sinclair 1979:76-77).

Perhaps more serious than the loss of educated Jordanians is the loss from the rural sector of workers who have gone either to urban areas or abroad, where wages are higher. In fact, it has been suggested that this manpower loss rather than weather conditions has been responsible for the decline in production in the agricultural sector over the past several years (Birks and Sinclair 1979:76).

1.6 HEALTH CHARACTERISTICS OF THE POPULATION

As is the case for many lesser developed nations, statistical information on health conditions for Jordan is of only limited reliability. The limited funding and the small staffs of the Ministry of Health and the Department of Statistics with responsibility for the development of health statistics virtually preclude the presentation of accurate statistics relating to mortality rate, death rate, and disease prevalence. The Ministry of Health maintains an information system for reportable diseases and mortality figures are also reported; large-scale underreporting is, however, prevalent throughout. The following figures, presented in Gallivan (1977:xi), have been adjusted to account for such underreporting.

general health statistics (Gallivan 1977)

crude death rate: 14.7 per 1,000 persons

infant mortality: 90-100 per 1,000 live births

maternal mortality: 13.5 per 1,000 obstetrical hospitalizations.

average life expectancy: 53 years

domestic water consumption per day per capita: 20-40 liters

1.6.1 Major Health Problems

Reportable diseases for 1975, in order of prevalence, were trachoma (resulting from excessive dust and lack of moisture in the environment), measles (there are no significant immunization programs), infectious hepatitis, typhoid fever, dysentery, malaria (dramatically reduced since the institution of an international eradication program in 1956),

staphylococcal meningitis, tuberculosis (about 500 new cases per year, primarily among semi-nomadic population groups), whooping cough, tetanus, and diphtheria. Inadequate immunization programs appear to account for occurrences of preventible diseaeses such as measles, whooping cough, poliomyeletis, tetanus, and diphtheria, while the high occurrences of infectious hepatitis, typhoid fever, and dysentery can be traced to water contamination and personal hygienic practices (Gallivan 1977: 26-28).

Among children under fifteen, who, together with women of reproductive age, comprise as much as 70% of the population, major health problems are: gastro-enteric and respiratory infections, preventible infectious diseases, and conditions associated with childbirth (Gallivan 1977:ix).

Despite a continuing improvement in the nutritional status of children it was recently learned from an examination of public hospital admissions that twenty percent of children admitted to hopsitals were actually suffering from malnutrition, attributed to factors such as early weaning to unhygienic cow's milk, prolonged breast feeding with little or no supplementation, lack of health and nutrition knowledge on the part of mothers, unsafe water sources, and poor sanitation facilities (Gallivan 1977:x).

1.6.2 Parasitic diseases

While incomplete reporting remains a problem for accurate assessment of the status of parasitic diseases, a recent study identified about 524 cases of Leishmaniasis, 259 of them in the East Jordan Valley, where studies have revealed that the disease has been hyperendemic for decades. Another parasitic disease which, like Leishmaniasis, is associated with chronic morbidity, is hydatid disease (Unilocular Echinococcosis), which in endemic areas is transmitted between dogs and sheep (Arthur D. Little 1979:1,3-26).

Although it is not now a health problem in Jordan, all of the factors necessary for the transmission of schistosomiasis are reported to be present in Jordan except for the presence of established colonies of vector snails. Temporary colonies of snails have been reported, however, and, moreover, a 1977 survey revealed that about 8% of the foreign workers (who are coming in increasing numbers to perform agricultural labor in Jordan) had urinary schistosomiasis. The Ministry of Health, aware of the potential problem, has taken measures by destroying temporary colonies of vector snails as they are identified (Arthur D. Little 1979:1,3-26).

1.6.3 Principal causes of death

Percentage Distribution of Age-Specific Causes of Death 1974

Cause of Death	less than 1	1-4	5-14	15 and over	All ages
Vascular diseases	4	7	17	44	23
Neoplastic diseases	N/A	1	7	10	5
Respiratory diesease	28	18	10	17	20
Enteritis & Diarrhea	36	26	7	N/A	16
Accidents & Injuries	1	9	25	12	9
Perinatal Causes	15	N/A	N/A	1	6
Malnutrition/Anemias	6	4	3	1	3
Other known causes	15	35	30	15	19
All Known Causes	100 (1733)*	100 (627)	100 (342)	100 (2333)	100 (5035)

1.6.4 Medical care

Population per physician: 1,803

Population per nurse: 3,203

Population per hospital bed: 599

Despite the preponderance of health and disease problems associated with underdevelopment and poor water supplies, Jordan's health care systems tend to be directed toward the disease patterns of developed countries, where a large number of Jordanan physians have received their medical training. Thus, rather than placing emphasis on preventive and curative efforts at an early point in the health care system, Jordan's health care program has tended to focus attention and money on hospital-level care of acute illness episodes (Gallivan 1977:ix).

As of December 1975 there were 35 hospitals in Jordan: 13 of these, accounting for about 49% of beds were operated by the civil government; 4, accounting for 32% of beds were operated by the military; 18, accounting for the remaining 19.5% of hospital beds, were privately operated (Gallivan 1977:44). Significant patterns in the distribution of hospital facilities are: concentration in urban locations; almost complete concentration of private and military facilities in the north; location of civil government facilities in Amman governorate in a proportion slightly in excess of the population; and an inadequate number of inpatient facilities in Irbid governorate.

In addition to services offered by hospitals, outpatient services are also available in clinic facilities. Including hospitals there were in 1975 a total of 565 locations offering outpatient care, the largest number of which (363) were clinics or health centers operated by civil governments. Most of these clinics are staffed only by male nurses with various decrees of training, with physicians

visiting once or twice a week (Gallivan 1977:46).

A certain amount of traditional medicine, aimed principally at the exorcism of evil spirits considered responsible for illness, continues to be practiced in Jordan (Gallivan 1977:43). Of particular importance among traditional practitioners, are the traditional midwives or dayah, who are estimated to attend about 62% of births in the country (Galliva 1977: 50).

There has also been a distinct lack of coordination in the provision of health care. In order to remedy this situation and make more efficient use of the diverse sources of health care, a Supreme Health Council has been established (see 2.1.3.9.1).

1.7 Water supply and sanitation

Water supply

Inadequate water supply and sanitation are major contributors to the gastro-enteric diseases which are responsible for many childhood deaths in Jordan as well as the high incidences at all age levels of diseases such as infectious heptaitis, typhoid, and dysentery. (Gallivan 1977: 32). A particularly striking example of Jordan's susceptibility to waterborne diseases occurred in January 1976, when approximately 4,300 persons in the Salt area were affected by an epidemic of bacillary dysentery (Gallivan 1977:34-35).

Water consumption in Jordan for 1975 was estimated at 421 million cubic meter and is expected to increase to approximately 555 MCM by 1980. Only about 10% of this use was accounted for by domestic consumption. Despite indications that there is an excess of water supplies of water demands (an estimated 51 MCM for 1975), severe shortages of water, especially domestic waters, were reported for 1975; these were traced to two major causes: operational problems in water supply systems and a geographical incongruence between available water sources and water users (Gallivan 1977:33). The situation is especially serious in Amman, where the water supply system has not been able to keep pace with a population that has increased seventeen-fold since 1948. Much of Amman's population must rely on water from tanker trucks, which are reported to be in greater number in Amman than in any other city in the world (Gallivan 1977:34).

A survey covering 747 communities but not including Amman recently established than only 1.5% have satisfactory (in quality and quantity) potable water supplies for 80% of their residents; 18% provide satisfactory supply to 50% to 79% of their residents, and 1% provide satisfactory supply to 1% to 50% of their residents. The remaining entities (more than 66% of the total) have no potable water supply systems at all.

Domestic water level consumption per capita per day has been estimated at from 40 to 60 liters per day for Amman; 10 liters per day for the Jordan Valley; and 20 liters for the rest of the country. This contrasts with 163 liters per day for Damascus, and an average of 35-90 per day for developing countries as a whole(Gallivan 1977:33). [U.S. consumption

Water quantity is therefore being increased without a corresponding increase in water quality (Sycrisis 1977:56).

Sanitation

Only Amman and Salt have water-borne excreta disposal systems. While the Amman system is new and its construction in stages make it open to continual expansion, the Salt system, which serves about 40% of the population, is antiquated. In Aqaba a primary treatment plant serves part of the newer urban areas. Engineering studies for the renovation of the Salt system have been completed, however, as have studies for new systems for Zarqa and Jerash (Gallivan 1977:35).

Amman's sewage collection system and activated sludge treatment plant is designed to handle 60,000 m3/day average flow (78,000m3 peak) and to serve 300,000 inhabitants. Effluent from the treatment plant is discharged to Seil Zarqa; the sludge is anaerobically digested, dewatered in drying beds and given to farmers for use as soil conditioner or fertilizer. Because of operation problems, the effluent process is only 80% efficient. (Arthur D. Little 1979:1:3-74). Data on wastewater quality for Amman indicate that sewage is characterized by levels of BOD and solids higher than typical U.S. averages, even for strong sewage. (Arthur D. Little:1:3-75).

Industrial wastewaters are usually dishcarged untreated into nearby streams or ponds or into septic tanks. No regulations cover such discharges (Arthur D. Little 1979:1:3-75).

Those buildings not connected to the Amman or Salt systems use sub-surface seepage pits or cess pools for water carried wastes. Wastes from such systems tend to percolate through to and contaminate the communities' water supply aquifers (see above under water quality).

Refuse disposal

Although most of the larger communities in Jordan have systems to collect, transport, and disposal of refuse, these systems are all underequipped and understaffed and all dispose of refuse in open-burning dumps. The systems present health hazards because of rodent and insect infestations and also lead to air and water pollution (Gallivan 1977:35).

The five year plan foresees a JD1,000,000 investment for the establishment in Amman of an integrated scheme for the collection, transport and disposal of garbage through more sanitary methods (Gallivan 1977:35).

1.8 POPULATION AND BIRTH CONTROL

Jordan has reported to the UN that it finds its birth rate acceptable. However, the government tolerates private family planning activity, and, while no policy favoring family planning has been a instituted, the 1976-1980 national economic plan cites a need for "the adoption of a clear policy regarding family planning which aims at raising the social, economic, and health conditions of citizens, and enabling all families to determine

the ideal number of their members within the framework of acquainting them with the implications and effects of population growht and with the possibilities and methods of family planning." (Gallivan 1977:19).

The only family planning organization is the:.

Family Planning Protection Association
P.O. Box 19999
Jerusalem.

It runs ten private family planning clinics. Family Planning International has given assistance for demographic studies and related projects; assistance has also been provided by the IPPF and the Pathfinder Fund.

2.0 ORGANIZATIONS WITH INTEREST IN ENVIRONMENT AND NATURAL RESOURCES

2.1 CENTRAL GOVERNMENT AGENCIES

Jordan is a constitutional monarchy, with executive power vested in the King who governs with the assistance of the Council of Ministers and legislative power vested in a bicameral National Assembly. There are eight administrative provinces, three of which have been under Israeli occupation since 1967.

2.1.1 Councils and interministerial bodies

2.1.1.1 National Planning Council (NPC)

Established in 1971, the NPC is the only Jordanian institution empowered by law to formulate social and economic development plans on the national level.

Its functions are: to formulate long-range national plans aimed at the development of Jordanian society in the economic, social, cultural, and manpower fields; to identify manpower needs of the country and assist Jordanians in meeting those needs; to set up a system to evaluate and monitor development programs; to establish centers or institutes for organization, legislation, planning, development, and research; and to serve as the link between all ministries and foreign financial sources--development projects require the prior approval of NPC, its Board of Directors, and the Cabinet.

Among the projects in which the Council is involved are: the Hitteya Aqaba Railway, the Hussein Thermal Power Station at Zarka, the Highland Irrigation Project (Abu-Assiussun Wehaideh, etc.), the Hofa-Za'tari Water Supply Project, and several road-building projects.

Composition: A Board of Directors composed of the Prime Minister as President; the President of the NPC, who also serves as vice president of the Board, has the rank of minister.

Operating budget for 1976(est): JD261,000/0.19% of total.

2.1.1.2 Jordanian Council for Human Environment Affairs

The Jordanian Council for Human Environment Affairs was established on July 24, 1973; it has established an environment secretariat with responsibility for implementing its resolutions (Johnson and Johnson 1977) No further information on the activities of this organization was available.

2.1.1.3 The Highest Committee for Public Safety

Set up on instructions from the King in September 1977, this is an interministerial committee charged with initiating, developing, organizing and directing activities for diesease control, public cleanliness, improvement of the environment, and water and food

control. The committee reportedly meets regularly to discuss and form national policy on environmental problems (Preparatory Committee ...1978a:42).

2.1.2 GOVERNMENT MINISTRIES

2.1.2.1 Ministry of Agriculture
Amman

Operating budget for 1976: JD2,494,500/1.8% of total budget

Subunits

Veterinary and Health Directorate
- -operating budget 1976: JD337,100/ 0.25% of total budget

Forestry and Soil Conservation Directorate
- -projects: afforestation projects, including acquisition of lands for afforestation
- -operating budget 1976: JD367,800/0.27% of total budget
  50,000 of which was for acquisition of land for afforestation

The Directorate is composed of four Divisions: the Division of Soil Conservation, the Division of Nurseries, the Division of Forestry, and the Division of Investment and Protection.

Directorate of Agriculture Production and Plant Protection
- -established in 1952 with the object of carrying out research in agriculture and extending agricultural information to farmers;
- -operating budget 1976: JD790,400/0.58% of total budget

- -individual projects have included the development of agriculture in the highlands, including olive planting (140,000), the running of the Al-Hussein Agriculture Station at Al-Karak (50,000), and Nursery Development (175,000);

Agricultural Research and Extension Directorate
- -operating budget for 1976: JD598,400/0.44% of total budget
  Agricultural Training Center (32,000?)

Under this Directorate are the Division of Agricultural Extension, the Division of Documentation, and the Division of Agricultural Research.

Division of Agricultural Research

Subsections of this Division deal with: plant protection; field crops; fruits; vegetables; soils, fertilizers and irrigation; and animal husbandry. Each subject-matter section has a head of section plus research officers and research assistants. As of 1972 the division had a total of 67 employees, 5 with Ph.D.'s, 14 with Masters of Science degrees in Agriculture, and 48 with

Bachelor of Science degrees in Agriculture (Aresvik 1976:229).

The Division operates experimental stations both in the Jordan Valley and the upland regions. As of 1976, there were a total of eight stations, with the major station in the Jordan Valley. Various stations concentrated on matters such as: subtropical irrigation agriculture; fish culture and fruit horticulture; sheep breeding; range management; temperature agriculture; and settlement schemes in the southern desert area (Aresvik 1976: 231). Stations on the whole were said to suffer from lack of field support workers and a high turnover in personnel at the administrative level. The work of the stations and the Division as a whole was hampered by the 1967 war, which forced the closing for three years of the stations at Deir Alla in the Jordan Valley (Aresvik 1976:232-235).

Division of Agricultural Extension

Agricultural extension personnel are based at the headquarters of the provincial governorates and report to the director of agriculture at the governorate headquarters. Subordinate personnel living within villages are responsible for matters such as the distribution of improved seeds and fertilizers and the collection of statistical data for the Ministry (Aresvik 1976:235).

Directorate of Livestock Production and Ranges
-estimated budget 1976: JD90,500/0.06% of total budget
-research in acclimatized dairy cattle

Directorate of Veterinary and Animal Health

The divisions of this directorate are: the Institute of Animal Health; the Division of Fisheries; and the Division of Veterinary Services.

2.1.2.2 Ministry of Transport
METEOROLOGY DEPARTMENT
Amman Civil Airport

Operating budget for 1976: JD231,000/0.17% of total budget

Deals with climatology and agrometeorology.

-it has published: Climatological Atlas of Jordan; Handbook of Climatological Data

-The Department is headed by a director general and includes an agrometerologist and a climatologist among its top-ranking employees. There are about 230 other employees, about 30 of which are scientists (Paylore 1977:96).

2.1.2.3 Ministry of Industry and Trade

Statistics Department

The Department's Demographic Section is responsible for censuses.

Projects include: a Socio-Economic Study of the Population, a Family Budget survey, the development of a Statistical Training Center.

Publications: the Department publishes an annual Statistical Yearbook in English and Arabic, which contains statistics relating to demography, agriculture, and economics.
Operating budget for 1976(est): JD193,500/0.14% of total budget

Electricity Authority

Directorate of Standards

2.1.2.4 Ministry of Tourism and Antiquities

Operating budget for 1976(est): JD351,000/0.26% of total budget

Activities include restoration of antiquities sites (only about JD3,000 projected expenses for 1976).

The Ministry has responsibilities relating to the National Parks and Historic Monuments system of Jordan and is a members of the International Union for the Conservation of Nature (Tryzna 1976).

2.1.2.5 Ministry of Interior for Municipal and Rural Affairs

Operating budget for 1976 (est): JD241,000/0.17% of total budget

Projects include studies for planning of cities and villages and regional planning, as well as the construction of village schools, and surveying activities.

The Ministry, whose chief civil servant is by law required to be a civil engineer, provides technical assistance to local councils for the construction of, among other things, sewage disposal facilities.

The Ministry administers the Municipal and Village Loan Fund, which finances water distribution systems if requested by municipal or village councils and subject to the Fund's approval. In 1977 the Fund, which provides funds only for communities of at least 1,000, loaned about $370,000 for 16 water related projects, accounting

2.1.2.6 Ministry of Education

Operating budget 1976(est): JD16,350,000/12.1% of total budget

The ministry is responsible, among other things, for general education and elementary education as well as for preparatory and secondary education (63% of its budget in 1976); teacher training (4.5% of its budget in 1976); vocational education (2.9% of its budget in 1976); agricultural education (1.6% of its budget in 1976); and illiteracy control and adult education (0.34% of its budget in 1976).

2.1.2.6.1 Education Council

Composed of the Minister of Education as President and 15 other members, the council serves to advise the Ministry on educational policy, planning, and procedural matters.

2.1.2.7 Ministry of Supply

Maintains a Center for Corn Research (JD20,000 budget? for 1976).

2.1.2.8 Ministry of Health

Operating budget 1976(est): JD5,950,000/4.3% of total budget
The ministry runs laboratories, has a program for preventive medicine and curative medicine, and runs training and education programs.

The Ministry is responsible for monitoring and controlling the bacteriological quality of water but reportedly lacks the funding and the personnel to perform this task adequately.

2.1.2.8.1 Supreme Health Council

Formed in 1977 to plan, organize and coordinate all health services and the country and to promote medical research, the Council's president is the the Prime Minister, while the Minister of Health serves as vice president. There are 17 other members. The directorate of planning and foreign relations at the Ministry of Health is to act as secretariat.

2.1.2.9 Ministry of Finance
Lands and Survey Department
P.O. Box 70
Amman

Operating budget for 1976(est): 205,550/0.15% of total
Functions: cartography.

The Department is charged with making general surveys of the country, defining the general boundaries of villages, and drawing up the maps indicating these boundaries. It is also charged with land settlement.

2.1.3 INDEPENDENT AGENCIES AND GOVERNMENT ENTERPRISES

2.1.3.1 Natural Resources Authority(NRA)

Operating budget for 1976(est): JD1,575,000/1.2% of total budget

As provided for by the 1968 by which it was established the functions of the NRA are: to formulate a national water policy to be approved by the Council of Ministers; to formulate a policy for the utilization and development of mineral and rock resources of the country to be approved by the Council of Ministers; to cooperate with the Ministry of Agriculture in the development of agriculture in those areas brought under irrigation and reclamation; and to offer technical advice and consultation in the field of mineral exploitation. With the formation of organizations such as the Jordan Valley Authority with broad powers to control water supply and water policy within its area of jurisdiction, the importance of the NRA's role in water policy has been severely reduced (Preparatory Committee...1978c:19-20).

The NRA is reported to be suffering from a lack of manpower caused by the brain drain--the loss of Jordanian expertise and manpower to foreign countries which can offer more attractive financial inducements to trained Jordanians. During recent years the NRA has lost more than 75 of its best drillers, 100 hydrologists, hydrogeologists, geophysicists, drilling engineers, chemists and civil engineers, and more than 300 mechanics, electricians, welders, blacksmiths, carpenters, and fitters (Preparatory Committee...1978c:26).

Subunits:

Directorate of Geological Research and Mining

-research has included work in geophysics and oil exploration;

-operating budget 1976 (est): JD252,170/0.19% of total budget

Technical Services Division

-the Division operates a minerals laboratory, which according to one assessment is "well equipped to carry out most mineralogical and analytical procedures, routine and non-routine, which are likely to be required" (Leo 1978:2). Specific sections of the laboratory have equipment for dealing with mineralogy, mineral dressing, clay, and chemistry. The laboratory was found to be weakest in the category of mineral separation. Furthermore, the mineralogical section was found to be understaffed and in need of a well-qualified mineralogist-petrographer and one or two well-trained technicians. (Leo 1978:7). The laboratory operations were scheduled to move into new quarters in mid-1978.

Another investigator (Pressler 1978:12) with interests primarily in non-metallic mineral resources in Jordan, found the laboratory set-up deficient in terms of both equipment and expertise to the

point of not being able to perform its functions properly. He found the laboratories in immediate need of: a complete Petrographic and Mineraological Laboratory; a well-equipped and managed Analytical Laboratory; a complete Mineral Beneficiation Laboratory; and an Industrial Materials Testing Laboratory (Pressler 1978:12).

Lands Directorate

Irrigation Directorate

Operating budget 1976 (est): JD745,550/0.55% of total budget

Activities include the development of water resources, and repairs of irrigation systems. About JD20,000 were allocated for soil studies projects in Al-Qatrana, Sultaneh, and Wadi Al-Abyad in 1976.

Water Resources Development Directorate

The activities of the directorate include exploring and developing groundwater and surface water resources, coordinating hydrological and meteorological activities, and water resources research.

Operating budget 1976(est): JD139,900/0.1% of total budget
This budget a appears to cover principally projects concerned with well drilling and irrigation in high areas.

Water Resources Division

The Division was formed in 1970 through the amalgamation of the Groundwater and Surface Water Divisions of the former Central Water Authority.

Subsections of the Division cover: groundwater, hydrometry, hydrometeorology, water quality and pollution, and special studies. The staff numbers roughly 150, with about 24 scientists.

The Division runs a water quality laboratory and a hydrological library and maintains experimental areas in Wadi Sulelhi, Wadi Um Ed-Dananneer, Wadi Swaqa, and Wadi Abdoun watersheds. All of its stations are equipped with standard instrumentation. The Division maintains both hydrometry and evaporation stations.

The Directorate publishes an annual report as well as annual technical reports of rainfall and evaporation.

Under its current research program the Directorate at last report was working on a hydrological atlas of Jordan; a surface water computerized filing system; the establishment of the Abdoun experimental watershed; and water pollution studies of industrial areas.

Completed research includes: water table contour maps for the entire country; a computerized program for storage and retrieval of groundwater data; 3 digital models for Dhuleil,

2.1.3.3 Amman Water and Sewerage Authority (AWSA)

Responsible for water supply in the area of Amman, AWSA has set a goal of increasing daily consumption of water from the present rate of 40 liters per person per day to 100 liters by the year 2,000; it also intends to reduce the percentage of piped water lost to actual usage from 54% to 30%.

It activities since its establishment in 1972 have included the replacement of old distribution pipes, the completion of twelve new wells, the construction of two main pumping station, construction of 4,000 cubic meters of new storage facilities, and the laying of approximately 200 kilometers of new pipes. (Syncrisis 1977:55).

2.1.3.4 Water Supply Corporation

With responsibility for water supply for all areas except Amman and the Jordan Valley, the Water Supply corporation has set a 1980 objective of improving water supply facilities in 90% of the 773 locations it serves to the extent that per capita consumption of water will reach 40 liters per person per day.

Operating budget for 1976: 330,000/0.24% of total budget

Functions include: digging wells, extension of water distribution networks and reservoir construction, and works aimed at increasing water capacity in connection with electricity and water supply projects.

Afflicted by the same brain drain that affects so many other organizations in Jordan, the WSC is reported to have lost 125 of its staff between July 1977 and January 1978 (Preparatory Committee...1978c: 26).

2.1.3.5 Royal Scientific Society
P.O.B. 6945
Amman

The Society is an idependent agency supported by government funds. According to the organization's charter, formulated in 1973, its objectives are: "To carry out research, conduct studies, and offer scientific and technological consultation, especially that which relates to the economic and social development of the Kingdom and to the proper utilization of the country's resources, with the purpose of increasing the national income and improving the standard of living of the citizens." Its activities are directed primarily towards industrial research.

The Society maintains a research and study center with a library of 40,000 volumes and 1,500 periodicals. Its fields or interest are: electrical and electronic engineering, computer systems, mechanical engineering, chemical industry, building materials research

and economics. The Society also maintains a technical information center.

Subdivisions includes: Industrial Chemistry Department,
Inorganic Technology Division
Ceramics Division
Computer Division

The Society publishes the Bibliography of Jordan*.

2.1.3.6 Jordan Research Council (defunct as of 1976)

Founded in 1964, the object of the Council was to supervise the planning, organization, and coordination of research aimed at raising the scientific, economic, social and health standards of the country and to encourage and support both private and governmental research. The Council had a library of over 1,767 volumes.

The Council was abolished in 1976; its belongings were distributed among other institutions, but as of 1978 its functions had not yet been assumed by any other institution. ("National Policy Making..."1978).

Operating budget for 1976 (the year it was disbanded) was JD23,000.

2.1.3.7 Jordan National Geographic Center (not certain of status)
P.O. Box 20214
Amman

Field: cartography.

2.2.0 Provincial and Local Government

East Jordan is divided into 6 administrative provinces or governorates: Ajlun, Balqa, Kerak, Ma'an, Nablus, and Amman, each headed by a governor appointed by the King or Prime Minister and assisted by one or two Assistant Governors and a small clerical staff. Each Governor has funds available for general development, which could be used, among other things, for water supply or distribution.

Governorates are broken down into districts, subdistricts and areas, each headed by a civil administrator appointed by the Ministry of the Interior and assisted by a small clerical staff.

Municipalities and villages are headed by a municipal mayor or village mukhtar and council, elected by the citizens but approved by a small clerical staff of civil servants appointed by the Ministry of Municipalities and Rural Affairs (MMRA), which was recently formed from and still works closely with the Ministry of the Interior.

*This publication, mentioned in the World of Learning 1978-1979 (London: Europa Publication 1978), could not be located in the Library of Congress, and no other information concerning it could be found.

-Small projects such as slaughterhouses, clinics and sewage disposal are proposed and executed by local councils and financed by the Municipal and Village Loan Fund (MVLF) with technical assistance provided by the MMRA (Arthur D. Little 1979:II:6-185).

-In many cases changes in technology have increased financial and engineering requirements beyond the capacity of local councils, so that water and electricity, especially in larger and more densely populated areas, are becoming the responsibilities of central government enterprises such as the Natural Resources Authority and the Jordan Electricity Authority. There is also the strong possibility that responsibility for sewage disposal may in time be moved from local to central government (Arthur D. Little 1979:I:3-59).

2.3.0 INTERNATIONAL ARRANGEMENTS

2.3.1 Syro-Jordanian Commission

Formed as the result of an agreement between Syria and Jordan signed on June 14, 1953, the Commission is concerned with the utilization of the water of the Yarmuk basin, in particular for the irrigation of arable land and generation of electrical power. The Commission has been involved in arrangements concerning the Maqarin installation. Its concerns include investigation of methods of preventing both silting in the reservoir and the contamination of its waters and the control of malaria.

2.4.0 NON GOVERNMENTAL ORGANIZATIONS

2.4.1 Royal Society for the Preservation of Nature

P.O. Box 6354
Amman

Formerly the Royal Jordanian Shooting Club, this private organization, in the absence of any appropriate body within the Ministry of Agriculture, the ministry officially charged with hunting and wildlife preservation, has been delegated the authority to deal with wildlife conservation, including the management of the Shaumari wildlife reserve near Azraq. The Society also sets hunting quotas and seasons and issues all game licenses (Clarke 1977?:133).

2.4.2 Seil Zarqa Pollution Control Committee (not certain of status)

A scientific-technical organization, the committee set up in 1976 to study the problem of pollution of Seil Zarqa (a tributary of the Zarqa River) and propose ways and means of pollution prevention and control (Preparatory Committee...1978a:41).

2.5.0 EDUCATIONAL AND TRAINING OPPORTUNITIES (See also 1.4)

Universities:

The Jordanian government provides scholarships (an estimated JD595,500 in 1976 or about 3.6% of the budget of the Ministry of Education), which by one recent count supported 1268 students, 990 of whom were studying at the University of Jordan or Yarmouk University and 278 of whom are studying abroad (Jordan 1978:99).

University of Jordan
Amman
Founded 1962

Education is in English and Arabic
Under national and autonomous control, the university is supported by funds from the Ministry of Finance as well as from a 1% tax on imports.

Number of students: 7,018; Number of teachers: 415
About 80% of the faculty are Jordanians (Jordan 1978:99).

Relevant faculties:
- Faculty of Economics and Commerce
- Faculty of Sciences
- Faculty of Medicine
- Faculty of Nursing
- Faculty of Agriculture (see below)
- Faculty of Education
- Faculty of Law
- Faculty of Engineering
  - -no civil engineering.

Programs offered by the University lead to a BS/BA degree in 36 fields and a MS/MA in 14 fields.

One of the University's major objectives is "to perform and promote scientific research" and "to develop and promote technology in the service of the society." In pursuance of this objective the University in 1972 established a deanship for scientific research and graduate studies with responsibilities including the organization, support and promotion of scientific research, particularly as it serves the development of Jordan and other nations of the Arab world. The unversity is required by a bylaw of 1973 to develop a research plan to be implemented by the various academic department; no such plan had been developed as of mid-1978 ("National Policy-Making Body..." 1978:225).

Faculty of Agriculture

Staff: In addition to a Dean and Assistant Dean, there are PhD's in animal production and protection, crop production and protection, soil and irrigation, and agricultural economics.

Facilities: The faculty has modern laboratories and greenhouse facilities as well as an on-campus 40-hectare station for field studies. There is also a 100 hectare farm below sea level in the Jordan Valley.

Interests and research: The academic program offers majors in crop production and protection.

Research, which emphasizes solutions to the problems of Jordanian agriculture, focuses on questions such as: wheat, barley, and tomato production and improvement; mechanization of harvesting; studies on weeds, insects, diseases and important crops; soil moisture conservation; agricultural economics with application to wheat, fertilizers in irrigated and rainfed areas, farm management, and farm systems analysis; protein production from sheep and goats through use of agricultural wastes (Paylore 1977:99).

Yarmouk University
Yarmouk[near Irbid] (1,350 students/76 teachers)

Founded by royal decree of June 1, 1975; instruction since academic year 1976/7.

Education is in English and Arabic.

The University offers a Bachelor of Sciences and a Bachelor of Arts program in several department of sciences and arts. Its objective is to serve Jordan and other Arabic countries through teaching, research, and extension. Faculties and departments including science and arts, engineering, medicine, agriculture and veterinary medicine, and a unit for research and graduate studies (Jordan 1978:99).

Other universities are the Bethlehem University (750 students/70 students), and Birzeit University (885 students/84 teachers). Both are private, but although Bethlehem offers instruction in both Arabic and English, Birzet is designated as an Arab institution with instruction in Arabic only. Both have Faculties of Arts and Sciences, but neither seems to offer the potential for the training of scientific and technical personnel provided by the University of Jordan and Yarmouk University. Bethlehem University also has a School of Nursing and a Teachers College. Both Bethlemen and Birzeit Universities are on the West Bank.

Colleges:

Agricultural Institute
Tulkarm, West Bank

The Institute is a teacher-training institute for teachers of agriculture, science, mathematics, Arabic, Islamic and social studies, English, and physical education

Jordan Statistical Training Center
Amman
Founded 1964:
To train government employees and others in statistical methods.

2.6.0 Baseline and statistical information

Maps:

A topographical map on the scale of 1:750,000 has been prepared by the Directorate of Military Surveys

There is also a topographical map on the scale of 1:100,000 by the Department of Land Surveys (21 sheets)

Geological maps:

1:250,000: 5 sheets, published in Hanover, 1968
1:100,000 14 sheets (1974)
1:250,000 3 sheets (Prepared by the Lands and Survey Department for area east of rift valley) 1954
1:50,000 Military Survey (Directorate of Military Surveys; 170 sheets, 1965).

Climatological and meteorological monitoring

There are 41 existing climatological stations and 68 existing rainfall stations; there are 30 meteorological stations

Under Jordan's development plans for 1973-1975, the government included the development and completion of a network of agrometeorological stations as well as the establishment of a a meteorological office at Aqaba airport (Johnson and Johnson 1977 58).

Fisheries and marine research

A modern marine laboratory is under construction near Aqaba at the cost of over a million dollars. To be administered jointly by the University of Yarmouk and the University of Jordan, the laboratory is to replace minimally-equipped research facilities presently located in rented housing and equipped with only a small Boston Whaler as a research vessel. The new facility will be equipped with, among other things, an open-water aquarium system with aquaculture ponds outdoors. With the exception of two marine technicians, the staff of the present facility consists of non-Jordanians, and additional foreign scientific personnel is expected under a contract with the University of Nice as well as under planned arrangements with the Norwegians. Qualified Jordanian scientific personnel will also be available when four Jordanians now taking Ph.D's in marine sciences have completed their studies (Potential...1978:44).

The Ariculture Research station at Yabis in the Jordan Valley is reported to include fish culture as one of its concerns.

Environmental assessment

A major environmental impact study designed to assess the effects on the human and natural environment of the Maqarin Dam (Yarmouk River) and the Jordan Valley Irrigation System Project Stage II has recently been completed by Arthur D. Little, Inc. for the United States Agency for International Development (A.I.D.). A.I.D.'s funding of these project is contingent on the findings of this study (See Arthur D. Little 1979).

Water pollution monitoring and water quality determinations
(Preparatory Committee...1978a:40-41)

The Water and Soil Laboratory of the Natural Resources Authority is the chief laboratory for chemical analysis of water quality in Jordan. Specializing in analyses of major chemical constituents, the laboratory mainly serves water projects initiated by the NRA and other agencies, issuing reports on water quality determinations.

Within the Ministry of Health are an Environmental Sanitation Section and a Public Health Laboratory which routinely performs bacteriological tests on water samples, using the WHO-recommended multiple-fermentation tubes test for coliform bacteria (MPN) and for Escherichia coli (Elchman test). Chemical tests are performed occasionally.

The Municipality of Amman operates a Food Control Laboratory, established in 1973, which routinely performs bacteriological tests on samples from the Amman water system and from swimming pools. Analysis is based on standards applied in West Berlin, the city which assisted Amman in the establishment of the laboratory. Occasionally plate counting is also performed.

The Amman Water and Sewerage Authority operates at the Sewage Treatment Plant (Activated Sludge) at Ein Ghazal a laboratory which conducts tests on raw, settled sewage and on final effluent as part of the operational control of the plant.

Air quality monitoring

No air quality documentation is available for Jordan. In order to establish background pollution levels, however, a single sampling stations has been located at Shobak, a remote site in the uplands south of the Dead Sea.

3.0 LEGISLATION RELATING TO ENVIRONMENT AND NATURAL RESOURCES

3.1 WATER LEGISLATION

3.1 Water resources and water pollution control

There exists for Jordan no comprehensive water law, provisions covering this area being scattered in different laws. Two basic principles for pollution control are contained in such laws: restricted zoning for catchment areas, and control of waste discharge into waterbodies and sewers. Laws on pollution have reportedly not been fully implemented either because of inadequacies in the laws themselves or because of lack of competent enforcement personnel (Preparatory Subcommittee... 1978a:43).

Although the Natural Resources Authority was granted comprehensive control of water resources by the law considered under 3.1.1, subsequent legislation has eroded this comprehensive control by granting absolute powers for setting of water policy and control of water resources to organizations such as the Jordan Valley Authority (see 3.1.3).

3.1.1 Natural Resources Authority Law No. 12 of 1968

Grants to the Natural Resources Authority [already created in 1966] the following authority:

1. Irrigation projects:
   - -planning, designing, constructing, operating and maintaining water irrigation projects, etc.
   - -settlement of disputes relating to water resource utilization within irrigation project areas;
   - -soil surveying and classification, land reclamation and, where necessary, parcelling of land within irrigation projct areas;
   - -specifying crop patterns and applying Government water policy within the irrigation project areas;

2. Water policy:
   - -establishing national water policy for approval by the Council of Ministers, such policy to have the objective of "the preservation of the Kingdom's natural and political water rights as well as the development, preservation and maintenance of the Kingdom's water resources for utilizing in various purposes aimed at raising economic, social and health standards";

3. Groundwater exploitation
   - -organizing and directing the construction of private and public artesian wells and dealing with matters pertaining to exploration and drilling for groundwater; no drilling is to take place without the permission of the Authority;

4. Pollution control
   - -defines pollution as "the change of the physical, chemical and bio-

logical characteristics of water to such an extent that may limit its use," and prohibits any person from introduction into waters any polluting material without a permit specifying the kind of polluting material and the protective measures that must be taken.

3.1.2 Water Supply Corporation Law No. 56 of 1973

This law grants to the newly created Water Supply Corporation, responsibilities for water supply previously under the Natural Resources Authority.

The Water Supply Corporation (WSC) is given responsibility for:

1. planning, designing, constructing, operating, and maintaining water supply projects for drinking purposes and domestic uses, including water distribution and sales and drainage; to this end the WSC is to conduct economic studies relating to sewerage and water resources;
2. water supply policy
   -the WSC is to draw up a policy for water supply, aimed at improving the environment of the population in health, economy, and social life;
3. providing, through the Water Councils, water for all segments of Jordanian society as well as controlling water pollution, flooding and water wastage;
4. cooperating with the Ministry of Health in matters involving health aspects of water supply, including ensuring that "the water distributed to the consumer be suitable for use in conformity with the approved specifications and measures, especially bacteriological and chemical.

water pollution control

The law defines water purification as the removal of all harmful substances so that drinking water is up to the WHO standards. The corporation has the power to claim protection zones for waterworks as may aquire land and property for that purpose.

3.1.3 Jordan Valley Development Law No. 18 of 1977

This law establishes the Jordan Valley Authority with the responsibility for economic development of the Jordan Valley, including all matters concerning water supply, including:

1. studies for the evaluation of water resources;
2. planning, design, construction, operation and maintenance of irrigation projects, hydropower stations, wells, pumping stations, reservoirs, and water delivery and distribution networks as well as of surface and subsurface drainage networks;
3. settlement of disputes arising from use of water resources;
4. organization and direction of construction of private and public wells;
5. planning, design and construction of domestic water supply projects, including distribution networks.

3.1.4 Amman Water and Sewerage Authority Temporary Law No. 48 of 1977

This law replaces the Amman Water and Sewerage Law No. 19 of 1973 as the legislation defining the functions of the Amman Water and Sewerage Authority (AWSA), which include:

1. ensuring supply and distribution of water within its area;
2. protecting water supplies from pollution, including issuing instructions for sampling of water;
3. preventing waste of water;
4. ensuring draining of sewage effluents, surface water, and storm water by scientific methods;
5. planning for water and sewerage to meet future needs;
6. locating restricted areas to protect the water basin and recharge areas;
7. limiting and restricting the use of water.

3.1.5 Public Health Law No. 21 of 1971

The chapter on sewerage requires all sewerage systems to conform to health regulations. Pollution is not defined.
Drinking water is defined as water "free from all physical, chemical or bacterial pollution."
The Ministry of Health is empowered to examine water and to forbid distribution of unsafe water; new water systems are subject to the Ministry's approval.

3.1.6 Public Sewerage Law: Temporary Law No. 12 of 1977

Valid for all municipalities except Amman, this law provides the legal grounds for municipalities to install and operate sewerage systems and to collect revenues for them. Industrial wastes are to conform to established standards for acceptance of discharge into the public system.

3.1.7 Law no. 20 of 1973: Code of Agriculture

-grants the Ministry of Agriculture authority to determine irrigation procedures.

3.2 FORESTRY LEGISLATION

3.2.1 Act no 20 of 1973: Code of Agriculture

The law applies to both Government forests (state land registered as forests or land registered in the name of the treasury) and private forests (all plantations growing by natural agencies on land belong to individuals or corporate bodies and consisting of forest trees and shrubs);

Part X: Conservation of Trees and Plantations:

-provides for action to be taken against persons who cause or allow their livestock to cause damage to plantations, trees, or plants belonging to another party;

Part XI: Forestry: soil conservation

-a license is required for the cutting of wood from government or private forests for the preparation of charcoal as well as for the transportation of wood and the storage of forest materials;

-prohibitions:

-"No forest trees, shrubs, plantings, or plants from Government or private forests may be cut, burned or trimmed, and no branches may be cut by means of any tool or otherwises removed by hand; nor shall they be deprived of their bark or leaves."
-but owners of private forests may obtain a license to to carry out technical pruning;

-prohibitions are placed on living or erecting structures within Government forests; persons living in government forest lands and neighboring areas may be evacuated; those refusing to leave are liable to imprisonment of from two weeks to one month;

-no fires permitted if they may cause a forest fire;

-prohibits encroachment on Government forest lands by cultivation or excavation or digging of wells or caves

-grazing is prohibited on forested land without authorization from the Minister or his deputy, who are to define matters such as types of livestock, conditions for obtaining a license, grazing schedules, etc.

-the Minister of Agriculture is to prohibit grazing of native goats in specified areas if such grazing constitutes a danger to forest resources and agriculture;

-no cutting of forest trees of any kind is permitted in government or private forests during the period from the beginning of March to the end of May;

-no wild carob, terebinth, almond, pear, and almond trees are to be felled, although pruning for reproduction or grafting purposes is permitted;

afforestation:
-afforestation and soil conservation efforts are to be carried out at the expense of the government in accordance with instructions issued by the Minister of Agriculture on any land of the following description:
  -uncultivated land with a slope in excess of 25%
  -sloping land affecting water resources and water works;
  -sites of tourist value to be afforested for amenity purposes;
-the Minister may distribute free of charge any quantity of forest planting stock in any area, if he feels that this serves the public interest;
-owners may be permitted to restock the forest with produce-yielding trees in accordance with conditions defined by the Minister of Agriculture;

enforcement:
-Ministry of Agriculture is chief enforcement agency;
-decrees issued by the Ministry are to determine procedures to be followed;
-officers of the Ministry of Agriculture are authorized to seize forest materials obtained without a license and to arrest those cutting or transporting forest materials;
-forestry cases to be referred to the courts of the peace or to the responsible administrative officer;
-forestry province collectors to collect fines imposed by the courts or by responsible admnistrative officers; funds to be used for financing of forest development;
-the Minister is to permit the importation of forestry materials.

3.2.2 Other forestry legislation

The following legislation, listed in Johnson and Johnson 1977, has in all likelihood been superseded by the provisions of the Agricultural Code of 1973 (3.2.1).

Act no. 64, 1953: relates to compulsory planting of trees during 1953.

Compulsory tree planting law 1951

Woods and Forests Law, 1927 (amended 1951): protectiong of woods and forests; delimitation of boundaries, etc.
Act no. 35, 1958: Draft Compulsory Afforestation Law 1961: under consider for enactment by the government: conservation, preservation, improvement, and beautification of land;

Law No. 18 of 1952 prohibiting the grazing of goats.

3.3 SOILS

Law No. 20 of 1973. Code of Agriculture.

Article 103

-afforestation and soil conservation efforts are to be carried out at the expense of the government in accordance with instructions issued by the Minister on any land of the following description:
  -uncultivated land with a slope in excess of 25%
  -sloping land affecting water resources and water works;
  -sites of tourist value to be afforested for amenity purposes.

3.4 WILDLIFE

3.4.1 Law No. 20 of 1973: Code of Agriculture

Articles 144 to 155

-the hunting of birds and wild animals is prohibited without authorization from the Ministry of Agriculture, who is also to fix fees for hunting authorizations;
-the Minister of AGriculture is to determine areas and seasons for hunting as well as species of wild animals and birds which may be hunted;

- prohibitions:
  -killing, taking or hunting or birds useful to agriculture; as well as their sale or transfer;
    -Minister of Agriculture to determine species of birds covered;
  -destruction of nests or removal of eggs;
  -use of vehicles, floodlights or automatic weapons prohibited in hunting; no traps for birds; use of lures (flags, animal skins, animal calls) or points of concealment such as butts or stands is prohibited;
  -water birds specified by the Minister not to be affected by the above;
  -Hunting Committee to be appointed to advise on matters such as hunting areas and seasons and animals to be hunting
  -cruelty to animals prohibited;

enforcement: employees of the Ministry of Agriculture, the members of the Security and Armed Forces; any other person appointed by the Ministry is authorized to arrest any offender any hand him over to the nearest police station.

NOTE: Much of the implementation of this and other wildlife legislation, including the setting of hunting quotas and seasons and the issuance of game licenses, has been delegated to the nongovernmental Royal Society for the Preservation of Nature (see 2.3.1).

3.4.2 Other legislation dealing with hunting and

The following legislation, listed in Johnson and Johnson 1977, has in all likelihood been superseded by the 1973 Code of Agriculture (4.4.1).

Jordanian Law of Hunting: No. 28, 1957:
-protection of young wild birds and eggs;
-hunting and export of birds;
-establishment of hunting seasons

Ordinance No. 1, 1958: relates to game protection, hunting of the gazelle;
Ordinance No. 2: relates to general game protection;

Law for the Protection of Game No. 8, 1966 includes licensing regulations, shooting regulations and hunting seasons.

Regulation no. 60, 1966: regulation for protection of game.

Defense Order No. 23, 1962: Prohibits hunting and fishing

Laws restricting the hunting of rare and endangered animal species.

3.5 FISH AND FISHERIES

3.5.1 Law No. 20, of 1973: Code of Agriculture

Part IV : Aquatic resources

-applies to any water animal and includes sponges, mollusks, crustacea, water reptiles and aquatic mammals;
-applies only to persons fishing for commercial purposes:
-fishing operations require a license from the Ministry of Agriculture

-prohibitions: the use of explosives or poisonous or otherwise harmful materials to catch fish, whether for commercial or other purposes;
the damaging of or removal from territorial waters of coral;

-the Minister of Agriculture is to issue decisions on:
-granting of fishing authorizations;
-limitations on marine or freshwater fishing areas;
-prohibition of fishing methods and technqlues likely to damage fishing grounds or affect conservation and reproduction of fish;
-declarations of areas and seasons in which fishing may be prohibited or permitted for specified kinds of fish only;
-prescription of catch limits for specified kinds of fish;
-determination of the size of the mouth and mesh of nets to be used in fishing.

3.6 MINERALS

3.6.1 Mining Law of 1926

This law regulates all prospecting, exploring, and mining within Jordan.

- reserved areas are villages and forest land, land within 100 meters of railroads or reservoirs, and historical or holy sites; but the Prime Minister, with the approval of the Council of Ministers, may grant mining rights for reserved land subject to payment to the owner of four-fifths of the royalties paid and compensation for damages caused;

- land privately owned is subject to mining rights only with the consent of the owner; but exploitation may occur if they owner is properly compensated;

- provides for the issuance of prospecting permits, which enable the holder to enter specified areas of land and excavate for minerals; more extensive work is allowed under a propsecting license;

- provides for the issuance of exploration permits, to be granted only to applicants capable of demonstrating sufficient capital or credit and technical knowledge to undertake geological and mineral surveys of the area concerned;

- holders of propsecting or exploration permits or licenses are guaranteed ancillary rights such as access to water, cutting of timber, and erection of structures and buildings

- exploitation: may take place under a mining right or a mining lease;
  - -a mining right is granted only for alluvial minerals and is valid for one year with unlimited one-year renewals;
  - -a mining lease, granted for 30 years, is granted for an area which does not exceed the percentage limitations imposed on exploration permits.

3.6.2 Oil Mining Law of 1940

Provides for the granting of petroleum concessions giving the concessionaire the right to explore, exploit, and store or transport petroleum, natural gas, and other hydrocarbons within the concession area.

3.7 HEALTH

Laws of 1971 and 1976 define the powers of the Ministry of Health; the law of 1971 establishes a Supreme Health Council (see 2.1.2.8.1) as an advisory body to the Ministry with the object of effecting coordination of all health care providers in the country.

3.8 POLLUTION

Johnson and Johnson 1977 report laws for the abatement of pollutants in the cities but give no specific. See also: 3.1.1, 3.1.2, 3.1.4, and 3.1.5.

3.9 AGRICULTURE

Law no. 20 of 1973: Code of Agriculture

Covers: organization of agricultural production; registration of crop varieties; crop seed; organization of fruit orchards and nurseries; establishment and operation of olive mills; agricultural fertilizers; crop protection (including use of pesticides); conservation of trees and plantations; forestry: soil conservation; pastures; livestock, including animal health; slaughtering and flaying; aquatic resources.

3.10 CONTROL OF PESTICIDES AND FERTILIZERS

Law no. 20 of 1973: Code of Agriculture (Articles 64-69)

- -a license from the Minister is required for manufacture, processing, sale, or marketing of pesticides;
- -the Minister is to appoint a Pesticides Committee to select or identify pesticides and determine which may be marketed, what standards they must meet, and their prices, etc.
- -the Committee is to advise, among other things, on: pesticide sampling and analysis procedures; prohibitions on transportion of pesticides;
- -similar provisions, including the establishment of an Agricultural Fertilizers Committee apply to fertilizers (articles 52-57).

3.11 ANTIQUITIES

Law No. 27 of March 25, 1968, The Law of Antiquities (Official Gazette no. 2089 of April 16, 1968). This law repeals a previous law of 1959.

The law covers: trade in antiquities;
licensing for excavations;
ownership (state) of antiquities;
penalties for offenders.

4.0 RESOURCES

4.1 WATER RESOURCES

Water resources and their limited availability are the major environmental concern in Jordan. Although it is generally agreed that water is a scarce commodity in Jordan, there is no precise information on the exact extent of water resources. One recent estimate places total available resources (replenishable surface and groundwater) at 1,100 million cubic meters per year (MCM/y), with 880 MCM/y available from surface sources and the remainder from groundwater. However, another recent study, focussed on North Jordan, an area which although accounting for only 55% of the country's surface area contains about 97% of its population and may also contain the overwhelming majority of its water resources, estimates total natural replenishable resources at 625 MCM/y, only 77 MCM/y of which would come from groundwater.

Present total water utilization in Jordan is estimated at around 450 MCM/y: about 400 MCM/y for agricultural irrigation, about 40 MCM/y for domestic water supply, and about 5 to 10 MCM/y for industrial purposes. As population increases, demand for water for domestic purposes (already available in inadequate quantities) will increase, while pressures on water supply for irrigation and for industrial purposes are also expected to grow. It may be possible to meet this increased demand for domestic water only by decreasing or holding stable present water supplies available for irrigation (AID Amman: 1979: Appendix: 2-5).

PRESENT AND PROJECTED WATER USE IN JORDAN (Frantz 1978)

Type of use	present	1985	2000
Domestic/ Industrial	46 MCM/y	190 MCM/y	300 MCM/y
Agricultural	405 MCM/y	730	730

For North Jordan alone, it has been estimated that given present population growth and plans for agricultural expansion through irrigation, there will by 1987 be a water deficit of 140 MCM/y, a deficit which will increase to an estimated 298 MCM/y by the year 2000 (Howard Humphreys 1978:Table 5).

4.1.1. Rainfall and climate

4.1.1.1 The resource

The climate of Jordan is generally described as Mediterranean. Much of the weather comes from the west, precipitation resulting, from moist air moving northeast from the Mediterrean, while northeast winds in the winter months create cooler temperatures by bringing in polar air from Asia. Only in summer is Jordan's weather occasionally affected by warm air masses from the deserts to the east. There are few occurrences of violent storms.

rainfall (see map page 35a)

Rainfall, limited generally to the period between September and May, is heaviest in the northern highlands, which receive an average of 300-600 millimeters per year, with regions of highest rainfall (600-700 millimeters) occurring near Jerash/Ajlun and west of Amman. Generally for all areas, rainfall is highest in the north and at higher elevations, the higher elevations in the south receiving considerably less rainfall than similar elevations in the north.

The Jordan Valley, falling as it does within the rain shadow of the West Bank mountains paralleling the rift valley, receives less rainfall than do the highland areas; in the north rainfall levels are from 200-300 millimeters per year, diminishing to less than 3 millimeters per year at Aqaba in the southermost part of the country.

The desert areas to the east and south, which constitute the bulk of Jordan's territory, receive the least rainfall, less than 150 millimeters per year--ranging from 0-25 millimeters even for November through March, the months of highest precipitation.

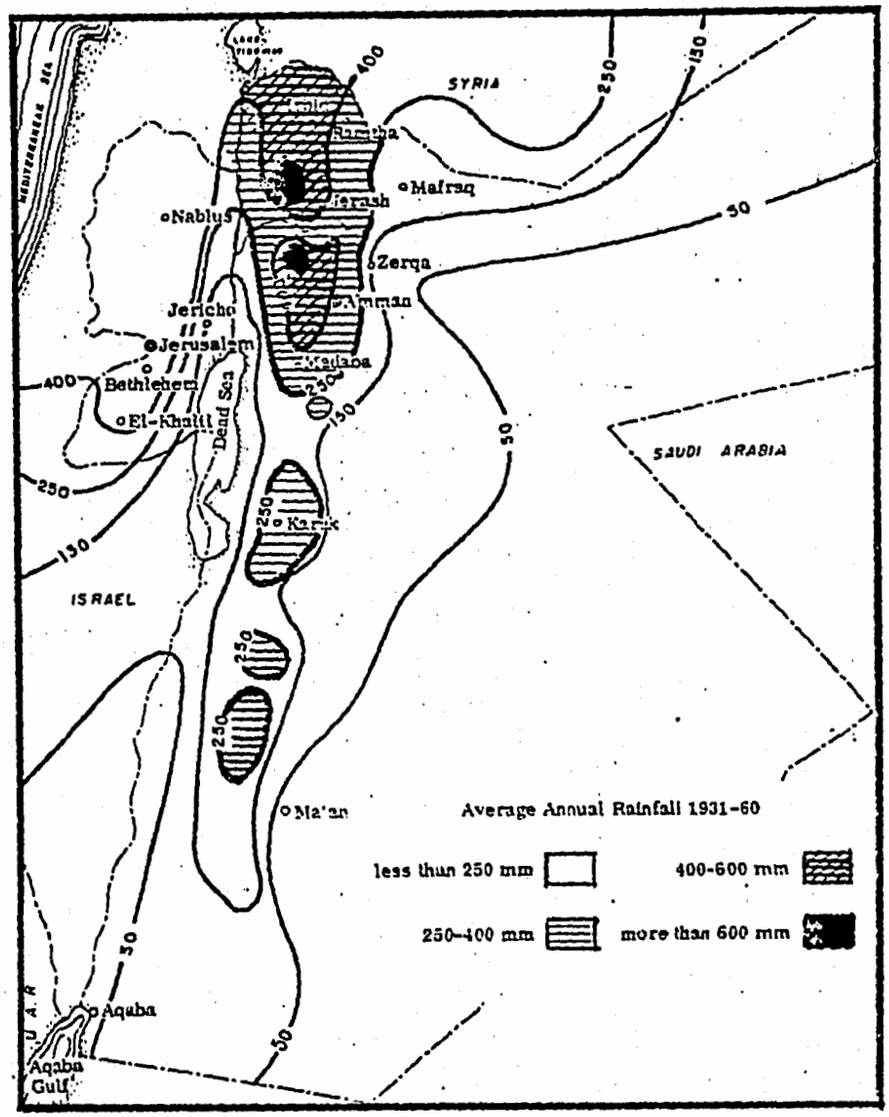
Rainfall tends to be erratic in occurrence, fluctuating widely from year to year. This variability serves an major constraint on water resource planning, which depends on the expansion of surface water resources through the catchment of seasonal water flows in wadis (AID Amman: 1979: Appendix to CDSS).

The rate of evaporation is especially high in the desert areas.

Temperatures are highest in the Jordan River Valley, lowest in the uplands, and in-between in the desert. July and August, the driest months of the year throughout the country, are also the hottest, with temperatures ranging from 30-32 degrees C in the Jordan Valley and 20-24 degrees C the highlands. Temperatures as high as 45 degrees C have been recorded in the Rift Valley. December and January, the months of heaviest rainfall, are also the coolest, with mean temperatures ranging on the average from 4 to 8 C in the highland areas.

Humidity falls into a pattern with temperature and precipitation. The highlands, which are the coolest region and receive the most rain, are also the most humid, while the valley and desert are less humid. The mean monthly humidity range for the country as a whole is 35% to 76%.

RAINFALL DISTRIBUTION IN JORDAN
1931-1960



Source: Aresvik 1976: 20.

ONTHLY RAINFALL AND TEMPERATURE IN JORDAN
-thur D. Little 1979:1:3-8).

	Rift Valley (Jordan Valley)		Uplands		Eastern Deserts	
	Temp.(C)	Rainfall (mm)	Temp.(C)	Rainfall	Temp.	Rainfall
ı.	14	0-75	4-8	25-150	10	0-25
›.	14-16	0-75	4-8	25-100	10-12	0-25
r.	16-20	0-50	8-10	10-100	12-14	0-25
r	20-24	0-10	12-14	10-25	16-18	0-10
y	26-28	less than 10	14-20	less than 10	20-26	less than 10
ın	28-32	0/trace	18-22	0/trace	22-28	0/trace
ıl	30-32	0/trace	20-24	0/trace	26-30	0/trace
-ug	30-32	0/trace	20-24	0/trace	26-30	0/trace
ep	28-30	0-3	24-28	0-3	18-22	0-3
ct	26	0-10	16-20	0-10	20-22	0-5
lov	20-22	0-50	12-14	10-50	16-18	0-25
ec	14-16	0-75	6-10	25-100	10-12	0-25

4.1.1.2 Utilization of rainfall

The average total annual rainfall in Jordan is estimated at from 6000 to 7000 MCM/y, most of which is lost to evaporation and evapotranspiration. It has been estimated than only 10% of the total local rainfall could eventually be put to use (Arar 1978:2).

4.1.1.2.1 Agriculture

By some estimates only about 4.2% of Jordan's territory can be considered suitable for rainfed farming; however, a large part of this area is otherwise unsuitable because of rock or shallow soils or steep slopes (Arar 1978:2).

Wheat, which accounts for the overwhelming majority of the land under field crops, is farmed in the uplands, predominantly under rainfall, accounting for from between 37,000 to 226,000 tons of wheat per year(Abanadah 1978:2). The production level for this crop, dependent as it is on rainfall, varies widely from year to year, plunging, for example, from 245,000 metric tons in 1974 to only 50,000 metric tons in 1975.

4.1.1.2.2 Water harvesting

Rainfall harvesting practiced in the Near East region for nearly 4000 years has permitted agriculture to develop in regions with an average rainfall of only about 100 mm per year. Water thus harvested is usually collected in ponds in small depressions or in cisterns; some cisterns constructed in Roman times still function today (Arar 1978:3-4). Rainwater is also collected in cisterns for domestic use.

4.1.2 Surface waters

The annual surface water potential of Jordan, including rivers and water collected in reservoirs, is estimated at from 850-880 MCM per year (UNWC 1976:9; Preparatory Committee...1978a:1). For North Jordan alone, surface water resources have been estimated at 683 MCM/y, about 550 MCM/y are available for economic exploitation (Howard Humphreys 1978: Table 4).

4.1.2.1 Rivers

4.1.2.1.1 The resource (see map, page 37a)

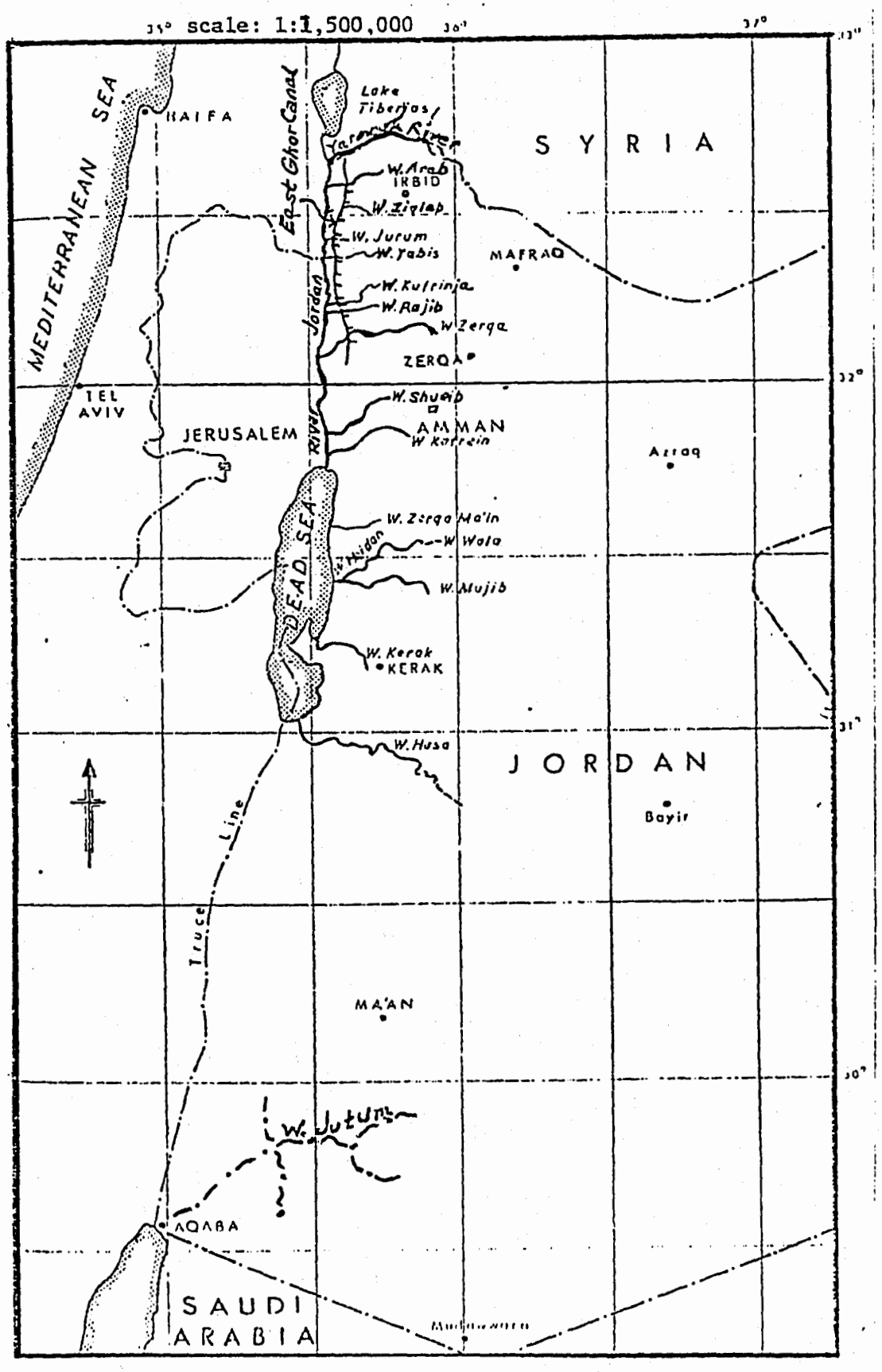
The total stream flow of usable rivers in East Bank Jordan is about 880 MCM per year. However, about 400 MCM/y of this flow, attributable to the Yarmouk River at Adasiya, originate from catchments in Syria. Only the remaining 480 MCM are actually resources of the streams of Jordan. In general, river flow tends to be heavier in the north, decreasing toward the south.

Streams are fed by both rainfall and groundwater discharge (baseflow). Although the various catchment areas of Jordan during an average year would receive a rainfall volume of about 8,065 MCM (about 75% of this actually within Jordanian territory), the total flow of 880 MCM is only about 10% of this and analyses have indicated that considerable parts of these flows originate not from rainfall runoff but from groundwater (Frantz 1978:11).

The Jordan, a sluggish river, flows south from Lake Tiberias to the Dead Sea; its very sinuous course is broken in many places by cascades; the river is generally from sixty to 25 feet wide and from three to six feet deep during most of the year. Because of high levels of salinity the waters of the Jordan are not considered in water resources planning; however, most of the significant rivers of Jordan fall within the catchment area of the Jordan, which covers a total of 6,000 square kilometers (UNWC 1976:8). The flow of the Jordan at the outlet of Lake Tiberias has been reduced and the salinity of the river increased in low water season by Israel's diversion of its waters (Nyrop 1974:46). Furthermore, planned diversion of the waters of the Yarmouk River, the Jordan's chief tributary in the north, will lead to yet higher levels of salinity in the Jordan River.

MAJOR RIVERS AND WADIS OF JORDAN

Source: Hunting Technical Services and Sir M. MacDonald & Partners. 1965.



MAJOR RIVERS AND WADIS OF JORDAN: AVERAGE ANNUAL FLOWS

River/Wadi	Average annual flow (MCM/y)	Catchment area (km2)
East Ghor Side Wadis (drainage to Jordan River)*		
Yarmouk River (at Adasiya)	387.0	6,805
Wadi Araba	28.8	254
Wadi Ziglab	10.2	131
Wadi Jurum	11.0	119
Wadi Yabis	3.5	107
Wadi Kufrinja	6.0	27
Wadi Rajib	4.3	80
Zarqa River	67.1	3,440
Wadi Shueib	7.9	90
Wadi Kafrein	14.3	161
Southern Wadis (drainage to Dead Sea)**		
Wadi Zerqa Main	20.3(estimate*)	300
Wadi Mujib	102.9	6,570
Wadi Kerak	5.3(estimate)	n.a.
Wadi Hasa	48.8	2,500
Red Sea Basin		
Wadi Yutum (non perennial)	2.0***	—

*National Master Plan Estimates(1977) reported in Arthur D. Little 1979: 1:3-12.
**Hunting...1965
*** Aresvik 1976:111.

4.1.2.1.2 Utilization of rivers

4.1.2.1.2.1 Navigation

There does not appear to be any signficant river navigation in Jordan, although there were ferries on the Jordan prior to the 1967 war.

4.1.2.1.2.2 Irrigation

Irrigation accounts for the greatest part of water used in Jordan. Total irrigated area in Jordan, by one recent estimate, is about 33,600 (Frantz 1978:20). Of the some 405 MCM/y used for irrigation an estimated 230 MCM (57%) comes from river flows; this includes water collected in reservoirs (Frantz 1978:20). Most of this irrigation water goes to the Jordan River Valley.

Irrigation waters are drawn principally from the Yarmouk River in the north, which has been diverted to form the East Ghor Canal, which parallels the Jordan. With the completion of the Maqarin Dam on the the Yarmouk River in the north, irrigation will be extended to an additional 10,000 hectares in the southern Rift Valley.

The Jordan River, Jordan's largest river is too brackish to supply suitable water for irrigation; this salinity, especially marked in low water season, has been increased dramatically in recent years by Israel's diversion of waters at Lake Tiberias.

4.1.2.1.2.3 Hydroelectric power

Hydroelectric power is not at this time highly developed in Jordan, but hydroelectric powerplants are planned for the Maqarin Dam (20 MW) as well as for the King Talal Dam (2 MW). Frantz (1978) reports a few small-scale hydro-power installation at places such as Wadi Jurum.

4.1.2.1.3 River Pollution

River pollution is a significant problem only in the Zarqa River, which receives pollutants from several sources. Domestic waste water is one major pollutant, while additional pollutants derive from industrial activities such as phosphate mining, oil refining, a dairy, a yeast factory, and alcohol, battery and tanning industries (Hashwa and Salameh 1978:3). While most industrial wastes are discharged untreated into the Zarqa; some industries discharge their wastes into lagoons, the overflow from which may then reach a wadi or sell leading to the Zarqa (Preparatory Committee... 1978:8). As industrial growth increases (about 100 new industrial plants were registered in 1976 alone), this pollution will increase as well (Preparatory Committee...1978:8).

Although no long-term data on water quality are available for the Zarqa River, observations made in February 1979 indicated gross

pollution of the river from municipal and industrial wastewater discharges from Amman to some distance below Sukhneh. After this point, the river showed some signs of recovery. At the new Jarash Bridge, shortly before the point where the river enters the King Talal Reservoir water quality was considerably better than between Amman and Zarqa; however, at this point, the following observations were made: heavy attached algal growth indicated high nutrient availability; no fish were observed; there was a low diversity of aquatic insects; and the water had was cloudy or milky in appearance from either high concentrations of coloidal particles or some other unknown reason (Stanley Consultants 1979: 4-5).

The quality of the waters of the Zarqa River varies throughout the year. The above observations were made during a period of rather low flow. It is to be expected that because of high runoff rates during rainy season the river will carry a higher pollutant load at that time (Stanley Consultants 1979:5).

Pollution of the Zarqa River is of particular concern because it flows into the newly built King Talal Reservoir, the water of which are to serve not only for irrigation but also for domestic water supply in Amman.

4.1.2.2 East Ghor Canal

The Ghor Canal utilizes waters diverted underground from the Yarmouk River but is also fed by waters diverted from the Ziglab Reservoir and by various wadis along its course. It presently supplies irrigation irrigation waters for 13,000 hectares of land in the Jordan Valley.

Construction of the canal began in the late 1950's and several extensions have been added to bring the canal to its present length of about 96 kilometers. Under the Jordan Valley Irrigation Project Stage II additional water would be diverted from the Yarmouk River to permit the extension of the canal 14.5 further kilometers to the Dead Sea. This extension would permit the irrigation of an additional 11,000 hectares of presently unirrigated land.

In the Ghor Area some small communities may use the East Ghor Canal water, intended chiefly as a source of water for irrigation, as their water source as well as for deposit of their wastes. (Preparatory Committee...1978: 8).

4.1.2.3 Lakes and Reservoirs

4.1.2.3.1 The Resource

With the exception of the Dead Sea, which Jordan shares with Israel, there are no lakes in Jordan. There are, however, as indicated in the table below, eleven reservoirs, with a total storage capacity of 70.4 million cubic meters.

Reservoirs in Jordan (1976) [From Arthur D. Little 1979:1:3-13]

Name	Location/ Region	Water Source	Storage Capacity (MCM)	Uses*
Samma Sudud	Mafraq	local wadis	1.7	I,D
Ghadeer Abyad	Mafraq	local wadis	0.7	I
Um Jimal	Mafraq	local wadis	1.8	I,D
Bowayda	Mafraq	local wadis	0.7	I
Al-Lakafi	Dhuleil Area	local wadis	0.7	I,G
Qatrana	Qatrana Area	local wadis	4.2	G,D,I
Sultana	Sultana Area	local wadis	1.2	G,D,I
Ziglab**	Wadi Ziglab	Wadi Ziglab	4.3	I
Shueib**	Wadi Shueib	Wadi Shueib	2.3	I
Kafrein**	Wadi Kafrein	Wadi Kafrein	4.8	I
King Talal**	Zarqa River	Zarqa River	48.0	I

*Uses: I=irrigation; d=domestic supply; G=groundwater recharge
**Jordan Valley Irrigation Plan

King Talal Reservoir

As indicated by the above table, by far the largest reservoir is the King Talal, formed by the damming of the Zarqa River, which has a storage capacity estimated at from 48-52 MCM. The reservoir provides water for the East Ghor Canal and also is designed to permit sprinkler irrigation of 6,300 hectares of land lying above the main canal. In addition, there are plans to use the waters of the reservoirs for domestic water supply. Although the dam was completed in 1978, the unusual dryness of the 1978-1979 rainy season, has permitted the reservoir fill to only about 25% of capacity (Stanley Consultants 1979:1). Maximum water volume was reached in April 1978--about 32 mcm (Hashwa and Salameh 1978:3).

Maqarin Reservoir

Now in the final design state is the Maqarin Dam planned for the Yarmouk River along Jordan's northern border with Syria. The dam, approximately 125 meters high, will have a storage capacity of 250 million cubic meters of water. Target date for completion of the dam, which is the major feature of the Jordan Valley Irrigation System Project Stage II, is 1983-84. The waters of this dam are projected to enable the extension of the East Ghor Canal to the Dead Sea, thus permitting irrigation of the southern tip of the Jordan Valley. A 20 MW powerplant is also planned for the dam. In addition, a pipeline from the reservoir to Irbid is expected to supply that city with 24 MCM per year. The funding of the dam by U.S.A.I.D. is contingent on the findings of a recently completed environmental impact assessment (O'Neill 1979; Arthur D. Little 1979).

4.1.2.3.2 Pollution of Reservoirs: King Talal

River pollution is directly linked to the pollution of reservoirs formed by the damming of those rivers. Concern has been expressed particularly regarding the water quality of the King Talal Reservoir, the catchment area for which covers about 3300 square kilometers and includes the Zarqa River Basin, which receives industrial and domestic pollutants not only from Amman but also from Zarqa, Jerash, Reseifa, Baq'a and numerous villages (Hashwa and Salameh 1978:3). The highest water flow into the dam are likely in the wet months of December, January, and February, when the waters of the Zerqa Basin are at their highest; they will bring with them nutrient loads (phosphates, nitrates, etc.), as well as potentially harmful materials from the polluted Amman-Zerqa Wadi (Stanley Consultants 1979:6).

Pollution of the King Talal is of particular concern because plans for its use include domestic water supply for the Amman-Zarqa area.

Because the dam has not yet filled to its full capacity, there is as yet no information for describing the physical, chemical, and biological characteristics during a yearly cycle. (Stanley Consultants 1979:5); however, sampling of the waters of the reservoir during July 1977 to October 1978, indicates that for the entire length of the study period the reservoir was being continuously contaminated with waste water from domestic, farm and industrial origin (Hashwa and Salameh 1978:7). The research found the waters of the reservoir eutrophic, with the lower layers depleted of oxygen and enriched with hydrogen sulfide and the upper layers rich in planktonic organisms, including algae, blue-green bacteria, heterotrophic bacteria, coliforms, and fecal coliforms. Total dissolved solids exceeded 1000 ppm supplemented with viruses, toxic end-products, and heavy metals. (Hashwa and Salameh 1978:10).

A water treatment plant has been constructed which has been judged adequate for treating the waters to the point at which they should meet WHO (1971) drinking water standards. However, several improvements to the plant were suggested by a team of consultants including a method of screening out the heavy algal growth anticipated in the reservoir and an intake structure designed to take in water at all depths rather than at the proposed single depth of 3 meters. It was also recommended that the water be monitored for possibly carcinogenic trace organic chemical compounds as well as for the presence of trihalomethanes and selected chlorinated hydrocarbon pesticides in the water (Stanley Consultants 1979:30). Another group of researchers, who examined the waters of the reservoir during 1977 and 1978 recommended that the waters of the dam not "be used under the present circumstances for drinking purposes even after treatment," and further recommended long-term research to assess the water quality in all its aspects before it is committed for domestic use (Hashwa and Salameh 1978:11).

The outlook for the quality of the waters of King Talal Dam is, however, not promising. All indications are that pollution of the reservoir will increase for several reasons, including: planned sewerage systems for Zerqa, Jerash and Ruseifa, all of which will discharge their effluents

in the Zarqa basin; increased use of fertilizers and pesticides as agricultural development expands; expansion of existing industrial plants and construciton of new ones; increased solid waste refuge from growing urban centers and continued use of open-dump disposal (Preparatory Committee...1978:53).

4.1.3 Springs

Springs, an important water resource in Jordan, supply water for all purposes. An estimated 75 MCM of water used annually for irrigation originates from spring diversions (Frantz 1978:20).

Annual Discharge of East Jordan Springs by District
(Source Aresvik 1976)

District	Average Annual Total (MCM)
Irbid	102
Amman	62
Baqa	38
Karak	46
Maan	7
Total	255

4.1.4 Groundwater

4.1.4.1 The resource

Estimates of available groundwater resources in Jordan vary considerably. The Water Master Plan (Frantz 1978) places the total amount of annual groundwater recharge in East Jordan at 580 MCM, with approximately 220 MCM available for exploitation (the remaining 360 MCM/y is thought to appear as baseflow in streams or to be lost to evaporation). The Plan also estimates that over and above this rechargeable groundwater resource Jordanian aquifers contain 12,000 MCM of stored, non-replenishable groundwater.

In contrast to the above estimate, a recent and reportedly reliable estimate recognizes annual groundwater resources at only 100 MCM. (A.I.D. Amman 1979: Appendix 6). The recent survey of water resources for North Jordan, the area of greatest water demand, estimates yearly available groundwater resources at 77 MCM (Howard Humphreys 1979:Table 4).

Within the Amman area, which accounts for over 70% of the water demand in Jordan, it has been calculated that the total quantity of groundwater recharge into both the upper and lower aquifers underlying the area is only 12-13 million cubic meters per year, while the total extraction is about 18.5 million cubic meters per year. The 6 MCM per year overdraft is, however, possible, only because of entry into the aquifer of water from cesspools and leaking water pipes, a phenomenon which has also contributed to the deterioration of groundwater quality (Marelius 1978: 4).

The majority of the population is located on the plateau, where the potential for increase groundwater is believed possible and feasible. With regard to quality, those groundwater resources having a high rate of annual replenishment are of good quality, while groundwater stored in deep aquifers where recharge rates are low, are generally unsuitable for use. Generally speaking, groundwater quality is good in terms of salinity in Syrian Jebel Druze, southwards to the Azraq and Wadi Dhuheil regions (extreme north); Ajlun-Amman (north); Karak-Ras En Naqb (south); and northwards from the Um Salim mountains (south). Groundwater of poor quality is found in: the central axis of the East Jordan Valley (and the Wadi Araba in the west); the whole eastern region except the extreme north and south; and a connection between these regions, extending from the Dead Sea to the east. Some local sources within the poor quality region are good. (Arthur D. Little 1979: 1:3-14).

4.1.4.2 Groundwater utilization

Groundwater sources presently supply about 32% (roughly 146 MCM) water used each year in Jordan. All piped water systems in Jordan use groundwater (Preparatory Committee 1978:3). Furthermore, an estimated 100 MCM of the some 405 MCM of water used annually for irrigation are pumped from groundwater (Frantz 1978:20).

4.1.4.3 Groundwater depletion

Heavy demand on limited groundwater supplies is reported to be leading to depletion of groundwater aquifers. There are said to be some cases of aquifers being drawn down at rates significantly above their expected annual replenishment rate. This exhaustion of aquifers has been accelerated by private wells used as sources of industrial and irrigation water (A.I.D. Amman 1979:Appendix 6). Overdemands on groundwater supplies and the resulting necessity for finding new water sources to meet the needs of growing populations and expanding industrial activities are therefore a major concern in Jordan.

4.1.4.4 Groundwater pollution

Deterioration of groundwater quality in Jordan may be attributed to: three major factors: recycled irrigation water; pumping of saline water from deeper aquifers; and wastewater from human settlements and industry. In larger communities, where groundwater quality deterioration is the most widespread, quality changes are caused by overflowing cesspits, septic tanks, and lagoon effluents that can percolate through fissures in the rock and reach groundwater reservoirs. On the other hand, percolation through the beds of the Seil Amman and the Seil Ruseifa (the streams in the Amman-Zarqa area which receive heavy effluent loads) is so heavy that the streams can not assimilate it (Preparatory Committee...1978:6).

It has been recently estimated that an average of approximately 35% of the total water consumed in Amman from the aquifer system is

replenished by cesspool effluents (Preparatory Committee...1978:7).

Frequent specific pollutants of groundwater are: gasoline and oils, particularly in urban areas; nitrates stemming from septic tanks, cesspits, sink-holes, anhydrous ammonia used in agriculture, industrial effluents with high nitrogen wastes, domestic effluents, and excessive irrigation water in the area of Amman (a preliminary study carried out on 110 wells in the Amman metropolitan region during 1973-1975 revealed increasing concentrations in most producing wells in that area, particularly around workshops, paper industries, a tanning factory, a steel plant, a dairy, and a blanket factory); and bacterial pollution, again from inadeqate sewage disposal (Preparatory Committee...1978:24).

4.1.4.4 Groundwater exploration

As the demands on Jordan's limited water supplies become greater, the need for exploration for new sources of water becomes increasingly important. Groundwater exploration is presently being conducted by both the Natural Resources Authority and the Jordan Valley Authority. One set of investigations, supported by U.S.A.I.D. is focussing on the Rift Valley (A.I.D. 1979).

4.1.5 Desalinated water

The Royal Scientific Society Society has set up an experimental 550 gallon per day desalination plant at Aqaba with the assistance of the Federal Republic of Germany but staffed entirely by Jordanian engineers. Water from the plant is intended for isolated communities along the shore or inland communities with brackish water supplies. (Uniterra, November 1977:7).

4.1.6 Recycling of water

A certain amount of unintended recyling of water presently takes places as water from cesspools and leaking water supply systems enters the groundwater aquifers in areas such as Amman (Marelius 1978:5). There are plans to recyle water from the King Talal Dam for use as domestic water in Amman; however, these plans are contingent on better purification of industrial and domestic effluents from Amman and Zarqa, whose rivers feed into the dam reservoir (Frantz 1978:64;Hashwa and Salameh 1978:3).

4.1.7 Water Policy

Despite the overwhelming importance of water resources for the development of Jordan, the country does not yet have a national policy body for the water sector. The government's concern with water resource problems was evidenced, however, by the convening in March 1978 of Jordan's first National Water Symposium, which brought together representatives from all organizations in the country with significant interest or expertise in water resources and representatives of donor nations and organizations as well. The major conclusion of the conference was that Jordan urgently

needs a national water authority with full legal powers and competencies and with adequate well-trained staff to engaged in long-term forward planning, to set policy for all aspects of the water sector, including allocation of available resources, and then to implement the policy. Since that meeting, the government has acted to prepare the legislation necessary to set up such a body, but no recent information was available for this profile on the progress made toward actually forming it (AID/Amman 1979:6-7).

Recent studies of the water situation which make recommendations relating to water policy are: the National Water Master Plan (see Frantz 1979), which attempts to survey water resources and make proposals for their use; the North Jordan Water Use Strategy (see Howard Humphreys 1978 for a summary), which examines water supplies for North Jordan and recommends a strategy for their use; and papers from the National Water Symposium (see Reference List at the end of this profile), which cover all areas of water use, quality, etc. in Jordan. Studies related to specific projects include: Amman/Zarqa Water Resources (VBB-Swedish in association with FAWZI); Wadi Mujib Dam (McDonald, U.K.); and the Aqaba Regional Supply (Howard Humphreys, U.K.). A major study carried out in the 1960's by Hunting Technical Services deals with water resources for the whole of East Jordan (see Hunting Technical 1965).

4.2 FORESTS

4.2.1 The resource

Jordan is generally broken down into three vegetation zones: Mediterranean, Irano-Turanian, and Saharo-Sindian. The Mediterranean region, typical of the Amman area and generally of the highlands, is an area of higher rainfall; forests are the dominant vegetation along with maquis (woodland composed of low trees and shrubs up to 4 meters tall); the Irano-Turanian zone of the Northern Jordan River Valley, is typified by dwarf shrubs and grassy plants, with rainfall of from 200-350 mm per year; and the Saharo-Sindian Region, which, with rainfall ranging from 25-200 mm per year, is represented by the Southern Jordan River valley and the large desert area which occupies the bulk of the country east of the Jordan River; vegetation here is limited to dwarf shrubs and herbaceous species.

Centuries of human habitation in the Middle East have resulted in changes in the environment, especially in the composition of the plant cover of the area. Human activity including clearing of land for agriculture, cutting of wood for lumber and fuel, grazing by domestic animals, and fire have led to the replacement of native species by new or previously secondary species and have changed or altered plant association in large areas of Jordan (Arthur D. Little 1979:1:3-19). This is especially marked in those agricultural areas, where indigenous plant communities have been replaced by agricultural crops and their associated weeds. Frequently soil losses following upon land clearing have severely limited or even precluded the regeneration of plant cover (Arthur D. Little 1979:1:3-19).

It is thought that most of the highlands of Jordan were formerly covered with forests of oak, pine, cypress, juniper, and associated vegetation which stretched from Ajlun in the north to the head of the Gulf of Aqaba in the south. This area was aligned north and south along the uplifted edge of the plateau forming the eastern escarpment of the Jordan Valley and the Jordan Valley in areas of sufficient rainfall. Forests today cover less than 1% of the total area of Jordan (Willimott 1978: 46).

The Forest Department controls about 131,500 hectares designated as forest land, but the actual forested area has been estimated to be much smaller: only about 36,000 hectares as of 1964 (Aresvik 1976:178).

Today there are only two main areas of forest growth in Jordan: the northern highlands and the southern highlands. Both areas are degraded but rainfall conditions in the north make forest regeneration in this area more feasible for regeneration than the south. The Jordan Valley and the deserts of the East are, with the exception of some wadi bottoms, devoid of natural forests (Aresvik 178).

Forests of East Bank Jordan (in hectares) (see map page 48a)
(Source: Aresvik 1976: 179; based on FAO Forestry Development: Report to the Government of Jordan. Rome, 1971).

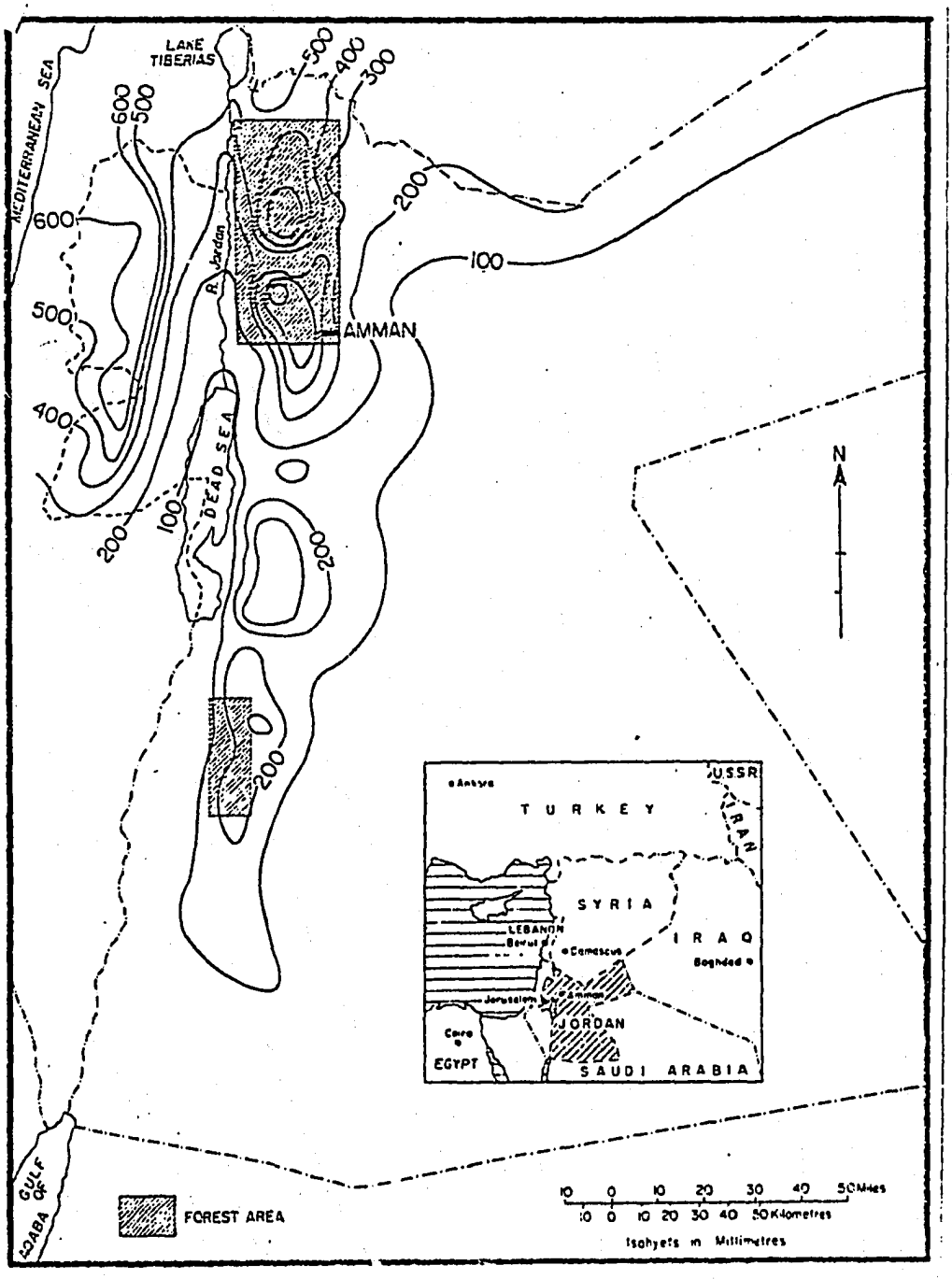
Forest type	Area	Government Forest Land	Private Forest Land	Unsettled Forest Land	Total
Broad-leaved evergreen	North	11,555	3,382	--	14,937
	South	1,056	245	4,746	6,047
Total		12,611	3,627	4,746	20,984
Broad-leaved deciduous	North	2,562	1,418	--	3,980
Broad-leaved coniferous	North,pine	109	34	--	143
	South,juniper	292	21	7,460	7,773
Total		401	55	7,460	7,916
Mixed	North	2,731	296	--	2,027
Wild Olive	North	97	9	--	106
GRAND TOTAL	North	17,054	5,139		22,193
	South	1,348	265	12,206	13,820
TOTAL		18,402	5,405		36,013

4.2.1.1 Northern highlands

In the northern highlands forests cover an area of some 80 kilometers in length running from the Wadi el-Arab in the North to the Wadi Kuffrein in the south; the maximum east-west width of this area is about 25 kilometers in the area of Ajlun. There are five forest associations distinguishable in the northern highlands: the broad-leaved Quercus coccifera (Kermes oak) forest, the broad leaved forest of Quercus aegilops; the coniferous forest of Pinus halepensis (Aleppo pine); the mixed oak-pine forest; and the forest of oak (Quercus coccifera) and wild olive (Olea europaea).

The Quercus coccifera (evergreen Kermes oak) forest covers the largest area in the north and is thought to represent a secondary forest produced by the overgrazing of the Quercus aegilops-Pinus halepensis climax forest. Trees, ranging from 2 to 5 meters in height occur in

POSITION OF MAJOR FOREST AREAS IN JORDAN
(from Atkinson and Beaumont 1971)



varying densities, with the densest stands on steep slopes and in other inaccessible locations. The forest occurs on limestone soils, especially on Terra Rossas, usually with a high proportion of bare rock outcrop. Most of the trees, as judged by ring counting techniques, are less than 40 years old. Associated with the oak are other evergreen species such as Pistacia lentiscus, Ceratonia siliqua, Arbutus andrachne, Phillyrea media, Cistus villosus (rock rose), and Poterium spinosum. There are also infrequent occurrences of small deciduous trees and shrubs such as Crataegus azarolus.

The Quercus aegilops forest covers an area of 100,000 hectares in discontinuous areas begininning in Amman and extending as far north as the Yarmouk River. Occurring at slightly lower altitudes (550-750 meters above sea level) than the Quercus coccifera forest, it grows on red and brown limestone soils similar to those of the evergreen oak forest. Larger trees are often more than 10 meters in height, while the average age of stands ranges from 80-120 years. Associated trees are Pistacia atlantica (terebinth/butm), Ceratonia siliqua (carob/karoob), and Styrax officinalis.

Pure stands of the Pinus halepensis forest occur only in small stands, most notably the Dibbin Forest west of Jarash, where the pines, growing in association with Quercus coccifera, Arbutus andrachne, Pistacia palaestina and Pyrus syriaea, comprise about 50 to 80% of the total tree numbers. Trees are up to 50 centimeters in diameter and range in height from 2.5 to 10 meters. This forest type occupies only slightly more than 1000 hectares and grows on Rendzina and White and Light Brown Limestone soils derived from soft and marly calcareous strata.

The mixed forests of pine (from 5 to 25%) and oak (Q. coccifera) cover only about 300 hectares in the highland area between Ailun and the Wadi Zarqa.

Another small area in the northern higlands is covered by a forest association of oak (Q. coccifera) (about 80%) and wild olive (Olea europaea) (about 15%) which occurs only on the southward falling slopes

of the Wadi Zarqa to the southwest of Jarash. The chief associated tree is Ceratonia siliqua.

4.2.1.2 Southern Highlands

The forests of the southern highlands are considerably more degraded than those of the north. There are two major forest associations: Quercus coccifera and the forest of Juniperus phoenicia.

Quercus coccifera associations is found in four remnant areas between Tafila and Petra along the line of the rift valley escarpment. The generally small stunted trees reach maximal height of about 4 meters, and the forest as a whole gives the appearance of open scrub woodland. There are occasional representataives of Pistacia atlantica, Daphne linearifolia, and Crataegus azarolus. Ground vegetation is poor and

desert species such as Poa sinaica and Artemisia herba-alba grows between the trees.

The Juniperus phoenicia forest, occupying about 150,00 hectares in steeply sloping Nubian Sandstone areas, stretches in a continuous line from the Wadi Dana to the village of Um Suwwana. The lower limit of the forest, which grows on thin and eroded sandy soils, is 600 meters; the upper limit is about 1500. Tree diameters are about 40 centimeters, while heights range from 1.5 to 5 meters. The forest grows in association Cupressus sempervirens, which near Rashadiya occurs in a pure stand with individuals of up to 10 meters in height. There fenced and protected grouping may be as old as between 250 and 400 years (Atkinson and Beaumont 1971:310).

In addition to this native forest growth there are scattered throughout the country plantations of eucalyptus, a species particularly well-suited for development in wadi bottoms and other areas of Jordan and widely use in early reforestation attempts in Jordan (Willimott 1964: 54).

4.2.2 Utilization and deforestation

4.2.2.1 Utilization

WOOD PRODUCTION AND UTILIZATION (from FAO Yearbook of Forest Products)
(thousands of cubic meters)

	1963	1966	1971	1972	1973	1974	1975	1976
Total wood production	19	22	7	9	11	12	9	10
Fuelwood	16	18	3*	4*	5F	5	5	3
Industrial roundwood	3	4	4F	5F	6	7	4	7

Jordan also produces a certain amount of paper and paper board: 5,000 metric tons in 1976.

Jordan is almost totally dependent on imports for both wood and wood products. FAO statistics for 1976 show total imports of wood and wood products for that year at $30,167,000. Major shares of these imports were wood-based panels, paper and paper products, and railway ties.

4.2.2.2 Deforestation

Reasons for deforestation have varied from time to time (A&B 1971:310), although overgrazing, clearing of land for agriculture, and exploitation of forest for fuel have been persistent problems.

The effects of deforestation are many: soil erosion resulting from the

loss of vegetative cover; loss of valuable timber resources; and damage to watershed areas.

4.2.2.2.1 Overgrazing

Overgrazing, especially by goats, has been a major cause of depletion of forest resources since the period of Roman occupation. Goats not only eat leaves and shoots of trees but also destroy seedlings and ground vegetation, thereby hindering revegetation. If goats remain, there is little chance of a forest maintaining itself. The problem has been especially severe in times of drought, when goats normally grazed in in the steppe area, move down to the forest margin. Deforestation from overgrazing has been more severe in the southern forests, since arid conditions resulting from lower levels of rainfall make for a more finely balanced and therefore more readily disrupted ecological balance. Overgrazing in this area results from herds of camels, sheep and goats brought in during the summer season by nomads from the east Jordanian desert (Atkinson and Beaumont 1971:311).

4.2.2.2.2 Clearing of land for agriculture.

Various groups of settlers have persistently swept into Jordan, clearing forest for cropland, an activity encouraged by the suitability of the climate in the northern highlands for the production of wheat, vines, and olives. Such cultivation has removed the continuous canopy of vegetation that protected the soil cover, resulting in massive soil erosion which in many areas precludes the regrowth of forest (Atkinson and Beaumont 1971:310). Clearing of forest land for shifting agriculture, which creates great destruction but results generally in very poor returns, was reported as still being practiced on a greatly reduced scale in 1964 (Willimott 1964:61).

4.2.2.2.3 Felling of trees for timber

Exploitation of tree for timber has been practiced in the forests of Jordan for centuries. Especially suitable as timber for roofing poles in housing construction are the junipers; at Petra juniper timbers are remain in reasonably sound condition in a structure built in about 312 B.C. (Willimott 1964:57). Massive and poorly managed exploitation of forests did not begin, however, until the late nineteenth and early twentieth centuries (Willimott 1964:57).

4.2.2.2.4 Barking of oak roots for their tannin matter

Although no longer practiced, the habit of barking the roots of oak trees (Quercus calliprinos) for tanning matter accounted for the loss of large numbers of trees. This pratice was especially prevalent in the Bir Ediddabbaqhat forest near Shaubak in the south (Willimott 1964: 61).

4.2.2.2.5 Collection of wood for fuel and charcoal

Shortage of fuel has for centuries led to massive destruction of trees especially in the forests of the Southern Highlands. The decimation of forests for this purpose reached its high point, however, during the First World War, when there was added to local demands for firewood,

the needs of the Turkish government for fuel to fire its locomotives; a special branch was in fact built into the forest area of Nijil in the south simply to transport evergreen oaks, cypress, juniper, and pistachio wood for the railway system (Willimott 1965:58). Forest fuels have also been exploited for lime burning and charcoal production. FAO figures (see 4.2.2.1) show a dramatic drop in the amount of wood produced for fuel in the last decade; this can be accounted for by the increased use on the part of Jordan's expanding urban population of oil, cooking gas, and electricity for domestic use (Aresvik 1976: 136).

4.2.2.2.6 Other factors contributing to deforestation

Climatic changes possibly affecting forests and vegetation are difficult to assess because of a lack of long-term rainfall records for the area. However, there are indications that average rainfall for the firest half of the 20th century was lower than for the second half of the 19th century, and it has been suggested that reduced rainfall has in all likelihood reduced the rate of natural forest regeneration in those areas transitional between steppe and forest (Atkinson and Beaumont 1971:311).

4.2.3 Reforestation

Earliest attempts at reforestation in East Bank Jordan began in 1943, with systematic efforts beginning in 1948. These activities have been conducted under what is now the Forest and Soil Conservation Directorate of the Department of Agriculture, which operates nurseries from which seedlings are distributed both for private plantings and for the projects of the Directorate itself (Aresvik 1976:182). The area under control of the Directorate has increased over the years, growing from 68,100 hectares in 1958 to 131,500 hectares in 1976; during that same period the area of planted forest increased from 32,000 to 94,000 hectares (Aresvik 1976:183).

In the early 1970's about JD1.5 million were designated for the reforestation of about 122,000 hectares to reduce erosion caused by flood runoffs, to preserve available soil moisture, and to reestablish the capacity of annual rainfall to maintain an adequate level in subsurface aqiufers. According to official estimates, approximately 9 million seedlings were planted in the East Bank from 1967 through 1971 (Nyrop 1974:212). Survival rates for seedlings in reforested areas have been estimated at from 40 to 50% (Aresvik 1976:182).

Official reforestation figures for the years 1971 through 1976 are as follows (Jordan. Dept. of Statistics 1976:127).

	1971	1972	1973	1974	1975	1976
Area newly planted with forest trees (in hectares)	830	1,920	1,220	2,500	3,600	1,800
Thousands of seedlings planted.	1,338	1,734	1,201	2,500.0	3,600	2,000

4.3 SOILS

4.3.1 The resource (see map, page 53a)

Jordan is for the most part underlain by calcareous rock represnting many ages and types. In the north central part of the country there are, however, large areas of basalt laval flows while scattered volcanic intrusions occur along the western escarpment. Sandstones and granites are prominent in southwestern Jordan.

Red Mediterranean soils are typical of areas with greater than 275 mm rainfall; although usually derived from calcareous rocks, such soils are also occasionally derived from basalt and sandstone. Most of the good agricultural soils of the Jordanian plateau belong to this group, which, when deep, serve as excellent cropland. Their naturally high fertility is evidenced by thousands of years of continuous cultivation without extensive fertilization. Red Mediterranean soils in drier areas have a clay content higher in limestone debris; soil depth is quite variable, and topsoil tends to be predominantly loam (Aresvik 1972:22).

Yellow Mediterranean soils are found in some parts of the highlands and in the Rift Valley. Transitional between the Red Mediterranean and the yellow soils, these are are often cultivated with wheat and barley. Good water retentivity make them the best soils for range in the driest part of the semiarid region of the country. Where water is available, they are suitable for irrigation (Aresvik 1976:22).

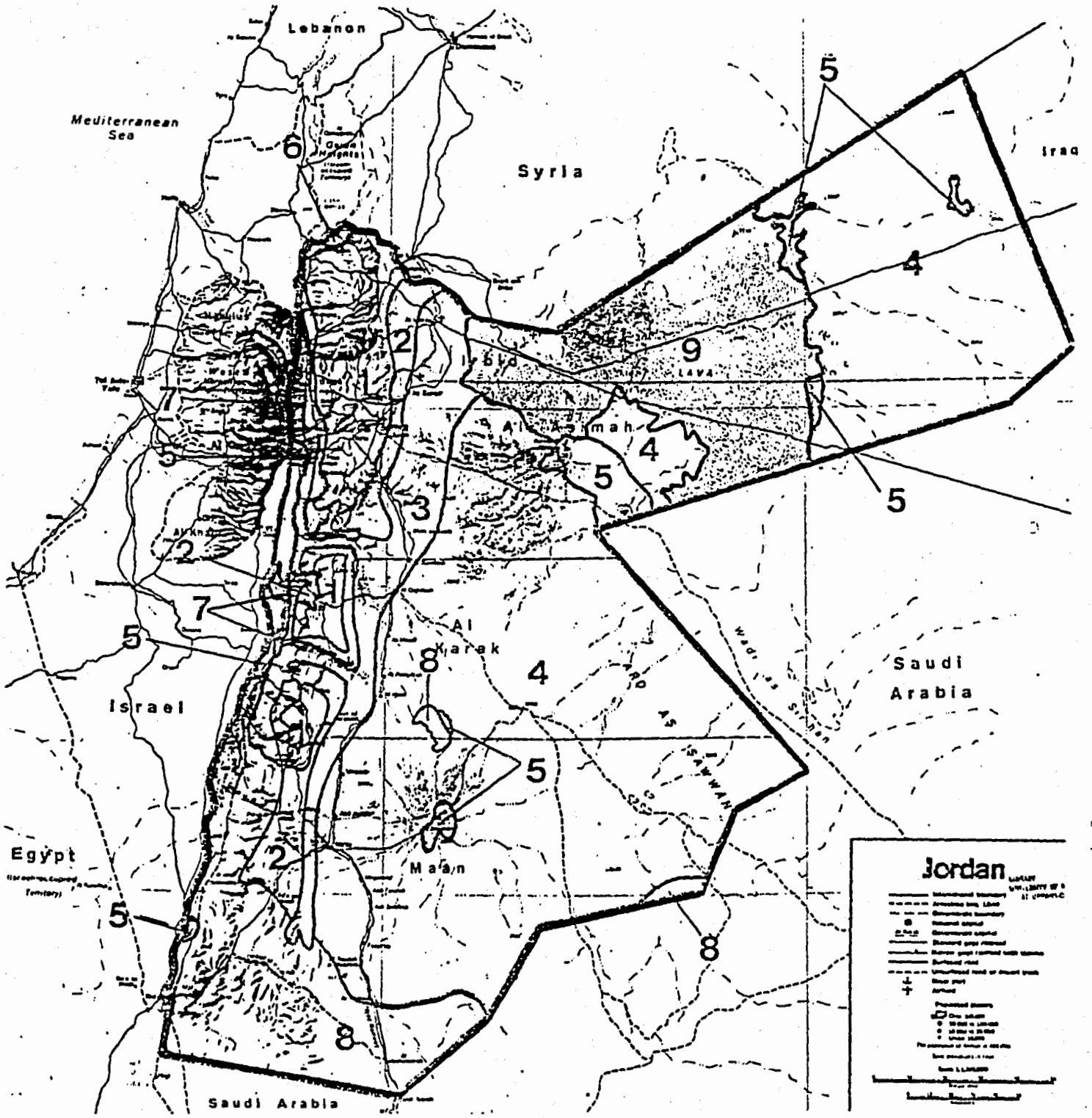
Yellow soils, typical of the arid climate are extremely calcareous, varying in origin from weathered limestone and chalk to colluvial loess. These soils which typically support steppe vegetation have suffered badly from degradation of many kinds: uprooting of shrubs for fuels; excessive ploughing; trampling; overgrazing; and wind and water erosion. It is difficult to regenerate range on these soils (Aresvik 1976:22-23).

Much of the eastern half of the country is covered with grey desert soil (Sierozem) with a layer of flint chips, pebbles, and stones covering a shallow poorly developed horizon of fine-textured material underlain by calcareous bedrock. These soils, which occupy about half of Jordanian territory, are low in organic matter and have low natural productivity; they are generally characterized by a light surface salinity. They support vegetation chiefly suitable for grazing and are generally of only limited agricultural significance. There are, however, indications that agricultural production could take place in areas where underground water is available (Aresvik 1976:23).

In extreme southwestern Jordan soils are derived from the breakdown of sandstone and granite (principally regosols and lithosols), while in seasonally inundated areas in the desert strongly saline Solanchaks and gypsum soils predominate (Madany 1978:7-8).

Alluvial soils, varying in texture from coarse soils in some of the

(from Manady 1979 as based on F. Bender. 1974. Geology of Jordan: Contributions to the Regional Geology of the Earth [Supp. vol. 7]. Berlin: Gebrueder Borntraeger)



1. Red Mediterranean soils
2. Yellow Mediterranean soils
3. Yellow soils
4. Grey desert soils (Sierozem)
5. Solonchaks and gypsum soils
6. Rendzinas
7. Jordan Valley Complex
8. Regosols
9. Basalt Lithosols

wadis to fine silty clay in flood plains, are widely distributed throughout the country. Their composition varies from limestone gravel in the north to granite gravel in the south. (Aresvik 1976:23).

4.3.2 Its utilization

Soil type and moisture conditions combine to make about 9% of Jordan suitable for cultivation (see Agriculture: 5.2.).

4.3.3 Problems with soils

4.3.3.1 Soil erosion

Soil erosion, a severe problem in certain areas of Jordan, arises from several practices: overgrazing; deforestation; and improper land use, especially inappropriate farming methods. A study by Beaumont and Atkinson (1971) of the highly eroded Wadi Ziqlab watershed in northern Jordan, identified all of these factors as contributing to erosion in that area, which, because of the sloping nature of the land and the tendency of the soil to form a surface crust under the influence of moisture, was found particularly subject to erosion.

Soil erosion not only leads to reduced productivity; it also can result in the siltation of reservoirs and a consequent reduction of available water sources. In the catchment area for the King Talal Reservoir, for example, about 95% of the land is said to be affected by sheet erosion resulting from overgrazing, cultivation, and lumbering; the reservoir has an estimated half-life of only 20-25 years if nothing is done about siltation arising from these erosion problems (Arthur D. Little 1979: 11:6-49.). While problems with the planned Maqarin Reservoir are not expected to be so severe, concern has been expressed that loss of grazing land to water as the reservoir is filled, may also result in increases in grazing pressures and subsequent erosion (Arthur D. Little 1979:11:6-49).

Causes of soil erosion

Overgrazing Overgrazing by sheep, camels, and goats has resulting in severe deforestation and loss of vegetative cover and consequent soil erosion. According to once source, the decay of land in Jordan is "largely the result of the nomad and his goat...." (Willmott 1964: 55). Measures designed to prevent grazing in certain area have been difficult to enforce because these animals are an important symbol of wealth in Jordan. According to Beaumont and Atkinson (1969:146), the reluctance of the herdsman to reduce his flocks makes overgrazing "an almost insoluble problem to the conservationist."

Deforestation (see 4.2.2.2)

Farming practices
Several agricultural practices common in Jordan contribute to soil erosion. The practice of ploughing up large areas of land in areas more suitable for grazing land has been responsible for soil erosion

in many areas(Willimott 1964). Furthermore, the spread of farm mechanization has contributed to soil erosion, especially on farmed slopes. Whereas the traditional nail plow has only minimally disturbed the land, disc or mouldboard ploughs used in conjunction with tractors disturb the soil at great depths. Furthermore as reported by Willimott and others, such ploughs are frequently used up and down slopes, a practice encouraged by the narrow nature of many farm plots. This ploughing causes gullying and allows the soil to be washing along the plough furrowing. Nail ploughing, by contrast, was generally done with animal-drawn implements across the slope (Aresvik 1976:91).

Beaumont and Atikinson (1971) observe that for the Wadi Ziglab watershed area of northern Jordan, erosion by water is exacerbated by the monoculture of cereal crops, which leaves the ground surface bare of vegetation during the heavy rainfalls of the winter months.

other factors

Willmott (1964), dealing principally with the southern highlands of Jordan, also identified as causes of soil erosion, the removal for domestic fuel and limestone burning of Artemsia herba-alba, a ragweed-like plant that acts as a soil-stabilizer, and the increase in motorized transport on grazing land, which makes tracks on the land, leads to the destruction of vegetation, and results in gully erosion.

4.3.3.2 Increases in soil salinity

Excess soil salinity is a problem which frequently accompanies irrigation. In the Jordan Valley, the most heavily irrigated area of the country, soils to the south of the Zarqa River are reported to be significantly saline, with salinity levels influenced chiefly by upward movement of water from lower levels. This salinity is felt to be controllable, however, since the soils is also very permeable, thus permitting the leeching necessary to flush out excess salts. However, irrigation water for these areas must continue to be low in salts in order to permit successfuly crop production and leeching must be performed recurrently (in some areas as much as once a year) if salt levels are to be kept tolerably low (Arthur D. Little 1979: II:6-154).

4.3.4 Soil conservation measures

Legislation designed to control soil erosion prohibition grazing on certain types of land and call for afforestation and soil conservation measures for uncultivated land with a slope in excess of 25%. (see 3.2 and 3.3).

In the severely eroded Wadi Ziqlab watershed, soil conservation practices, first introduced in a coordinated manner in 1964, have aimed at the reduction of the rate of soil removal through the introduction of barriers to downslope soil movement. The program concentrated on the construction in parts of the watershed of contour walls, gradoni terraces, and gully plugs in conjunction with a policy of afforestation. Intentions were to extend this program into other watersheds (Beaumont and Atkinson 1969).

4.4 WILDLIFE

4.4.1 The Resource

Despite the desert and arid nature of most of the country, Jordan has had a large wildlife population, which has, however, been drastically reduced since the beginning of the present century.

Mammals include the ibex, gazelles, and antelopes, which along with foxes, jackals, wolves, rabbits and hares, inhabit both the desert and cultivated areas of the country. The more remote mountain areas are said offer habitats for several varieties of wild cats, including leopards, while wild boars are hunted south of the Dead Sea.

Several venemous snakes occur, the most deadly of which is the Levant Viper.

Migratory birds including waterfowl, storks, and smaller land birds, are a prominent feature of Jordan's wildlife scene, while game birds, including partridges, woodcocks, pigeons, quail and grouse are year round residents of areas where water is available. The Azraq oasis, some 112 kilometers east of Amman is of particular importance for birdlife because it serves as a stopping over place for migratory birds.

4.4.2 Its utilization

Little data were available on the present utilization of wildlife in Jordan, although there are indications that desert animals such as the Arabian oryx and the eggs of ostriches and other birds have provided food for nomadic herdsmen (Mountfort 1969:34).
The oasis of Azraq, with its thousands of migratory birds in spring and summer is also of interest to tourists.

4.4.3 Endangered species

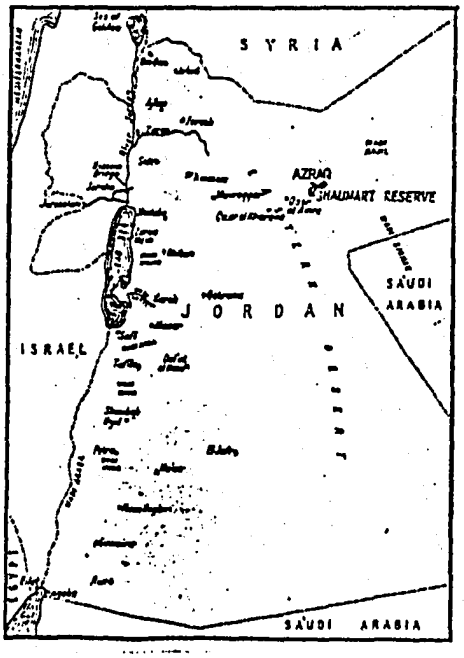
Much of Jordan's larger wildlife was exterminated by overhunting between 1930 and 1960. Some larger wild animals such as the Arabian oryx, Onager and Asiatic lion have entirely disappeared, while some such as the wolf, leopard, cheetah, and ostrich may be locally extinct. Remnant populations of mountain, dorcas, and goitred gazelles occur. Some smaller animals such as the longeared hedgehod and houbara bustard are relatively rare in occurrence but their numbers cannot be documented.(Clarke 1977?: 133).

Several factors account for the decline in wildlife numbers. Habitat deterioration resulting from livestock overgrazing in the semi-arid zones which comprise much of Jordan is one reason, but uncontrolled hunting during the years immediately before and following the second world war served to accelerate this decline, dramatically reducing the numbers of animals such as gazelles from thousands to a few small groups in scattered and remote areas. (Clarke 1977?:133).

Only one Jordanian animal appears on the U.S. Fish and Wildlife Service's list of Endangered and Threatened Wildlife and Plants (1977 edition). This is the Arabian Ostrich Strithio camelus syriacus.

4.4.4 Nature preserves

Concerned over the rapid disappearance of Jordan's wildlife, King Hussein in 1963 invited a group of British scholars, scientists and naturalists to conduct an extensive survey of Jordan's wildlife. This group, which surveyed both mountain and desert regions, gave particular attention to defining the status of endangered species in Jordan, and made recommendations for the establishment of national parks and reserves for the protection of both Jordan's wildlife resources and features of archaeological and geological interests. Three localites were recommended: the 4,000 square kilometer area of the Azraq oasis; about 2,000 square kilometer area around Petra in the Southern Highlands; and a national park centered on Wadi Ram in the Rift Valley (Mountfort 1969:36). The Azraq Oasis, about 112 kilometers east of Amman, is an extensive swamp and marsh area containing the only permanent standing fresh water in several thousand square miles of desert, is an important stopping-over place for migratory birds.



Despite the interest aroused by the work of the British expedition and despite the strong support of King Hussein, little action has been taken on establishing the park system envisioned in 1963. Jordan's first preserve declared by statute is Shaumari, which occupies 16 square kilometers (1600 hectares) within the southern part of the still proposed Azraq National Park in north-central Jordan. Future preserves, predominantly smaller areas, are planned in the immediate area of Shaumari as well as for other parts of the country.

The chief purpose of the Shaumari Preserve, established in 1972, is to provide a base in which to breed endangered species of animals for eventual release into the wild. The animals here concerned are the Arabian oryx, the Arabian gazelle, and the Dorcas gazelle. Although the park is under the general management of the Royal Society for the Conservation of Nature acting for the Ministry of Agriculture, the World Wildlife Fund, through the provision of two Toyota Landcruisers and the services of a project leader, has been of indispensable assistance in bringing the park to the stage at which it now reportedly fulfills the criteria for inclusion in the United Nations list of National Parks and equivalent reserves. Among the achievements of the project are: the construction of a fenced area capable of holding

250 gazelles or 60 oryxzes; the establishment of research programs to study range conditions and animal diversity in abundance; and the training of assistants to run the reserves. World Wildlife Fund personnel associated with the project has also advised the Government on its proposed national park system (Clarke 1977? 133).

Plans for possible mineral development in the area of the Azraq oasis could, however, lead to a reduction of the water level in that area and considerably limit its value as a wildlife reserve.

4.5 Fisheries

4.5.1 The Resource

The Jordan and Yarmouk Rivers support fish life, including such important species as Tilapia (locally called muscht), Cyprinus carpio (carp), Clarius lazeia (Nile catfish), and Barbus spp. (locally called kersin) (Arthur D. Little 1979:1:3-24).

Researchers have reported as many as 96 commercially important species of fish in the Gulf of Aqaba, Jordan's only marine waters. These include 24 open water species (mostly carnivorous), 6 bottom fish, and 67 species which occur in connection with coral reefs and grass flats. Some of these fish, particularly those of the open water, may be migratory; others are present the year round. Other species of commercial importance include the spiny lobster, oysters, squid, and octopus (Potential...1978:58).

4.5.2 Utilization

The contribution of fisheries to the national in terms of both production and employment is presently of limited significance. Fish is an acceptable food item for Jordanians, but as much as 90% of the fish consumed in Jordan is imported, principally from Syria.

4.5.2.1 Inland fisheries

Yields of fish from the Jordan and Yarmouk Rivers have been estimated at from 50 to 100 tons per year, about three quarters of which is reported to be tilapia (Arthur D. Little 1979:1:3-24).

Suggestions for the development of inland fisheries include: the construction of cement tanks for the cultivation of carp at perennial freshwater springs such as those at Shishan and Druze at Azraq, Hadetha, Maghara, and Sehar in the Karak area, and Sukhneh in the area of Zerqa; fish culture activity in the East Ghor canal; and fish cultivation in reservoirs such as Ziglab, Sheib, Kafraen and King Talal. According to one estimate fresh water fish-farming would enable a tripling of present national fish catch if these sources were utilized (Aresvik 1976:212). However, there are reports that efforts at commercial

fish farming in the Wadi Zigiba and the King Tal Reservoir have to date not proved successful (Arthur D. Little: 1979:1:3-24).

4.5.2.2 Marine fisheries

Marine fishing is limited to the Gulf Of Aqaba. No accurate figures on the size of catches in the Gulf are available, but FAO estimates for the period 1955 to 1971 ranged from 100 to 200 metric tons.

The fishing industry in the Gulf of Aqaba has recently been judged to be at "the lowest possible level of development" (Potential...1978:58). This results to some extent from lack of government interest in marine fisheries and its consequent failure to attempt to evaluate

the fishery potential of the gulf. Furthermore, most of the some 50 to 60 fishermen in the area are only part-time fishermen who are unable to earn a living simply by fishing. By one recent report about fifty 8-meter open motor boats with 8 to 10 horsepower engines are used in fishing operations on the Gulf, but for the most part fishermen fish the same areas and employ the same techniques that have been practiced for centuries. Various features of the Jordan coast of the Gulf of Aqaba make trawling impossible and the use of nets difficult (Aresvik 1976:209). Other limiting factors are the lack of organized fisheries and the inadequacy of of processing and marketing practices.

Efforts to develop the fishing industry in the Gulf of Aqaba have involved an economically unsuccessful project under UNDP/FAO auspices to operate a trawler in other areas of the Gulf of Aqaba. Working from the knowledge gained through this expérience, however, Jordan is continuing its efforts, again with UNDP/FAO assistance, to develop commercial fishing and fish production in the Gulf (Aresik 1976:210).

4.5.2.2.1 Possible constraints on development of marine fisheries

Despite these plans, there remains the distinct possibility that commercial fisheries in the Gulf may not be feasible. Although no extensive studies on the fisheries potential of the Gulf have been conducted, the Gulf is reported to be poor in the nutrients necessary to support large commercial fishing operations (Potential...1978:26).

4.5.3 Research

The establishment of the new Marine Science Station at Aqaba should be an important step in studying the fisheries potential of the Gulf. The Station will be equipped to conduct experimental studies in aquaculture (Potential...1978:59).

4.6 Coasts and Beaches

4.6.1 The resource

Jordan's only outlet to the sea is a 26 kilometer stretch along the northernmost point of the Gulf of Aqaba, a fingerlike body of water extending northeast from the Red Sea.

The Gulf, which is part of the Great Rift Valley System that continues north through Jordan into Syria is characterized by deep waters (up to 1830 meters) but a shallow sill at its southern end restricts flow with the Red Sea. Its waters are highly saline (43%), warm throughout the year (21 degrees C to 26 degrees C), well-mixed, highly oxygenated, and more or less uniform in density. Because no rivers flow into the desert from the surrounding desert, there is no fresh water input into the Gulf. The tidal range is less than 1 meter. As a result the flushing rate for pollutants is very low. (Potential...1978:7).

The Gulf contains some of the northernmost coral reefs and mangrove swamps in the world. There are an estimated 100 varieties of coral in the Gulf providing habitat for a varied but fragile marine life, including as man as 1000 identified species of sub-tropical fish. (Potential...1978:8).

4.6.2 Utilization of coasts and beaches

Economic activity on the Gulf of Aqaba is concentrated in the northernmost tip, centered around the cities of Eilat in Israel and Aqaba in Jordan. This activity is split between port activity and industry on the one hand and tourism based on the marine environment and the coral reefs on the other.

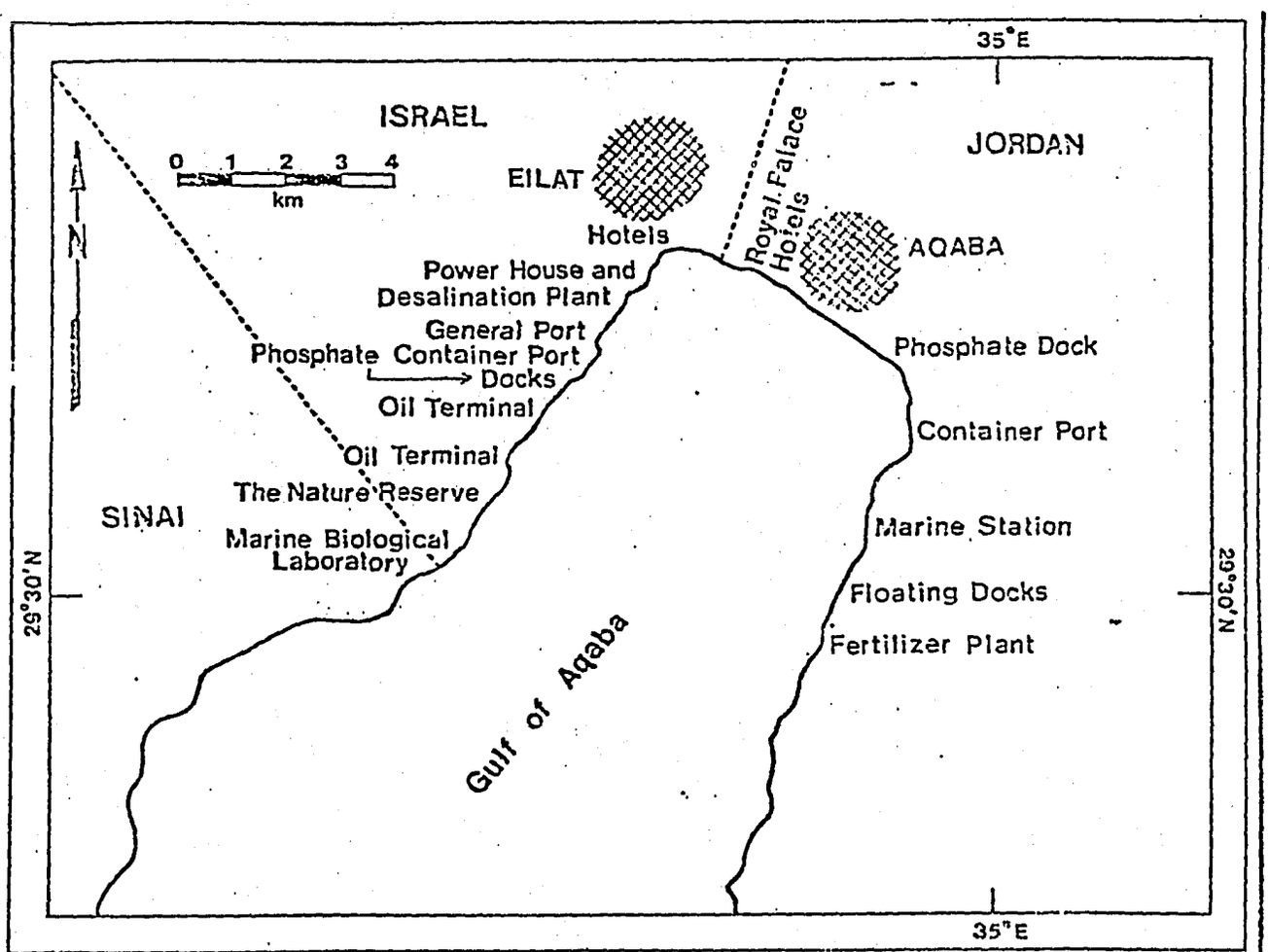
With regard to tourism, many hotels already exist along the waterfront west of Aqaba, and government plans for revitalizing the flagging tourist business include the construction of eight new tourist facilities. Furthermore, there is consideration being given to the construction of a lagoon at the head of the gulf to create an extra four miles of sea front and provide space for 400 private luxury houses and four first-class hotels (Potential 1978:11).

Port activity on the Gulf of Aqaba is also of great importance to the Jordanian economy, handling the vast majority of Jordan's imports and exports. Port facilities are currently being expanded; recent additions have included a large container port and portable floating docks. Tonnage of goods handled at the port is expected to increase from about 1.3 tons in 1977 to about 2.2 million tons by 1981. Growth is expected to increase as phosphate exports are expected to swell to 10 millions tons per year by 1985 and fertilizer. Also being developed are fertilizer and potash operations, a new waste treatment facility, an electricity generator (Potential...1978:11), and a lumber factory processing timber imported from Malaysia scheduled to be in operation

by 1979.

Complicating the picture for the ecology of the area is the varied economic activity centered directly across the Gulf in the Israel port city of Eilat with its hotels, a power house and desalination plant, port facilities, phosphate docks, and oil terminals (Potential...1978:8).

Fisheries, not highly developed in the Jordan Gulf of Aqaba, are considered in 4.5.2.2.



INDUSTRIAL DEVELOPMENT IN THE EILAT–AQABA REGION
(Source: Potential for Cooperative Projects in the Marine Sciences Among Israel, Egypt and Jordan. 1978?)

4.6.3 Pollution in the Gulf of Aqaba

4.6.3.1 Oil pollution

Oil pollution is a major problem in the Gulf of Aqaba. Much of this pollution can be traced directly to small oil spills which occur during the unloading of oil at the Israeli port of Eilat, which has served as an important terminal for the transshipment of Iranian oil to Europe. Oil

from such spills may end up on the coast in Israel, Jordan, or Saudi Arabia, where it threatens the development of both tourism and aquaculture. Larger oil spills have covered the beach in front of Aqaba's major hotel area. Neither Israel nor Jordan is equipped to clean up or contain a serious oil spills. Another source of oil pollution is oily bilge water discharged from the many ships using the port facilities in both Jordan and Israel (Potential...1978:14).

Gradual buildup of oil pollution, while not so spectacularly dangerous as a major oil spill, is a threat to the ecosystem of the Gulf, particularly the coral reefs. There are indications that chronic oil pollution intereferes with coral colonization of the reef flat by preventing normal settlement and development or coral larvae or both (Potential...1978:15). The short and long-term effects of these spills have not been studied.

4.6.3.2 Phosphate pollution

Phosphate pollution of the waters of the Aqaba occurs when phosphate particles entering the air in great clouds during phosphate loading settle out over the Gulf or along the coastline.

Although local scientists disagree about the environmental impact of phosphate dust on the ecology of the Gulf, , such phosphates can have several adverse affects, perhaps the most serious of which is degradation of coral reefs resulting from increased water turbidity from the presence of phosphates, limiting the photosynthetic capacity of the plants on which corals feed, smothering and interering with feeding and respiratory processes. The increased nutrient levels can also create plankton blooms and possible eutrophication (Potential...1978:20). Limited studies of the situation are being carried out by the Israelis in Eilat and at the University of Jordan.

4.6.3.3 Other pollutants

Other pollutants of potential danger to the Gulf include thermo-haline (including heavy metals) pollution from desalinization plants, biocides for preventing fouling in cooling water pipes, municipal and industrial waste discharges, and thermal discharges from electrical generating plants, and sedimentation from coastal construction operations. These problems promise to become increasingly serious as both Eilat and Aqaba continue to expand their populations and industrial operations (Potential...1978:21).

4.6.3.4 dangers to coral reefs

Coral reefs require highly saline water that is clear, free from sediment, and well oxygenated. Reef corals require light for natural biological processes, and a disturbance of light penetration will lead to destruction of the reef (Hulings 1977:2).

Apart from the danger to their continued existence by intentional blasting to clear areas for the construction of port facilities, coral reefs, which are the most sensitive of all marine communities to pollution, are threatened

by pollution already mentioned above, including sedimentation, thermal pollution, desalination effluents, oil, and sewage (Hulings 1977:4).

Sedimentation has resulted from land-fill involved in the construction of additional port facilities, particularly on the south coast, where fine sediment has entered the Gulf and covered coral reefs. Sedementation is also expected to result from the extensionm of port facilities in the Aqaba area (Hulings 1977:4-5).

Chronic oil pollution such as in found in the Jordan Gulf may actually be more destructive than singly large oil spills (Hulings 1977:5).

Thermal pollution will result from the electricity generating plant on the south coast scheduled to being operation in 1977. The discharge (about 700 m3 per day of water at 40 degrees centigrade) will be at the surface and cover an extensive reef complex (Hulings 1977:5).

Desalination effluents from the Royal Scientific Society project are small and are not expected to increase in the near future (Hulings 1977:5).

Sewage enters the Gulf from Jordan in the area of the phosphate loading dock. Although the effects of the sewage effluents are not clear and are in any cases difficult to differentiate from the effects of phosphates, increases in both phosphate pollution and effluents are anticipated in the near future. Increased phosphate could stimulate the growth of algae, which in turn could lead to the degeneration of reefs by reducing necessary supplies of light, oxygen, and food. Increases in algal growth attributed to phosphate dust have been reported for coral reef lagoons in Aqaba. (Hulings 1977:7).

Increased phosphate concentrations could also lead to phosphate poisoning manifested by the prevention of the formation of calcium carbonate skeletons. (Hulings 1977:7).

Salinity of the Gulf remains stable because of lack of significant freshwater discharge into the Gulf in combination with a high evaporation rate caused by high temperatures and low humidity of the prevailing winds. The Gulf is well-oxygenated; pH from the surface to 50 m is slightly above 8.0. Natural nutrient levels in the surface water are low, although they are considerably in the area of the phosphate loading station. (Hulings 1977:2-3).

4.7 MINES AND MINERALS (see map, page 64a)

Mining activity in Jordan dates back to as early as 3,300 B.C., when copper was mined to the east of Wadi Araba. Iron mining began in the Ajlun area as early as 700 B.C. and continued intermittently into Roman times. Before the 1950's, however, when large-scale exploitation of Jordan's phosphate resources was initiated, mining activity in modern times had been limited to quarrying of building materials for local use and to small-scale exploitation of salt deposits, brine, and clay. In recent years extensive eplorations into Jordan's mineral potential have been conducted by outside expertise as well as by Jordan's Natural Resources Authority.

4.7.1 Phosphates

Large-scale exploitation of phosphate began in the the 1950's after massive deposits of these substances were discovered in Ar-Rusaifa --directly to the northeast of Amman-- and Wadi Hasa (about 90 miles to the south of Amman. Reserves of these substances have been estimated at 307 million tons (Nyrop 1974:49), and are thought to be adequate for hundreds of years at current production rates. As of 1973 all phosphate mined was exported, but there have been plans to construct a phosphoric acid plant with a capacity of 110,000 tons per year, thus enabling Jordan to recover such valuable byproducts as uranium. (Chidester 1975:24).
Current production is about 1 million tons annually.

4.7.2 Copper and magnesium

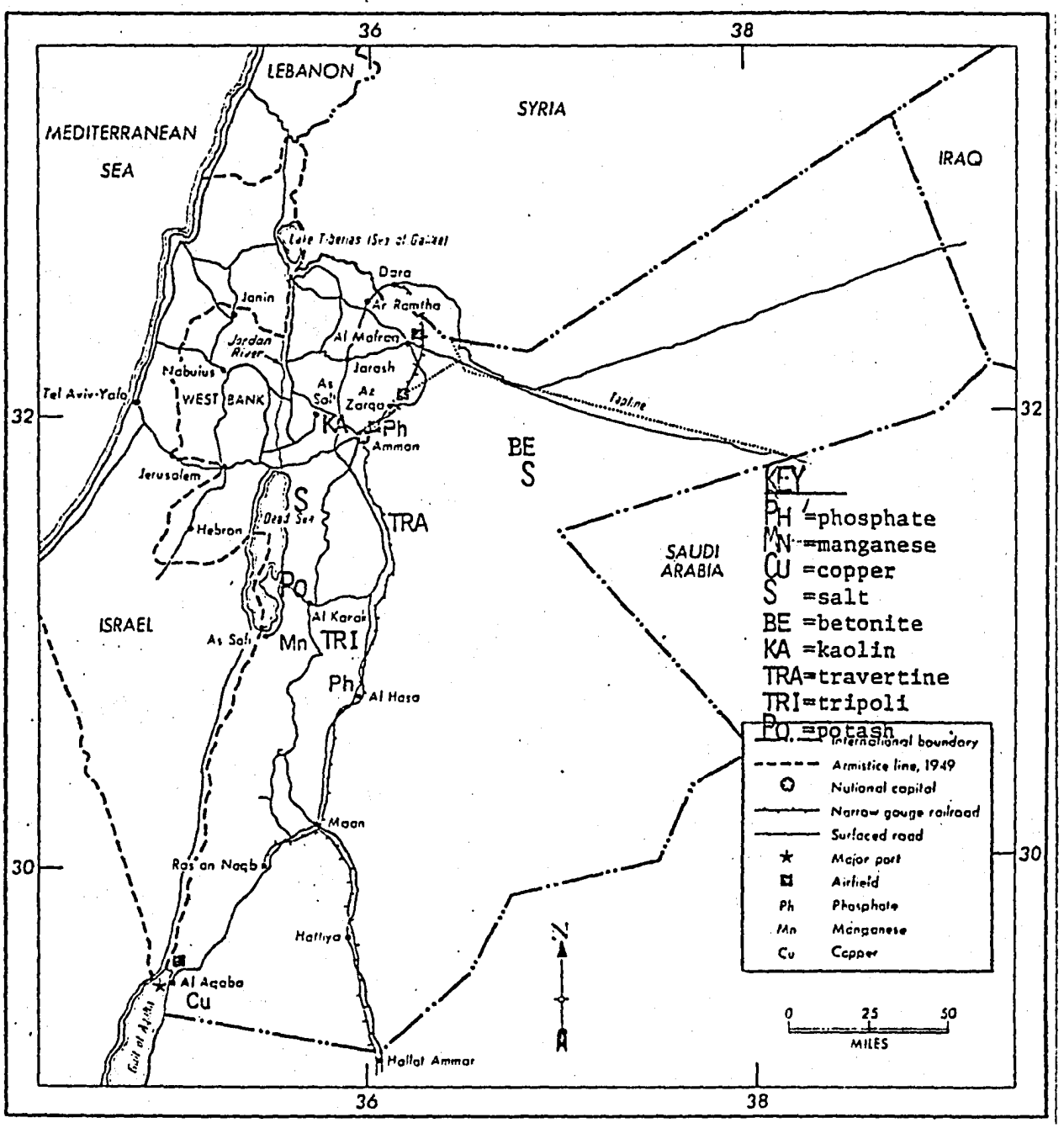
Large deposits discovered are reported between the Dead Sea and the Gulf of Aqaba. It has been estimated that about 700,000 tons of copper might be extracted from these deposits (Germany...Fed. Statistical Office 1977:8). Copper deposits near the port of Aqaba are estimated to be capable of an annual yield of 24 million tons of ore with an average of 1 percent pure copper content (Nyrop 1974:49).

Magnesium: directly to the southeast of the Dead Sea: of questionable value because of its high copper content (Nyrop 1974:49).

4.7.3 Potash

Plans are now underway for the production of potash on the eastern shore of the southern Basin of the Dead Sea with the main production plant at Safi, about 200 kilomters from Aqaba. Israel presently produces potash in quantites of 1.2 millions tons at points along its side of the Dead Sea. Exploitation is to be carried out by the Arab Potash Company, which was formed in 1965. The scheme involves

MINERAL RESOURCES OF JORDAN
(from Nyrop 1974 and other sources)



the production of fertilizer grade potash from carnallite to be precipitated out of Dead Sea brine in evaporation ponds. Production is expected to be about 500,000 tons per year. Water required for plant operations is to derived from groundwater or possibly from surface flows not needed for agriculutral irrigation in the area. Commercial production is scheduled to begin in mid-1982 and to reach full production capacity of 1.2 million tons per year by 1986. The prospective market for the potash would be India, to which the product could be shipped from Aqaba (A.I.D. 1978b).

The enviromental impact of the plant is expected to be small. Emissions from the plant are estimated at 1/10 to 1/100 of the quantities permissible under U.S. standards. Effluent discharged into the Dead Sea is not expected to have deletrious effects, while effects on plant and animal life in the area is expected to be minimal (A.I.D. 1978b:48).

4.7.4 Gypsum

Large reserves of good to excellent quality gypsum are available for manutacture of construction materials and other uses. Limestone for building stone is available in large quantities and is widely quarried (Chidester 1975:24).

An substantial gypsum deposit is on the Zarqa River. Operated by the Public Mining Co., it in 1977 sold 20,000 tons of gypsum of 88% quality to the cement plant northwest of Amman (about 40 kilometers away). This was the mine's only shipment. (Pressler 1978:9).

4.7.5 Kaolin and bentonite clays

Kaolin production at the Mahis mine was just beginning in 1978. The Mahis mine, run by the Public Mining Co., is reported to have contracted to furnish 4,000 tons of the better quality Kaolin to the ceramic factory and 20,000 tons of the lowest quality to a brick company. Much research is needed to ensure the optimal utilization of the various grades of kaolin in this deposit (Pressler 1978:2).

Bentonite is in beds in the sabakh surface at Azraq; it has not yet been fully analyzed and evaluated. Exploitation of this substance at Azraq Oasis, which is also the focus of development activities aimed at tourism, agriculture, and salt production on an industrial scale, might have adverse environmental effects, not only because the heavy equipment required for the operations might destroy the beauty of the oasis but because of possible effect on the hydraulic region of the area, which is an importance source of water, caused by massive inflows of artesian water required for mining operations. In addition, there might be detrimental effects on the migratory birds which use Azraq Oasis as a stopping place (Overstreet 1978:23) and also have occasioned the setting aside of this areas as a National Park.

4.7.5 Salt

Salt has traditionally been produced by evaporation along the Dead Sea. There are future plans for salt production at Azraq Oasis to replace production of salt from solar evaporation pans (Overstreet 1978:23).

4.7.6 Granite

A possible source of granite for building purposes is the Wadi Lebnan area about 40 kilometers northeast of Aqaba; a favorable export market for granite, which would also require processing in a cutting and polishing plant, is foreseen (Pressler 1978: 2-3).

4.7.7 Travertine

A deposit of good quality travertine has been located in the Jordan Valley south of Deir 'Alla. A popular decorative building stone in the north Mediterranean area, travertine might be used in Jordan and also serve as an export item (Pressler 1978:3).

4.7.8 Phosphorite "marble"

Presently being quarried in several places near Daba'a-Siwaqa about 50 kilomteres south of Amman, it is now used primarily as crushed stone chips for flooring, but might also be quarried as a decorative stone for building facades (Pressler 1978:3).

4.7.9 Feldspar

Deposits of feldspar, an important raw material for the glass and ceramic industry, have been found in the Aqaba area and there are indications of considerable potential for the commercial exploitation of this resource both for Jordanian industry and for export to the Middle East and Mediterranean countries (Pressler 1978:3-4).

4.7.10 Glass sand

Research has indicated the presence of rutile (TiO_2) in the Ras en Naqb glass sands in quantities up to 0.5% TiO_2. It has been suggested that rutile present in amounts ranging from 0.09 to 0.20% might be recovered as a byproduct during preparation of sand for a glass plant. The laboratories of the Natural Resource Authority are not, however, equipped to carry out studies on the feasibility of recovery.

Several suggestions have been made for the location of a glass plant to utilize Jordan's glass sands; Aqaba has been suggested as the most favorable site (Pressler 1978:7-8).

4.7.11 Light-weight aggregate

Along the Baghdad highway, about 30 kilometers west of H-5 is an area of cinder cones, one of which has been used for the production of red volcanic cinders for highway construction. It has been suggested that these cones might also be exploited as a source of light-weight aggregate for the purpose of lightening concrete block and concrete flooring materials (Pressler 1978:10).

4.7.11 Tripoli

Desposits of tripoli are located near Kerak and near Ainun and El-Shahabiyeh south of Kerak. This substance, which has not yet been exploited in Jordan, has several importance uses in abrasives, buffing and polishing compounds as well as for mineral fillers and extenders. (Pressler 1978:10-11).

4.7.12 Oil shale

Massive reserves of oil shale have been identified and investigated but not yet exploited (Chidester 1975:24).

4.7.13 Petroleum

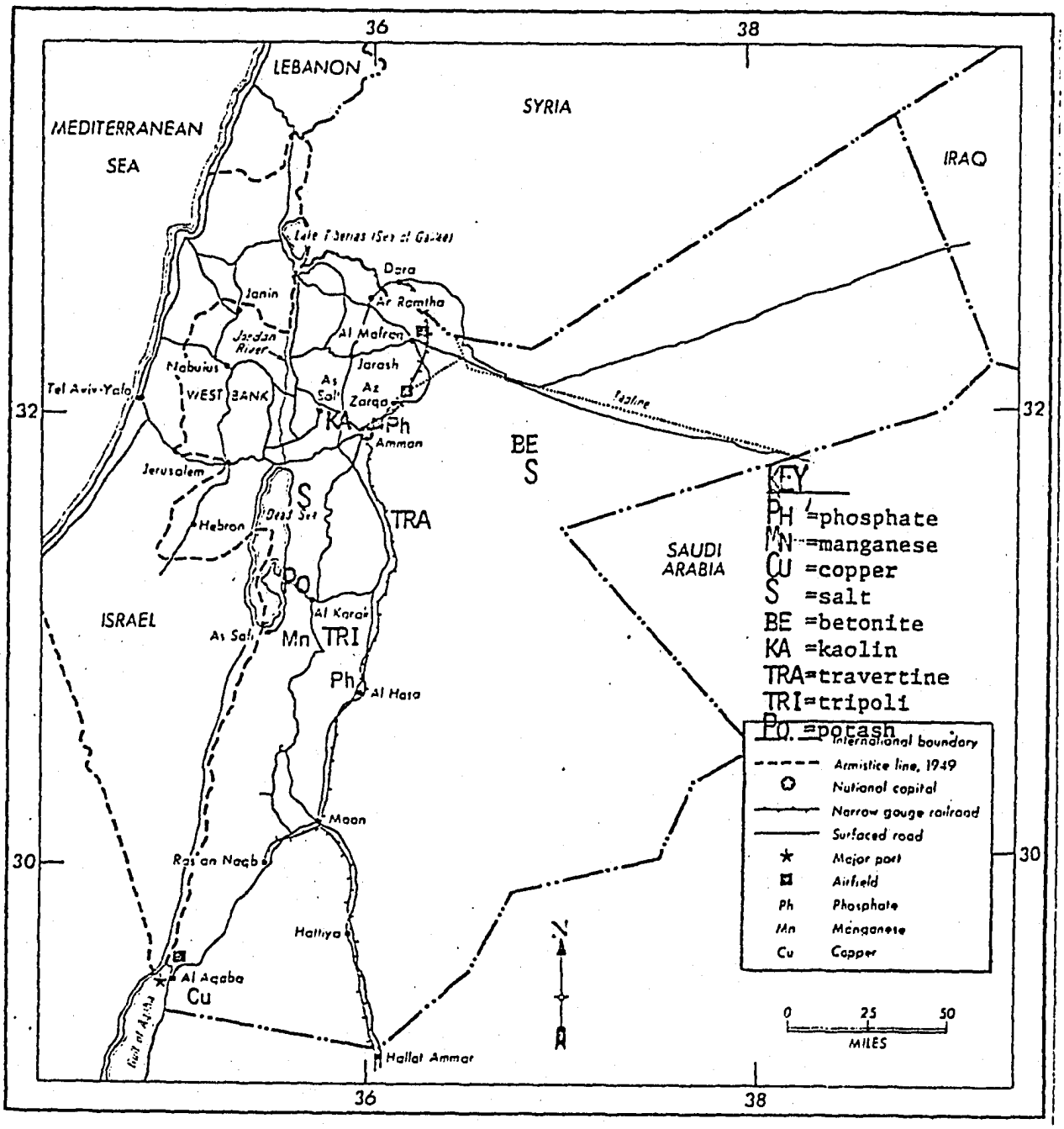
Despite extensive research, no deposits of petroleum have been found in Jordan.

4.8 AIR AND THE ATMOSPHERE

Meteorological conditions prevalent throughout most of Jordan favor good air quality by dispersing or diluting possible pollutants. These conditions are: consistent daily winds, the lack of a persistent cloud cover, topography, and a warm sunny climate. Overnight inversions occur in the valleys and the uplands, however, and the air below such inversions may contribute to significant accumulations of pollutants. The Meteorological Depart ments believe that daily winds and warmth normally break up such inversion within 6 to 8 hours after they are formed (Arthur D. Little 1979:11:6-14). For a discussion of air pollution problems in the highly industrialized Amman-Zarqa area, see 5.3.1.

MINERAL RESOURCES OF JORDAN

(from Nyrop 1974 and other sources)



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4.9 CULTURAL RESOURCES

4.9.1 Archaeological sites

The area of the Middle East currently occupied by the modern state of Jordan has been the scene of human activity for centuries. Although actual settlements in the area did not begin until some time during the Neolithic period (8000-4500 B.C.) and urban centers first appeared during the Bronze Age (3300-1200 B.C.), evidence of human occupation in this area dates back as far as 100,000 B.C. Archaeological finds in Jordan, therefore, cover an enormous stretch of human history, including major sites from the Neolothic period, the Bronze Age, the Iron Age, the Hellenistic Age, the Nabataean civilization, the Roman period, the Byzantine Empire, Early Islam, the era of the Crusades, and the Turkish occupation.

In all, Jordan contains some 800 known archaeological sites, most in the northwestern region, with 224 in the Jordan Valley alone. However, fewer than five percent of the known sites have undergone major excavations. Furthermore, many areas of Jordan remain unexplored. (Arthur D. Little 1979:1:3-29).

4.9.2 Threats to archaeological sites

4.9.2.1 Looting

Archaeological sites have been affected over the centuries by looting. Tourists continue to provide a ready market for stolen antiquities, although sales of such objects are now forbidden by law (Arthur D. Little 1979:11:6-71).

4.9.2.2 The Maqarin Dam

Development of water resources through the flooding of areas to form reservoirs can lead to the loss of archaeological sites located in proposed reservoir areas.

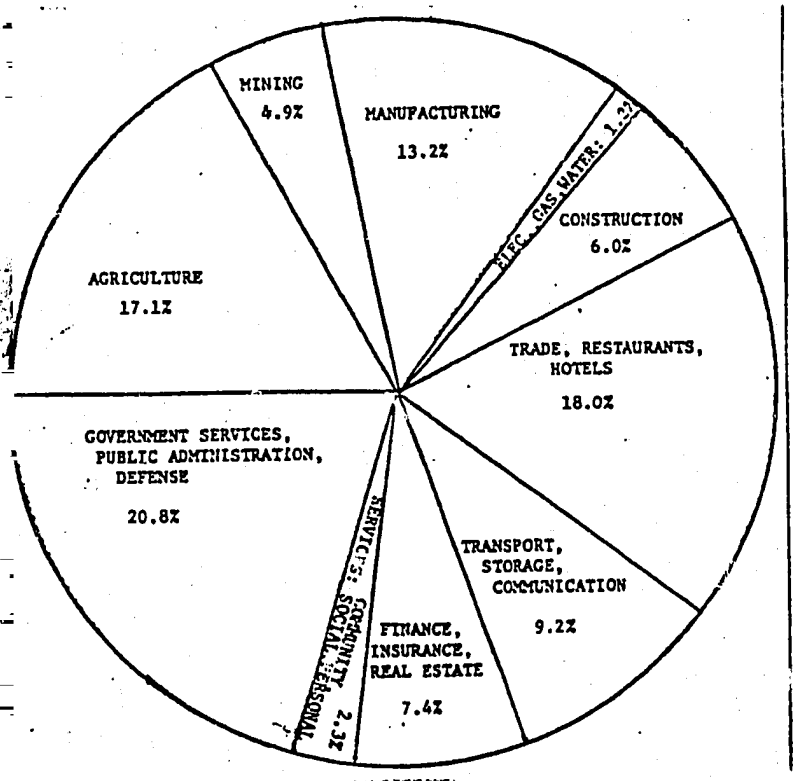
As detailed in the environmental assessment prepared for the Maqarin Dam on the Yarmouk River in north Jordan, there are 32 known sites in the area of the dam. These sites, ranging in size from 3.4 square meters to 8 hectares, represent about 100,000 years of history, beginning in the Lower Paleolithic and continuing through the period of the Turkish occupation. Only four of the 32 sites will not be affected by the dam. Of the remaining 28, however, 18 will eventually be completely destroyed under the present plan for the dam.

In the lower Jordan Valley, the area to be irrigated by the waters supplied by the Maqarin Reservoir, are 29 sites representing the Neolithic through the Turkish periods. All but one of the sites, the largest and most important of which is Ghassul (Neolothic/Chalcolithic) is threatened by the expansion of agriculture in the area. Dangers come not only from, ploughing and leveling of land but also from road building and from a possible increase in the incidence of site looting (Arthur D. Little 1979:11:6-61--6-70).

5.0 THE ECONOMY OF JORDAN

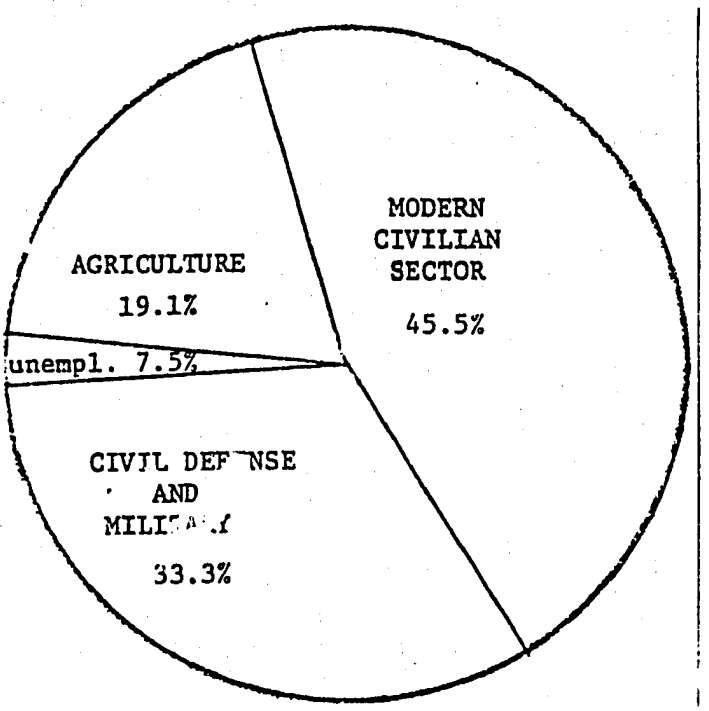
GNP: 1.9 billion (East Bank only, 1977 estimate)
Share of GNP per capita: $870
Real growth rate (1973-1977): 14%
Exchange rate: 1 Jordanian dinar (JD)= $3.32 (National Intelligence...1979)
Total government expenditures (1978): JD371.8 million

GROSS DOMESTIC PRODUCT BY SECTOR (1975)



Source: U.N. National Accounts Statistics, 1977.

EMPLOYMENT BY SECTOR (1975)



Total workforce in Jordan: 382,800.
An additional 150,000 Jordanians are working abroad.
(Birks and Sinclair: 1979:73)

5.1 General economic situation

5.1.1 General picture

The Jordanian economy has suffered several blows in the years since the country was founded in 1948. The Arab-Israeli wars of both 1948 and 1967 brought hundreds of thousands of refugees into the area of Jordan east of the Jordan River, and the war of 1967 resulted in the loss of the some 6,000 square kilometers of West Bank Jordan, which included among other things, valuable fruit and vegetable growing areas and many of the archaeological sites that had served to attract tourists to Jordan. Although trade and services have consistently accounted for nearly two-thirds of Jordan's Gross Domestic Product, agriculture had been, until recent years, the most important productive sector of the Jordanian economy with regard to both employment and exports; however, the contribution of agriculture to GDP has declined, dropping to about 7% in 1978, while employment offered in that sector fell from about 33% in 1972 to about 19% in 1975 and an estimated 18% in 1977. At the same time mineral development, principally phosphate production has become of increasing importance, supplying about 50% of exports in 1977, while the manufacturing sector, although predominantly concentrating on food and clothing production, has come to include cement production and petroleum among its activities. Tourism, which fell off considerably after the 1967 war, has experienced an upsurge with 1,073,294 visitors in 1976, significantly higher than the 1966 level of 617,000. Income from Jordanian workers abroad has also been of importance, remittances from such workers totalling $360 million in 1976. Development continues to rely heavily on foreign aid.

5.1.2 Jordanians abroad

In 1975 about a quarter of the Jordanian population lived and worked abroad, the largest single group in Saudi Arabia (66%), with another 18% in Kuwait and the remainder in other Near East countries. Most of these some 150,000 migrant workers (about 46% of the workforce) come from the modern sector non-farm civilian workforce. Among those Jordanians abroad in 1975, 69.4% had a secondary degree certificate or higher, as opposed to about 8.3% among a sample groups in Jordan itself; therefore, Jordan is said to suffer from a brain drain among its more educated population, who are attracted by higher wages in neighboring Arab states. In addition to this loss of expertise, much of it produced at Jordanian government expense, there are indications that Jordan's agricultural sector is suffering from a lack of workers as rural people leave the farms to join the modern sector in the cities or abroad (Birks and Sinclair 1979:78). Much farm labor in Jordan is now performed by laborers brought in from Egypt.

On the positive side, is the foreign exchange Jordan has been earning at an increasing rate as a result of remittances from migrant workers abroad; these remittances, coming particularly from unskilled or semi-skilled manual workers whose residence abroad is only temporary, accounted for 31.2 of imports and 32.4% of the gross national product in 1976 (up from 11% and 5.5% respectively in 1973). There is, however, the

strong possibility that as jobs in construction, which occupy a large pecentage of those workers sending remittances to Jordan, decrease in countries such as Saud. Arabia, workers will be returning to Jordan in large numbers and remittances will decrease accordingly (Birks and Sinclair 1979:79-81). In contrast to these lesser skilled workers, more highly educated and trained Jordanians tend to establish their residences abroad and to become increasingly lost to the Jordan economy (Birks and Sinclair 1979).

5.1.3 Development plan expenditures

Under the 1976-1980 development plan, which calls for a joint public and private expenditure of JD 765 million, the Jordanian government is emphasizing the development of the commodity producing section of the economy. Chief emphasis, therefore, has been placed on the development of industry and mining.

Expenditures projected under 1976-1980 development plan

Sector	Amount (millions of Jordanian dinars)	% of total
Mining and Industry	229.1	29.9%
Transport	119.9	15.6%
Water	97.4	12.7%
Housing, government buildings	88.0	11.5%
Electricity	42.8	5.6%
Agriculture	40.0	5.2%
Municipal and village affairs	38.8	5.1%
Education and welfare	34.6	4.5%
Tourism and antiquities	24.4	3.2%
Communications	20.1	2.6%
Miscellaneous	11.4	1.5%
Health	9.0	1.2%
Trade	3.8	0.5%
Work and vocational training	3.8	0.5%
Culture and information	2.9	0.4%
Social welfare	1.0	0.1%
Total	765.0	100.0 %

5.1.4 Development aid

Development aid, on which Jordan heavily depends, has come increasingly from Arab sources, particularly Saudi Arabia and Kuwait, but the United States still remains the largest single contributor, with an estimated JD 15 million in 1977.

5.2 Agriculture

5.2.1 General situation

Despite the recent decline in its share of the Gross Domestic Product, agriculture remains an important part of the Jordan economy, and Jordan's cultivable land has been called its principal natural resource (Arthur D. Little 1979:11:3-63). Although there has been some improvement in this regard, the agricultural sector still does not satisfy the country's food needs; major agricultural imports for 1976 were wheat, barley, potatoes, onions, apples, and pears.

Potential cultivable area for Jordan was estimated at around 871,200 hectares in 1975 (about 9.1% of the land area). However, only about 32.3 percent of that area was actually under cultivation and 9.5 per cent was fallow or not in use (Jordan...Min. of Information 1978:110). Total arable land in the East Jordan valley is estimated at 42,000 hectares, about 36,000 of which are irrigable (Arthur D. Little 1979: 11:6-129).

Water is the chief limiting factor for agriculture in Jordan. Rainfall, which tends to be erratic in occurrence from year to year, is low throughout most of the country, and weather factors such as drought and frost often account for widely fluctuating levels of agricultural production. Wheat production in 1972, for example, was 211,000 tons, declined to 50,000 tons in 1973, and jumped to 213,000 tons in 1974 (Jordan: Ministry of Information 1978:108). Agricultural production should increase as irrigation schemes make water more widely available; however, the possibility for increasing water supplies for agriculture is constrained not only by a limited water potential but also by increasing competition for such water from domestic and industrial users.

Other factors limiting Jordanian agriculture are: the size and nature of agriculture holdings (see 5.2.2) and inefficient farming methods. Another factor possibly contributing to low agricultural production is the loss of a substantial portion of the agricultural workforce, as workers are attracted to higher paying jobs in other Arab countries (see 5.1.2).

5.2.2 Farm size and land tenure

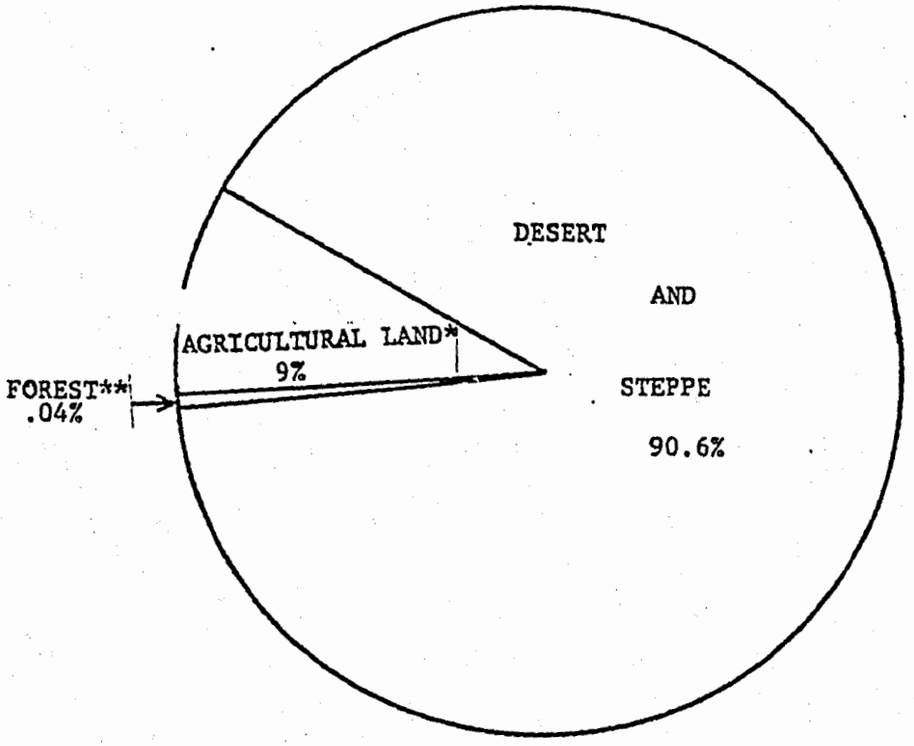
There are around 50,790 land holdings, about a third of which are less then one-tenth of a hectare and another third of which range from 1 to 5 hectares (Jordan, Min. of Information 1978:110).

The predominant form of land tenure is the owner-farmer. As indicated by the 1975 Agricultural Census, about 65% of the land was operated by owners and 20 per cent by owners and tenants; less than 12 per cent was operated by tenants only. Tenancies are based on sharecropping (Jordan, Min. of Information 1978:110).

The small size of most holdings and the additional complicating circumstance that many of these plots are narrow and run up and down slopes are major factors in explaining Jordan's low level of production for wheat, its

LAND USE IN JORDAN (East Bank)

Total area: 92,552 square kilometers



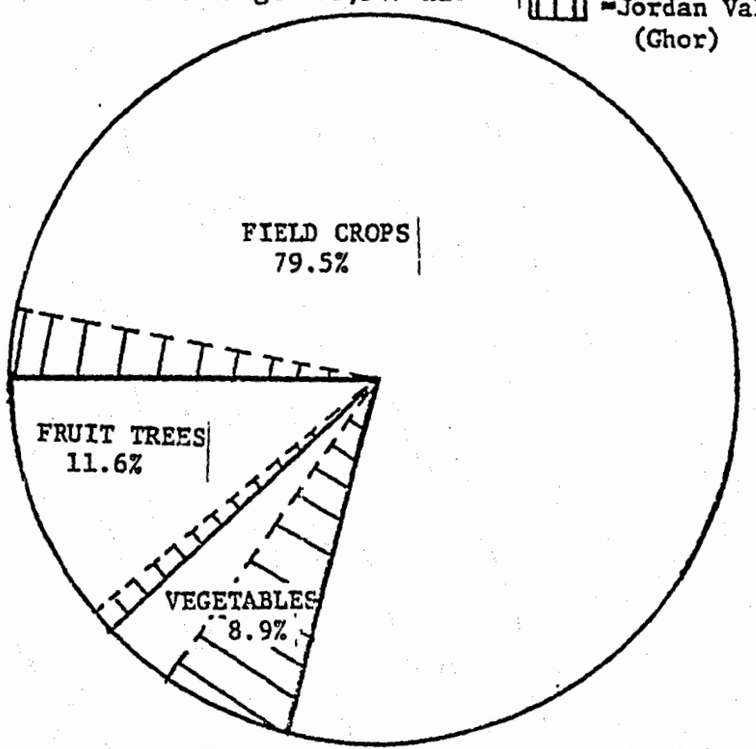
*Jordan Statistical Yearbook 1976: 120.

**Aresvik 1976:107.

USE OF CULTIVATED LAND: 1976

total hectarage=282,547 ha.

▥ =Jordan Valley (Ghor)



Source: Jordan Statistical Year-

major crop. Modern farm equipment is difficult to use on these plots, and the practice of cultivating up and down slopes plus a lack of soil and water conservation measures leads to soil erosion and reduction of productivity.

.2.3 Trends in agriculture:

East Bank statistics for the years 1956 through 1972 show a decrease in land under field crops from 93.4% of cultivated land to 83%, an increase in land planted to vegetables from 3.0% to 10% of cultivated land; and an increase in land planted to fruit trees from 2.9% to 7.1%. This is indicative of the trend toward a growing intensification of vegetable and fruit production in relation to the production of field crops. (Aresvik 1976:77). Vegetables have played an increasingly important role in total agricultural GDP, especially in relationship to the total amount of land planted to these crops. In 1972 the 83% of cultivated area in field crops yielded only 19% of total agricultural GDP, while the 17% in fruit and vegetables contributed 29%.

Another trend which goes hand in hand with the shift in crop production is the increase of irrigated land. Whereas only an estimated 30% of agricultural production value was derived from irrigated land for the period 1959-1961, estimates for 1972 show irrigated agriculture contributing 42% to agricultural GDP, 32% of which was accounted for by vegetables and fruits (Aresvik 1976:77).

5.2.3 Major crops

5.2.3.1 Field crops

MAJOR CROP PRODUCTION: 1973-1977 (Area in thousands of hectares, production in thousands of tons)

	1973		1974		1975		1977	
crop	area planted	pro-duct.	area planted	pro-duct.	area planted	pro-duct.	area planted	pro-duct.
Wheat	2,23.7	50.4	2,46.2	244.5	1,18.3	50.0	1,26.5	62.5
Barley	53.2	5.9	64.9	40.2	52.9	11.8	46.3	12.0
Lentils	24.2	4.8	21.6	29.5	14.9	5.2	13.5	6.0
Kersenneh	8.1	2.3	7.8	6.6	4.2	1.9	4.4	1.9
Maize	0.2	0.2	0.3	0.4	0.6	0.7	0.2	0.3
Sesame	0.7	0.1	0.8	0.1	0.3	0.1	n.a	n.a
Chick Peas	7.3	1.9	12.5	8.3	0.02	0.1	!.4	0.6
Broad Beans	0.3	0.1	0.5	0.7	---	-----	0.4	0.4

Source: Europa Yearbook 1978

As indicated by the above table, wheat is the principal agricultural crop of Jordan. Wheat is grown in several areas of the country, almost entirely under rainfall conditions. The principal wheat producing areas are the eastern area and the western plains area, which together comprise about 1,300,000 hectares bounded by Jarash in the north and Shawbak in the south. Only about 5,000 hectares (or about 2.4% of total wheat hectarage) were planted to wheat in the irrigated areas of the Jordan Valley as of 1974; these areas, however, account for an estimated average 5.4% of the wheat crop since yields per hectare are higher than in any other wheat-growing region in Jordan (Aresvik 1976:142). These yields, although high by Jordanian standards, are nevertheless far below those produced in irrigated areas of countries such as Egypt and Mexico (Aresvik 1972:142).

Although scarce and erratic rainfall is cited as the chief reason for low wheat yields in Jordan, other significant causes are poor soil-moisture management, poorly prepared seed beds, hand seeding, inadequate fertilizer applications, heavy weed infestations, and the use of low-yielding potential varieties of wheat (Aresvik 1976:144).

Tobacco is Jordan's major industrial crop. About 2,800 hectares were planted to tobacco in 1976, with production yields of 734 tons. As is the case with most of Jordan's agricultural products, production levels are low in contrast with other tobacco producing countries (Aresvik 1976:150).

5.2.3.2 Fruits and vegetables

Vegetables have gained increasingly in importance in Jordanian agriculture, principally because of the expansion of irrigated areas, about 90% of which are planted to fruits and vegetables. The Jordan Valley is especially favorable for vegetable production. Tomatoes, Jordan's largest vegetable crops, are an important export item. Jordan's vegetable yields are low, however, in relation to other vegetable producing areas and below actual potential; factors accounting for this situation are: the use of inferior disease-susceptible varieties, irrigation patterns which exclude mechanized tillage and chemical weed control, inadequate knowledge of optimum fertilizer rates, and insufficient use of crop rotations to maintain soil fertility and control disease and pests (Aresvik 1976:163).

Among fruit crops, olives and grapes have always been of great important in Jordan, but Jordan's climate permits the growth of a variety of fruit trees ranging from semi- and subtropical trees such as citrus, bananas, and date palms to deciduous fruit trees such as apples. Fruit tree production is concentrated mainly in Irbid and Ba'qa governorates, followed by Amman and Karak; citrus and banana trees are chiefly in the Jordan Valley area.

PRODUCTION OF FRUIT AND VEGETABLES:1973-1977 (production in thousands of metric tons)

Vegetables	1973	1974	1975	1976	1977
Tomatoes	83.1	133.3	145.0	87.9	85.7
Eggplants	14.7	32.4	39.6	42.8	24.6
Onions&Garlic	3.8	1.8	2.5	1.3	0.4
Cauliflowers&Cabbages	10.4	15.9	8.7	7.7	6.3
Watermelons&Melons	56.0	46.6	50.4	23.1	28.1
Potatoes	0.4	3.9	5.1	13.0	13.0
Broadbeans(Green)	1.8	3.4	3.1	4.7	6.5
Cucumbers	10.4	17.5	18.0	12.9	13.6
Fruit	**1973**	**1974**	**1975**	**1976**	**1977**
Almonds	0.2	0.8	1.0	0.6	0.4
Apples&Pears	0.4	4.0	1.4	0.7	1.2
Apricots	---	1.5	6.8	0.2	0.6
Citrus fruits	15.4	33.6	12.8	16.5	36.5
Figs	1.0	1.2	0.1	0.3	0.6
Bananas	2.3	4.4	6.3	4.5	3.4
Plums & Peaches	---	0.3	0.3	0.4	0.8
Olives	5.2	40.5	4.7	22.5	

5.2.4 Animal Husbandry

Animal products account for about a third of the total agricultural production of Jordan. Large parts of the country, particularly the steppe and desert-like regions comprising the greater part of Jordan are suitable only for nomadic or semi-nomadic animal husbandry, which is conducted principally by Bedouins. Nomadic herdsmen depend principally on natural growth in the spring and on fodder and cereal-by products in the summer. Attempts have been made to establishment permanent settlements for nomadic herdsmen. Such a settlement is located in the Qaal Jafr depression northeast of Maan in the south, where experiments are being carried out for watering animals and producing proper forage through the use of pumped groundwater (Nyrop 1974:211).

Whereas sheep and goats, the chief domestic animal, are rather evenly distributed throughout the agricultural areas of Jordan, cattle populations are concentrated in northwestern Jordan around Amman-Zerqa and Irbid (Aresvik 1976:

NIMALS AND ANIMAL PRODUCTION

animal production 1961-65 average/1977

961-65 verage (thousands	1974 of heads)	1977	slaughtered (thousands of heads)	meat (thous. m.tons)	milk (thous. m.tons)	cheese (thous. m.tons)	eggs (thous.)	skins	wool (raw)
6	2F	3F							
15	8F	9F							
78	38F	50F							
61	47	36F	25/12F	3/1F				505/ 240F	
ws 16	9F	9F			12/9				
752	792	820F	373/480F	5/6F	22/24F	2484/ 2651F		1120/ 1440F	1740/ 3700F
592	399	490F	340/415F	5/6F	17/14F			850/ 1038F	
17	16	19F							
1696	2700F	4500F							
				2/7F			4674/		
25	17	19F					8200F		

As is clear from the above table, livestock serve many purposes: meat, clothing, dairy products, and skins for handicrafts. In addition, domestic animals serve as work animals for sedentary farmers and also are a source of natural fertilizer. In addition to the above animal, honey bees are kept in many areas of the country; honey production in 1977 was estimated by the FAO at 50,000 tons.

5.2.4.1 Cattle

The Baladi breed of cattle, a mixture of groups of cattle raised in Jordan since early times, is the predominant breed, accounting in 1972-73 for approximately 83% of total cattle population. These cattle are well adapted to arid conditions and can survive under near starvation feeding conditions. Although developed as a triple-purpose meat, milk and draft animal, the Baladi cattle have proven uneconomical as dairy or beef cattle, and endemic disease and inadequate feed tend to restrict their usefulness in their principal role as work animals (Aresvik 1976:193).

In some areas, particularly Amman-Zerqa and Irbid, Holstein-Friesian cattle are used for dairy production, and the government has expressed interest in developing Holstein-Friesian cattle and eliminating the Baladi cattle for milk production. It is felt that cows for milk production could economically use feed grasses whose introduction in both irrigated and rainfed farming areas would be favorable for the improvement of crop rotations and soil structure (Aresvik 1976:193-194).

5.2.4.2 Sheep

The breed of sheep raised in Jordan is the Awassi, a hardy, fat-tailed, carpet-wool variety. These sheep kept mainly under nomadic and semi-nomadic conditions, are shepherded in the eastern steep grass land and the southern brush vegetation regions in the spring and moved to the uplands in the summer; in autumn and early winter they are driven to the eastern and southern deserts. This management system has resulted in malnutrition of animals, popor productive and reproductive performance, and high mortality from disease. Sheep are used both for wool and milk production, but their chief function is that of supplying the type of red meat most favored by Jordan's population (Aresvik 1976:194).

5.2.4.3 Goats

Raised chiefly in marginal farming areas, goats are kept mainly for meat production, with milk and hair as important by-products among the Bedouins. The majority of Jordanian goats are of the black hairy desert type, but Shami dairy goats from Syria are being imported in increasing numbers (Aresvik 1976:196).

5.5.4.4 Poultry

Commercial poultry production, which was not developed until 1958, is centered in the Amman-Zerqa area and around Irbid, the northwestern population centers. Concentration has been on meat production rather than on egg production, since the former is more profitable and because of the difficulty of competing with low-priced imported eggs from Eastern Europe, Lebanon, and Syria (Aresvik 1976:204-205). The government of Jordan has set a goal of increasing egg production to 100 million eggs per year.

5.2.4.5 Effects of livestock grazing

Jordanian rangelands have been misused for hundreds of years but destructive utilization has become increasingly widespread in the past few decades. (Arar 1978:2). This depredation is due principally to increases in livestock numbers, resulting in overgrazing. (Arar 1978:2-3). Valuable rangeland food shrubs are also uprooted to be used as firewood for cooking; the number of such shrubs uprooted by nomads alone has been estimated at 182 million per year (Arar 1978:2-3). Furthermore, overgrazing especially by goats, is cited as one of the chief reasons for deforestation in Jordan.

Since lack of water rather than lack of feed is the limiting factor in livestock raising as in agriculture in general (Arar 1978-2-3), it has been suggested that livestock water development employing such means as, for example, rainwater harvesting, be employed to allow available feed to be used more fully. However, it has also been pointed out that unless water development goes hand in hand with rational range

management, it could result in unwanted increases in livestock numbers leading to overgrazing and finally to desertification, as has occurred in, for example, the Sudan (Arar 1978:4).

5.2.5 Irrigation

By recent estimates, irrigated areas in Jordan cover from between roughly 25,000 hectares (only some 8% of cultivated land) , about 65% of which (15,800 hectares) are in the Jordan Valley. Schemes presently under construction are expected to permit the irrigation of 9,400 additional hectares in that area, while Stage II of the Jordan Valley Development plan has called for the extension of irrigation to about 11,000 hectares in the south Jordan Valley. Under recent changes in the Stage II Development plan, only about 5,000 irrigated hectares would be added; water previously intended for irrigation would instead be used for municipal and industrial purposes (Arthur D. Little 1979: 11:6-129).

The most important component of Jordan's irrigation system is the East Ghor Canal, which presently runs about 90 kilometers from the Yarmouk River in the north to within about 15 kilometers of the Dead Sea in the South. It is the construction of the proposed Maqarin Dam on the Yarmouk River in the north, which would allow for the extension of the canal to the Dead Sea and permit the irrigation of an additional hectarage of land at the southern tip of the Jordan Valley.

5.2.6 Fertilizers and pesticides

Because of high costs and lack of knowledge of their use, inorganic fertilizers have not been widely utilized in Jordan; sales of inorganic fertilizers for the years 1972-1976, as reported in the 1976 Statistical Yearbook of Jordan, were as follows:

Inorganic Fertilizers Sold to Farmers During 1972-1976
(in tons)

Year	Type of fertilizer: phosphatic	nitrogenous	other	total
1972	72	2,999	736	3,807
1973	n.a.	1,222	1,570	n.a.
1974	n.a.	820	280	n.a.
1975	n.a.	200	801	n.a.
1976	397	450	n.a.	n.a.

Import statistics indicate a somewhat higher use of such fertilizers: an average of about 11,000 tons per year between 1967 and 1973 (Aresvik 1976:94).

Fertilizer use is heaviest in irrigated areas, where farmers apply

fertilizer to vegetables and fruit trees; in rainfed areas use is both infrequent and low (Aresvik 1976:92). With regard to fertilizer per hectare of arable land under permanent crops, Jordan ranks lowest of all Near East countries, with only 0.6 kilogram of nitrogen and 1.1 kilograms of phosphate per hectare. Plans to use Jordan's phosphate resources to produce superphosphate fertilizers in Jordan, may increase fertilizer consumption (Aresvik 1976:95).

Insecticides, herbicides, and other chemicals are still in limited use: about 189 tons were reported as used in 1975 (Jordan...Min. of Information 1978:110), while the 1976 Statistical Yearbook for Jordan reports sales of the following kinds of agricultural chemicals for 1976:

Agricultural Chemicals Sold During 1976
(in tons)

Plant Chemicals	
Tree washes	.232
Fungicides	13.967
Greases for tree band	.113
Mercury compounds	---
Phosphatic compounds	4.583
Sulphuric compounds	33.728
Copper compounds	16.147
Yellow sulphur	48.950
Benzine Hexachloride	4.000
Others	4.710
Total	126.43
Veterinary medicines	6.000
Gases	.595
Total	133.025

Import statistics for pesticides indicate somewhat higher usage (737 tons in 1973); although such statistics indicate a rise in the use of agricultural chemicals, they nevertheless indicate a much lower level of use than in Egypt and Lebanon (Aresvik 1976:95-96).

As with fertilizers, use of agricultural chemicals is most common on vegetable crops in the Jordan Valley (Aresvik 1976:95).

5.2.7 Farm machinery

The use of farm machinery is increasing steadily. The number of tractors has grown from 1000 in 1950 to 3748 in 1975. Also growing in use are disc ploughs, disc drillers and harvesters. (Jordan...Min. of Information 1978:110). As mentioned above use of modern mechanized equipment in appropriate situations is a factor contributing to soil erosion (see 4.3.3).

5.3 Industry

Industry is not highly developed. In 1974 the contribution of industry, including mining to GDP, was about 15.9% industrial operation, including mining employe an estimated

Industrial development was hampered both by the 1967 war and by internal conflicts within Jordan itself. The Jordanian government is now seeking to promote industry; about 30% of the development expenditures under the 1976-80 Five-Year Plan are targeted for mining and industry. The Ministry of Economy has been authorized to establish industrial plants and to exert control over other industries. The establishment of small and competitive industries is being promoted. In order to assure markets for Jordanian products, tarrifs on imported goods have been raised.

Large industrial operations include an oil refinery, a cement plant, and food processing plants.

The present oil refinery is located at Zarqa; it processed 1,114,600 tons of petroleum in 1976, but production is expected to rise to 3.5 million tons (enough to cover domestic needs) by 1980. A second refinery, planned to be built in the south with aid from the Romanians, would permit the export of refined petroleum products (Europa 1978:460).

Jordan's only cement plant is located at Fuheis near Amman. Peak production at the plant has been 661,600 tons, attained in 1972; production is 1975 was 620,000 tons. The output capacity of this plant is being raised, however, and the goal is to increase production to 1.2 million tons in 1978 and 2.25 million tons by 1980. There are plans for a second cement plant in the South (Europa 1978:460).

A phosphate fertilizer plant has been scheduled to begin operations in Aqaba in 1980, with full production expected to be attained in 1983. (Europa 1978:460).

Other industrial activities include battery production, cigarettes, detergents, pharmaceuticals, paper, alcoholic drinks, and leather. Cigarette production, which is based partially on locally grown tobacco, accounted for JD 997,000 in exports in 1977.

Electricity production

Kilowatt capacity for 1978 (East Bank) was 250,000; 700 million kilowatt hours were produced during that year, or about 200 kilowatt hours per capita (National Basic Intelligence...1978:109).

5.3.1 Industrial pollution

Pollution from industry is most severe in the Amman-Zerqa region, where most industrial activity is concentrated. The area between Amman and Zerqa is characterized by hills and valleys surrounded by bricklaying plants, rock crushing plants, cigarette factories, the nation's petroleum refinery, paper mills, a chemical plants, and phosphate mining, and founderies, all of which contributing to both air and water pollution.

(Johnson and Johnson 1977).

Whereas documentation on industrial water pollution is available, there is no documentation on air quality, although a sampling station has been situated at Shobak, a remote site south of the Dead Sea in the uplands to establish background pollution levels (Arthur D. Little 1979:11:6-14).

In the Jordan valley the only man-made sources of pollution are motor vehicles and small boilers generating carbon monixide, hydrocarbons, nitrogen oxides, and particulates. In the uplands, particularly in Amman-Zerqa industry plus heavier concentrations of cars, trucks, and boilers contribute to air pollution problems. It has been suggested that nightly temperature inversions in Amman might work together with congested traffic and the emissions from over 150,000 small and inefficient oil furnaces to create unhealthy levels of pollution.

Such inversions, although never lasting more than six to eight hours, nevertheless mean that the population of the city is being exposed to potentially harmful air for about a quarter to a third of the time. Stone quarry operations further contribute to observed dust levels. Observers have noted a pall of dark haze over the Amman-Zerqa industrial region whose installations include: cement manufacture; phosphate mining and processing; paint and detergent production; textile plants; paper and pulp processors; dairies; distilleries; anmd chemical and petroleum refiners (Arthur D. Little 1979:11:6-15-6-16).

Phosphate dust associated with loading of this product at the port of Aqaba is reported to create an air pollution problem, saturating the air in the city and surrounding residential areas with phosphate dust. To combat this problem the port authority has been asked to install suction pumps to clear the air of phosphate dust in the loading and unloading areas ("The Port of al-'Aqabah"...1978).

5.4 Mining

Mining activities, which have grown in importance for the Jordanian economy since the exploitation of phosphates was initiated in the late 1950's, are covered in 4.7.

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NOTE: No information on Jordan's participation in MAB projects could be found. As of late 1977, there were no official MAB Biosphere reserves in the country.