DRAFT ENVIRONMENTAL PROFILE ON EGYPT

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Prepared by the
Arid Lands Information Center
Office of Arid Lands Studies
University of Arizona
Tucson, Arizona

Best Available Document
An Introductory Note on Draft Environmental Profiles:

The attached draft environmental report has been prepared under a contract between the U.S. Agency for International Development (AID), Bureau of Science and Technology (ST/FNR) and the U.S. Man and the Biosphere (MAB) Program. It is a preliminary review of information available in the United States on the status of the environment and the natural resources of the identified country and is one of a series of similar studies now underway on countries which receive U.S. bilateral assistance.

This report is the first step in a process to develop better information for the A.I.D. Mission, for host country officials, and others on the environmental situation in specific countries and begins to identify the most critical areas of concern. A more comprehensive study may be undertaken in each country by Regional Bureaus and/or A.I.D. Missions. These would involve local scientists in a more detailed examination of the actual situations as well as a better definition of issues, problems and priorities. Such "Phase II" studies would provide substance for the Agency's Country Development Strategy Statements as well as justifications for program initiatives in the areas of environment and natural resources.

Comments on the attached draft report would be welcomed by US MAB and ST/FNR and should be addressed to either:

Jim Corson
AID/MAB Project
Department of State
Room 410, SA-5
Washington, D.C. 20520

Molly Kux
Bureau of Science & Technology
Office of Forestry, Environment and Natural Resources
U.S. A.I.D.
Washington, D.C. 20523
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</tbody>
</table>
The environmental problems of the Arab Republic of Egypt relate to its peculiar situation of intensive irrigation agriculture and great population densities in a very arid land; 96% of which is as yet uninhabitable. The population of 38 million lives on the remaining 3-4% comprised predominantly of the Nile valley and delta. Attempts to raise significantly the productivity of Egypt's natural resources (especially soil resources) have led to problems of resource degradation and hazards to the health of large numbers of the population.

Unlike many Middle Eastern countries, Egypt's pastoral activity is minimal because the Mediterranean coastlands, once the granary of the Roman Empire, have lost most of their natural productivity through over-exploitation in the last millennium. Attempts to rehabilitate the area in this century have not met with great success, and recent plans stress economic activities besides those which are natural resource-based.

The better-known desert reclamation schemes of the delta fringe and oases of the New Valley will benefit from the experience gained in the last few decades on the functioning of water, soil and biotic systems in the situation of highly manipulated perennial irrigation schemes, although better control of the inputs and outputs of these systems seems to be necessary.

The major environmental problems faced by Egypt at present are:

1. **Soil damage and loss** - resulting from irrigation-induced salinization, to different degrees, of at least 28% of Egypt's irrigated soils. Pressures on soils in the better-watered coastlands prevent them recovering their ancient fertility. Windblown sands and urban sprawl remove arable soil from use entirely.

2. **Water pollution** - resulting from salinized drainage water from irrigated areas, agricultural pesticides, sewage disposal, industrial effluent, and overpumping of aquifers (allowing in contaminating, saline, marine water), all of which affect surface and groundwater bodies differently.

3. **Health hazards** - resulting from endemic water borne diseases spreading through the newly - converted (perennial) irrigation system, most seriously schistosomiasis and malaria.

4. **Pests and weeds** - resulting from the introduction of perennial irrigation, although some are endemic. The aquatic water hyacinth has recently become rife in waterways.

Measures to control these problems are evaluated briefly in the text.

M. Justin Wilkinson
Compiler
1.0 PREFACE

This report represents a desk study compiled from many and varied sources. The major task was to integrate and synthesize the vast amount of material available on Egypt's environment and natural resources.

2.0 INTRODUCTION

2.1 PURPOSE AND SCOPE

The report has three related aims: (i) to inventory the major natural resources of the Arab Republic of Egypt\(^1\); (ii) to evaluate the impacts on the environment of man's manipulation of natural resources; and (iii) to provide bibliographies on (i) and (ii) above, as well as some references to generally related topics.

It was necessary to limit, where possible, the concerns in this report to directly natural resource-related problems. Space and time prevented diverging too widely from this guideline. It proved possible, for example, to avoid such topics as agriculture per se and land tenure changes in Egypt. Therefore discussion in (ii) was restricted to environmental problems related to water, soils, flora and fauna. Environmental impacts of urbanization and industry were included, however, whereas those stemming from mining were not, these being considered relatively insignificant in contrast to the others.

It was considered invidious, generally, to discuss environmental dangers which will or may flow from economic development schemes which have not been initiated yet.

2.2 GEOGRAPHY AND CLIMATE

2.2.1 Boundaries and Administrative Divisions

Egypt occupies the arid northeast corner of Africa. It incorporates almost one million km\(^2\), roughly equivalent to the area of Colorado, Utah, Arizona and New Mexico combined. It is bounded on the north by the Mediterranean Sea, and on the east by the Red Sea. Libya lies on Egypt's western border, the

\(^1\) Referred to as Egypt hereafter.
### Governorates

#### City Governorates

<table>
<thead>
<tr>
<th>No.</th>
<th>City</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cairo (Al Qahirah)</td>
<td>Same</td>
</tr>
<tr>
<td>2.</td>
<td>Alexandria (Al Iskandariyah)</td>
<td>Same</td>
</tr>
<tr>
<td>3.</td>
<td>Port Said (Bur Said)</td>
<td>Same</td>
</tr>
<tr>
<td>4.</td>
<td>Suez (As Suweyra)</td>
<td>Same</td>
</tr>
</tbody>
</table>

#### Lower Egypt

<table>
<thead>
<tr>
<th>No.</th>
<th>City</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>Luxor (Al Ismailiyah)</td>
<td>Same</td>
</tr>
<tr>
<td>6.</td>
<td>Al Baharyah</td>
<td>Same</td>
</tr>
<tr>
<td>7.</td>
<td>Damietta (Dumyat)</td>
<td>Same</td>
</tr>
<tr>
<td>8.</td>
<td>Kafr (Al Shaykh)</td>
<td>Same</td>
</tr>
<tr>
<td>9.</td>
<td>Al Gharbiyah</td>
<td>Same</td>
</tr>
<tr>
<td>10.</td>
<td>Al Dakhillyah</td>
<td>Mansura (Al Mansurah)</td>
</tr>
<tr>
<td>11.</td>
<td>Ash Sharmiyah</td>
<td>Zagazig (As Zagazig)</td>
</tr>
<tr>
<td>12.</td>
<td>Al Minufiyah</td>
<td>Shbin al Kom (Shbin al Kawm)</td>
</tr>
<tr>
<td>13.</td>
<td>Al Qalyubiyyah</td>
<td>Banha (Banha)</td>
</tr>
</tbody>
</table>

#### Upper Egypt

<table>
<thead>
<tr>
<th>No.</th>
<th>City</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.</td>
<td>Gim (Al Jizah)</td>
<td>Same</td>
</tr>
<tr>
<td>15.</td>
<td>Al Fayyum</td>
<td>Same</td>
</tr>
<tr>
<td>16.</td>
<td>Bent Suweyf</td>
<td>Same</td>
</tr>
<tr>
<td>17.</td>
<td>Al Minya</td>
<td>Same</td>
</tr>
<tr>
<td>18.</td>
<td>Asyut</td>
<td>Same</td>
</tr>
<tr>
<td>19.</td>
<td>Suq (Sawhah)</td>
<td>Same</td>
</tr>
<tr>
<td>20.</td>
<td>Qena (Qina)</td>
<td>Same</td>
</tr>
<tr>
<td>21.</td>
<td>Arwas</td>
<td>Same</td>
</tr>
</tbody>
</table>

#### Frontier Governorates

<table>
<thead>
<tr>
<th>No.</th>
<th>City</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.</td>
<td>Red Sea (Al Bahr al Ahmar)</td>
<td>Hurghada (Al Gh)</td>
</tr>
<tr>
<td>23.</td>
<td>New Valley (Al Wadi al Jadid)</td>
<td>Kharga (Al Halloween)</td>
</tr>
<tr>
<td>24.</td>
<td>Marsa Matruh</td>
<td>Matruh</td>
</tr>
<tr>
<td>25.</td>
<td>Sinai (Sina)</td>
<td>Al Arish</td>
</tr>
</tbody>
</table>

**Note:** Names in parentheses are the formal names, which are used on many maps and in some of the literature.
Republic of Sudan on the southern border (1025 km from the sea), and Israel across a shifting, negotiated border in the Sinai peninsula, at present approximately along 33°30'E. (Nydop, 1976).

The Sinai peninsula was occupied by Israeli forces in the June 1967 war. After the October 1973 war the Suez Canal was regained by Egypt with a strip of land on its east side. The Gaza Strip is a narrow area stretching 40 km east from the Sinai border along the Mediterranean coast. Its Arab population was administered by Egypt after the 1949 Egypt-Israeli armistice, but since June 1967 it has been occupied by Israel.

The formal Sudanese-Egyptian boundary is modified by an administrative boundary for the purpose of allowing nomads the use of traditional water holes in two areas (A² and A³, Fig. 2.1).

Egypt comprises twenty-five administrative areas called variously governorates, provinces, or districts, which include four city-governorates Cairo, Alexandria, Port Said, and Suez), nine governorates in Lower Egypt (Nile delta region), eight in Upper Egypt (along the Nile south from Cairo to Aswan), and four so-called frontier governorates for the Sinai and desert area east and west of the Nile valley (Fig. 2.1). The formation of a 26th governorate, Nubaria, immediately southwest of Alexandria, had been announced but not fully organized in mid-1975.

2.2.2 Natural Regions (Fig. 2.2)

Only about 3.5% of Egypt's one million km² area is occupied, the rest being barren unpopulated desert, part of the arid zone which stretches from the Atlantic to Rajasthan.

(a) Nile Valley and Delta

The Nile valley and delta is the northern 1800 km of Africa's largest drainage system which originates in Lake Victoria in East Africa as the White Nile (Fig. 2.3). This branch provides only 10% of Egypt's flood season water when the other branches are full, but 80% of the low-water flow (January to June). Major branches such as the Blue Nile and Atbara provide 68% and 22% respectively of summer flood waters, which derive from the Ethiopian plateau. These therefore provide the floodwater which causes the Nile to overflow its banks, irrigating and depositing silt in Egyptian fields for millennia.

The valley is bounded by low escarpments and ranges from 18 km to 25 km wide. At Cairo distributaries of the Nile spread out
over an enormous delta 270 km across at the sea and 130 km in length. In the first century A.D. 7 distributaries existed, now only the Damietta and Rosetta branches lead the Nile's way to the sea.

Several coastal lakes exist. From west to east Lake Maryut (Mareotis) lies behind Alexandria, Lakes Tdku, Burullus and Waza occupy the delta fringe, and Lake Bardawil spans half of Sinai's Mediterranean coastline.
Fig. 2.3 The Nile Drainage System
Fig. 2.4 Annual Rainfall in Egypt
(b) The Western Desert

The Western Desert constitutes about 75% of Egypt's land area. The Gilf Kebir plateau in the southwest corner reaches more than 1000 m above sea level. Otherwise the western desert is an enormous monotonous plain of low altitude. The largest feature of the plain is the Great Sand Sea, lying generally near the Libyan border. Seven depressions are another less dominant landscape element, which are economically important as oases. The small Fayyum oasis is really part of the Nile hydrologic system, receiving Nile water by canal and supporting a large population. The Qattara Depression by contrast is the largest (23,000 km\(^2\)) and most inhospitable, containing highly saline soils, saline lakes and descending to 150 metres below sea level. The Siwa, Bahariya, Farafra, Dakhla and Kharga oases all support some agriculture, especially the latter two. Groundwater supplies beneath these oases are looked to as the basis of future development. These latter five oases, but particularly Dakhla and Kharga, constitute the New Valley, which it is hoped will support large populations in coming decades.

The "New Valley South" is a term used to refer to the southern extension of the Kharga oasis towards Lake Nasser (Fig. 2.2).

(c) Eastern Desert and Red Sea Highlands

The Eastern Desert comprises a sandy plateau surmounted by a chain of barren rocky hills reaching an altitude of about 2,200 m. Isolation of this area and the aridity have resulted in an unpopulated interior and a few villages on the Red Sea coast.

(d) Sinai Peninsula

The Sinai is a geological extension of the Red Sea Hills. In the south Mount Sinai and Mount Catherine and their red-colored massif reach well above 2,000 m. A plain stretches north with altitudes declining for 1000 m to sea level at the Mediterranean.

2.2.3 Climate (Europa Publications, 1978)

The coastline of the western delta, in the Alexandria region, receives up to 200 mm of rainfall annually because it lies across the path of prevailing westerly winds. To the west and east coastal rainfall declines to 150 mm. Rainfall drops dramatically inland, so that by the latitude of Cairo, 200 km from the Mediterranean, rainfall is 25 mm yearly (Fig. 2.4). Low, sporadic precipitation characterizes the rest of the country, making it one of the most arid in the world.
Summer temperature maxima reach highs of 38°C - 43°C in Cairo, and at times over 48°C. 32°C is the annual average temperature which consequently draws tourists and the wealthy to Alexandria in the summer. Winters are generally warm, with occasional rain showers. Cold fronts bring colder weather from time to time and even snow. Light snowfall.

In spring, a hot southerly wind (the Khamsin) blows from the Sahara, bringing sand storms and 20°C temperature increases with winds sometimes up to 150 km/hr. In spring and early summer an early morning fog sometimes develops over the delta.

2.3 POPULATION:

Egypt is the second largest Islamic country in the Middle East (338,228 million in 1976; Birta et al., 1978), being almost as large as Turkey. 96% of the population follows the Sunni branch of Islam, as do the majority of Islamic countries. Besides Egyptian, other

Table 2.1 Egypt, Density of Population by Governorate, 1966 Census and 1975 Estimates

<table>
<thead>
<tr>
<th>Governorate</th>
<th>Area (km²)</th>
<th>Population (1966)</th>
<th>Population (1975)</th>
<th>Density (per km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cairo Governorates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulaq</td>
<td>232</td>
<td>4,200</td>
<td>5,359</td>
<td>23,050</td>
</tr>
<tr>
<td>Alexandria</td>
<td>112</td>
<td>1,501</td>
<td>2,320</td>
<td>16,081</td>
</tr>
<tr>
<td>Port Said</td>
<td>250</td>
<td>256</td>
<td>347</td>
<td>864</td>
</tr>
<tr>
<td>Sohag</td>
<td>190</td>
<td>254</td>
<td>375</td>
<td>2,119</td>
</tr>
<tr>
<td>Total Governorates</td>
<td>634</td>
<td>5,568</td>
<td>8,387</td>
<td></td>
</tr>
<tr>
<td>Lower Egypt Governorates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ismailia</td>
<td>153</td>
<td>345</td>
<td>461</td>
<td>2,254</td>
</tr>
<tr>
<td>Buhayrah</td>
<td>1,773</td>
<td>1,979</td>
<td>2,597</td>
<td>1,115</td>
</tr>
<tr>
<td>Kafr El Sheikh</td>
<td>1,349</td>
<td>1,119</td>
<td>1,594</td>
<td>859</td>
</tr>
<tr>
<td>Qemesh (Tanta)</td>
<td>770</td>
<td>1,900</td>
<td>2,377</td>
<td>2,474</td>
</tr>
<tr>
<td>Dakahlia (Masr)</td>
<td>1,257</td>
<td>2,286</td>
<td>2,670</td>
<td>1,705</td>
</tr>
<tr>
<td>Sharqiyah (Zagazig)</td>
<td>1,812</td>
<td>2,106</td>
<td>2,606</td>
<td>1,115</td>
</tr>
<tr>
<td>Minufiya (Shibin El Kom)</td>
<td>1,458</td>
<td>1,697</td>
<td>2,382</td>
<td>1,482</td>
</tr>
<tr>
<td>Qalyubia (Benza)</td>
<td>356</td>
<td>1,214</td>
<td>1,568</td>
<td>3,327</td>
</tr>
<tr>
<td>Damietta</td>
<td>251</td>
<td>432</td>
<td>518</td>
<td>1,658</td>
</tr>
<tr>
<td>Total Lower Egypt</td>
<td>8,977</td>
<td>12,854</td>
<td>15,507</td>
<td></td>
</tr>
<tr>
<td>Upper Egypt Governorates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giza</td>
<td>418</td>
<td>1,640</td>
<td>2,265</td>
<td>5,448</td>
</tr>
<tr>
<td>Al Fayyum</td>
<td>696</td>
<td>941</td>
<td>1,089</td>
<td>1,360</td>
</tr>
<tr>
<td>Beni Suef</td>
<td>307</td>
<td>928</td>
<td>1,030</td>
<td>3,300</td>
</tr>
<tr>
<td>Minya</td>
<td>878</td>
<td>1,706</td>
<td>1,971</td>
<td>1,943</td>
</tr>
<tr>
<td>Assiut</td>
<td>600</td>
<td>1,416</td>
<td>1,562</td>
<td>2,394</td>
</tr>
<tr>
<td>Luxor</td>
<td>598</td>
<td>1,695</td>
<td>1,745</td>
<td>2,651</td>
</tr>
<tr>
<td>Qena</td>
<td>979</td>
<td>1,477</td>
<td>1,557</td>
<td>2,104</td>
</tr>
<tr>
<td>Assiut</td>
<td>341</td>
<td>321</td>
<td>329</td>
<td>1,238</td>
</tr>
<tr>
<td>Total Upper Egypt</td>
<td>4,723</td>
<td>10,321</td>
<td>12,197</td>
<td></td>
</tr>
<tr>
<td>Frontier Governorates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>372,973</td>
<td>332</td>
<td>409</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>336,712</td>
<td>30,076</td>
<td>37,000</td>
<td></td>
</tr>
</tbody>
</table>

*Estimates are calculations where figures from the censuses of the governorates.

small ethnic groups are Copts, Beduins, and Nubians. Arabic, English and French are spoken (Europa Publications, 1978).

More than one third of the delta's population centers on the four city governorates of Cairo, Alexandria, Port Said and Suez (nearly 9 million in 1975 - Table 2.1). The other nine delta governorates have almost 16 million people, with population densities ranging from 1,000 to 4,300 people per sq. mile, compared with the very high densities of 20,000 and 70,600 people per square mile in Alexandria and Cairo respectively (Table 2.1). Densities are very low beyond the Nile valley and delta which comprises 3% of Egypt's land area but supports 96% of the population.

Population pressure on especially land and water resources is Egypt's principal economic problem. It vitiates health standards in urban environments.

One authority estimates Egypt's 1897 population at 9.715 million (Birks et al., 1978). Average annual growth rates have increased from 1.51% in 1907 to a high of 2.46% in 1960, and have declined since to 2.31% which translates to the addition of about 800,000 people per year to the population.

The birthrate has dropped from 44.3/1000 recorded in 1927 to 35.1 in 1971. Death rates have declined drastically from 27.1/1000 in the 1927-36 period to 13.2/1000 in 1971 (Nyrop, 1976). 42% of the population was under 15 years of age and 50% under 20 in 1966. The diet of the average Egyptian is poor and contains little animal protein.

Table 2.2 Landownership in 1952 and 1965
(Figures are in thousands)

<table>
<thead>
<tr>
<th>Size group (Feddans)</th>
<th>Before land reform (1957)</th>
<th>After land reform (1965)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Owners</td>
<td>Area</td>
</tr>
<tr>
<td>Less than 1</td>
<td>2,015</td>
<td>718</td>
</tr>
<tr>
<td>1-4</td>
<td>624</td>
<td>1,344</td>
</tr>
<tr>
<td>5-9</td>
<td>79</td>
<td>573</td>
</tr>
<tr>
<td>10-19</td>
<td>47</td>
<td>638</td>
</tr>
<tr>
<td>20-29</td>
<td>13</td>
<td>309</td>
</tr>
<tr>
<td>30-49</td>
<td>9</td>
<td>344</td>
</tr>
<tr>
<td>50-99</td>
<td>6</td>
<td>429</td>
</tr>
<tr>
<td>100-199</td>
<td>3</td>
<td>427</td>
</tr>
<tr>
<td>200 and over</td>
<td>2</td>
<td>1,777</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,302</td>
<td>5,982</td>
</tr>
</tbody>
</table>

48% of the population is active in agriculture, which contribute 60% of the total export earnings. Land reforms instituted after the Revolution in 1952 which brought Col. Nasser to power have altered significantly the pattern of land ownership. Before 1965, 72% of Landowners were in the group of smallest land holders (1 feddan and below). By 1965 this figure has risen to 94.5%, more than doubling the total area in this class (Table 2.2). Neverthe
d less, half the agricultural land (49.3%) remains in the hands of only 5.4% of the agricultural population. It has been noted that the problem is less one of land distribution than overall scarcity. For this reason many schemes have been initiated to increase absolutely Egypt's arable acreage by reclaiming land from the desert (see 3.3.3 below).

1 feddan = 1.038 acres = 0.42 hectares
3.0 REVIEW OF NATURAL RESOURCES

3.1 MINERALS (U.S. Dept. of the Interior, 1976; Nyrop, 1976; Europa Publications, 1979; Kirwan, 1977) (Table 3.1)

Egypt’s mineral industry is underdeveloped compared with its known reserves of many minerals. The industry contributes 10% of the GDP ($700 million in 1974). Egypt’s major minerals are iron ore, petroleum and natural gas, and phosphates (Fig. 3.1). Many others are produced in small quantities, such as granite, limestone, gypsum, ilmenite, gold, aluminum, manganese, salt, and sand.

Table 3.1:
Role in the world mineral supply
(Thousand metric tons, unless otherwise specified)

<table>
<thead>
<tr>
<th>Map symbol</th>
<th>Major commodities</th>
<th>1974 production</th>
<th>Estimated share of production exported (%)</th>
<th>Share of world output (%)</th>
<th>Reserves (1 million metric tons)</th>
<th>Share of total world resources (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe</td>
<td>Iron ore</td>
<td>$1,300</td>
<td>20</td>
<td>(1)</td>
<td>400,000</td>
<td>(1)</td>
</tr>
<tr>
<td>H G</td>
<td>Natural gas (billion cu ft)</td>
<td>13</td>
<td>None</td>
<td>(1)</td>
<td>4,000</td>
<td>(1)</td>
</tr>
<tr>
<td>Pet</td>
<td>Ferrous, crude (million 42-gal bbl)</td>
<td>96</td>
<td>*5</td>
<td>(1)</td>
<td>3,900</td>
<td>(1)</td>
</tr>
<tr>
<td>Ph</td>
<td>Phosphate rock</td>
<td>550</td>
<td>39</td>
<td>(1)</td>
<td>100,000</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Estimated. (1) Less than 1%.


3.1.1 Iron Ore

The majority of iron ore mined derives from Aswan and the Bahariya oasis 360 km southwest of Cairo. 1,300,000 metric tons were mined in 1974, and transported by rail from both localities to smelters at Helwan near Cairo. Production by 1980 is projected to be 3,100,000 metric tons.

3.1.2 Phosphates and Related Development

Most of Egypt's minerals have been consumed at home. Only 30% of phosphate production is exported, but recent finds of very large reserves (1 milliard metric tons) at Abu Tattur in the Kharga area have enabled Egypt to plan on mining 3-10 million tons per annum (550,000 tons in 1974) and exporting 3 million tons of this by 1985.
Gulf of Suez: Oil Concessions

Egyptian Line
30°
Suez
Buffer
Line
Zone
33°
Israel Line
Ra's 'Adabiyah
Ra's Misailian
Ra's as Sidr
Egypt-Israel Agreement Line
(22 September 1975)
Ra's Abu Daraj
Ra's Zafarana
Abu Zanimah
Abu Rudays
Abu Jarbah
Ra's Shukhayr
Ra's Jarra (Garra)

Scale 1:1,300,000
0 30 Miles
0 30 Kilometers

Fig. 3.2 Gulf of Suez: Oil Concessions
3.1.3 Energy

Oil and gas comprise approximately 70% of Egypt's total energy requirements. They comprise about 30% of that needed for electric power generation, with Aswan's hydroelectric generation providing most of the remainder.

Petroleum production is expected to reach 20,000 metric tons in 1980. Of the more than 20 companies from 11 countries that operate concessions in Egypt, the most prominent are Phillips Petroleum Co., Exxon Corp., Continental Oil Co., Amoco International Oil Co., Shell International Petroleum Co., AGIP, S.D.A., and Mobil Oil Corp. Non-fuel mining operations are under several government organizations. Concessions in the important Suez area are indicated on Fig. 3.2.

In the 1970s two new oil fields, July and Ramadan, and several in the Alamein area both onshore (oil) and offshore (gas), and offshore of the delta (gas) came into operation. The large new Gharbiaa field in the Western Desert south of the Qattara Depression yields oil and gas.

The Aswan High Dam (see 3.2.1 below for detailed information) was constructed between 1960 and 1970 and incorporates twelve very large turbines for the generation of an estimated 10,000 million kwh of hydroelectric power annually. Apart from supplying industry throughout the length of Egypt, it will supply electricity to an ever-increasing number of rural communities.

3.1.4 Sinai (Sadd, 1979)

The Sinai peninsula holds significant amounts of exploitable minerals. Egypt's single coal field, near the north coast, has proven reserves of 35 million tons. The Gulf of Suez and Mediterranean coasts have great potential for oil and gas discoveries. Until 1967, 200,000 tons of low-grade manganese/iron ores were extracted yearly on the Gulf of Suez coast. Gypsum, kaolin, glass sand and various building materials of high quality were extracted before 1967.
3.2 WATER RESOURCES

3.2.1 Introduction

96% of the population of Egypt live in the Nile valley and delta, and depend on the hydrological system of the Nile which provides the vast majority of accessible water in Egypt. The remainder utilize groundwater supplies in the western Desert and Sinai and scanty supplies of rainwater along the Mediterranean littoral.

Attempts to improve the use of the Nile's water began in the early 1800's. Prior to these attempts more than 80% of the total flow was lost yearly to the sea, to the atmosphere and by seepage to underground aquifers. Improvements took the form of several barrages (Figs. 2.2, 3.3) and related canal systems (Fig. 3.3) down the length of the Egyptian Nile, and a dam at Aswan (raised in 1934 to produce a dam 330 km long with a doubled capacity of greater than 5 milliard m$^3$; Hafer et al., 1978; Nyrop, 1976). These enabled conversion from traditional basin-irrigation to perennial irrigation, a system which has allowed more than one crop to be planted each year. This has allowed population increases from an estimated 2.5 million in the early 1800's, to 9.7 million in 1897, 18.8 million in 1946 and more than 37 million in mid-1975 (Nyrop, 1976).

---

1Butzer (1976) has described the natural inundation of agricultural basins in the Nile valley: "Under natural conditions the Nile would ideally rise to bankfall stage in southern Egypt by mid-August, and then spread out through major and minor overflow channels or by breaches across low levees, to spill over into successive flood basins. As the flood surge moved northward, the last basins at the northernmost end of the valley would be flooded four to six weeks later. At the height of a normal flood, all but the crests of the levees would be briefly flooded, with average water depth in the flood basins about 1.5 m. During a poor flood some flood basins would remain dry, or otherwise the flood stage would be too brief or too low to allow flooding of the entire basin. After a span of several weeks or months, depending mainly on the relative elevation of the flood basins, the alluvial flats would emerge—in response to a combination of falling riverhead, dropping groundwater level, evaporation, soil infiltration, and natural drainage back to the channel through small "gathering" streams. The first basins in southern Egypt are normally dry by early October, and by late November all but the lowest basin hollows in the northernmost valley are drained, with persistent marsh in isolated, valley-margin backswamps or in the cutoff, oxbow lakes of abandoned meanders."

15
3.2.2 Nile Hydrological System

3.2.2.1 General Features

50% of the Nile's water is lost before it reaches Egypt's border. 34 milliard m³ of water is available in Lake Nasser/Nubia² of which 55 milliard m³ is apportioned to Egypt. To this may be added 12.2 milliard of Nile water which is re-used, and 0.5 milliard of groundwater pumped from wells. This gives a total of 58.2 milliard m³ available to Egypt, against its present (1977) need of 51.41 milliard m³ (Badran et al., 1979). The remainder is lost primarily by evaporation and runoff to the sea.
Efforts of many kinds are directed at reducing these losses, and increasing the efficiency of the systems so that potentially arable areas may be brought under irrigation. In fact, it has been stated, despite this quantity of extra water available at Aswan, that “Egypt may soon face a water shortage [in the absence of] very careful water management” (Kinawy, 1978) since population continues to increase at 2.5% p.a.

The Jonglei scheme (Fig. 2.2) aims to short-circuit Nile water through the Sudd region of stagnant swamps in Sudan where very large losses occur. 4 milliard m$^3$ of water could be supplied to Lake Nasser annually in the first phase of the scheme. Subsequent phases would attempt to eliminate losses in the Sudd zone. (Egypt, 1978a. Abs. 16).

The Nile’s seasonal discharge regime is presented in Table 3.2.

**TABLE 3.2 The Aswan High Dam Discharges During 1972**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.350</td>
<td>4.000</td>
<td>4.200</td>
<td>4.000</td>
<td>5.200</td>
<td>5.450</td>
</tr>
<tr>
<td>BF</td>
<td>27.200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>6.950</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug.</td>
<td>6.200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep.</td>
<td>4.300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct.</td>
<td>1.850</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov.</td>
<td>3.650</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec.</td>
<td>3.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BFW 37.200 milliards  Total 55.150 milliards


3.2.2.2 Lakes Nasser and Nubia (Hafez et al. 1978)

The Aswan High Dam was built 6.5 km south of the historic Aswan Dam, first built in 1902 and raised twice in 1912 and 1934, the second doubling capacity to more than 5 milliard m$^3$. The High Dam was begun in 1960 and completed in mid-1970. A canal leads water to twelve generating units capable of an energy output of 2.1 million kWh.

The water body is the second largest man-made lake in the world, second only to Lake Bratisk in the USSR. Its dimensions are given in Table 3.3.
Table I.1: Dimensions of Lake Nasser and the Total Reservoir

<table>
<thead>
<tr>
<th></th>
<th>Lake Nasser only</th>
<th>Total Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>292 km</td>
<td>540 km</td>
</tr>
<tr>
<td>Surface area at elev. 160 m</td>
<td>2,596 km²</td>
<td>3,037 km²</td>
</tr>
<tr>
<td>&quot; &quot; at elev. 180 m</td>
<td>5,245 km²</td>
<td>6,626 km²</td>
</tr>
<tr>
<td>Volume at elev. 160 m</td>
<td>95.4 km³</td>
<td>65.9 km³</td>
</tr>
<tr>
<td>&quot; &quot; at elev. 180 m</td>
<td>122.5 km³</td>
<td>156.9 km³</td>
</tr>
<tr>
<td>Shoreline length at 160 m</td>
<td>5,180 km</td>
<td>6,027 km</td>
</tr>
<tr>
<td>&quot; &quot; at 180 m</td>
<td>7,844 km</td>
<td>9,250 km</td>
</tr>
<tr>
<td>Mean width at elev. 160 m</td>
<td>8.9 km</td>
<td>7.1 km</td>
</tr>
<tr>
<td>&quot; &quot; at elev. 180 m</td>
<td>18.0 km</td>
<td>12.5 km</td>
</tr>
<tr>
<td>Depth at elev. 180 m</td>
<td>25.2 m</td>
<td>25.2 m</td>
</tr>
<tr>
<td>Maximum depth at elev. 180 m</td>
<td>130.0 m</td>
<td>130.0 m</td>
</tr>
</tbody>
</table>

Source: Hafer et al. 1978.

The most important results expected from the Kawan High Dam were (Benedict, 1978):

a. to provide a dependable supply of irrigation water for the agriculture of Egypt, even in years of drought;4 in particular storage of the annual flood would permit perennial irrigation to be introduced and long term storage, the so-called "century storage" of the water of several higher-than-average floods for use during a possible series of dry years;

b. the saving of large amounts of water which previously were lost to the sea for the reclamation of 1.3 million feddans of new land for cultivation;

c. the protection of life, property and crops against ravages of uncontrolled and annual floods;4

d. the supply of large quantities of cheap hydro-electric power with the hope that this would stimulate industrialisation sufficient to reduce Egypt's dependence on overseas cotton earnings.

3 Crops worth an estimated $600 million were saved in 1972 when the lowest flood in a century would have caused the loss of over one third of the harvest (Warburry, 1974).

4 Fluctuations have been moderated from extremes of 200 - 14,000 m³ sec⁻¹ to 930 - 2,600 m³ sec⁻¹.
3.2.2.3 The Canal System

From beginnings in 1902, 30,000 km of canals have been constructed in Egypt (Kinau, 1979) whereby 80% of the arable land has been converted to perennial irrigation and can be cultivated in summer.

In Egypt's canal system (Fig 3.3) the Bahr Yusuf dates from ancient times, and is perhaps the oldest major canal in the entire valley. Much of the length of the inland waterways occupies smaller alternate courses of the ancient Nile (Butzer, 1976). The canals provide not only irrigation water but transportation routes as well. The Ismailiya and Nubariya canals are integrated into land reclamation schemes, bringing water to areas which were not flooded by the Nile.

The ecological problems connected with perennial irrigation are presented below (4.1).

3.2.2.4 Groundwater and Drainage Water

(a) Groundwater

The total extraction from wells is about 2.9 milliard m³, of which 65% is used for non-agricultural purposes (Seddik et al., 1979). Extraction by governorate is listed in Table 3.4. 130 productive pumping installations.

Table 3.4 Groundwater Extraction in Egypt

<table>
<thead>
<tr>
<th>Governorate</th>
<th>Annual extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cairo</td>
<td>238,404,000</td>
</tr>
<tr>
<td>Guiza</td>
<td>66,836,154</td>
</tr>
<tr>
<td>Qalubia</td>
<td>277,143,625</td>
</tr>
<tr>
<td>Sharkia</td>
<td>142,429,426</td>
</tr>
<tr>
<td>Dakahlia</td>
<td>137,661,005</td>
</tr>
<tr>
<td>Gharbiya</td>
<td>26,976,687</td>
</tr>
<tr>
<td>Manufiya</td>
<td>95,735,882</td>
</tr>
<tr>
<td>Tahir Province</td>
<td>612,757,856</td>
</tr>
<tr>
<td>Beheira</td>
<td>11,033,216</td>
</tr>
<tr>
<td>Beni Suef</td>
<td>12,259,200</td>
</tr>
<tr>
<td>Minya</td>
<td>258,322,520</td>
</tr>
<tr>
<td>Assiut</td>
<td>101,733,040</td>
</tr>
<tr>
<td>Sohag</td>
<td>602,250,650</td>
</tr>
<tr>
<td>Qena</td>
<td>352,118,000</td>
</tr>
<tr>
<td>Aswan</td>
<td>996,450</td>
</tr>
</tbody>
</table>

Total in Lower Egypt about 1.6 milliard m³
Total in Upper Egypt about 1.3 milliard m³

Source: Seddik et al. 1979.
in the southern delta feed the downstream ends of
tegration canals to supplement lower summer supplies
(Kinawy, 1978).^

(b) Drainage Water (Badran et al., 1979)
2.3 million m\(^3\) of drainage water were re-used in the
delta for irrigation in 1976. A similar quantity flowed
to Qarun Lake in the Fayyum and was also re-used for
irrigation, giving a total of 4.6 million m\(^3\) re-used
in the Nile’s hydrologic system, a significant contribu-
tion to overall water use efficiency (3.2.2.6 below). Go-
vernment sources quote a figure of 12.2 million m\(^3/yr\)
as potentially re-usable (Egypt, 1978).^

3.2.2.5 Industrial and Agricultural Use
3.0 million m\(^3/yr\) (1972 records, Kinawy, 1978) of Nile-
water are withdrawn for industrial and domestic use, which
is only 6% of the Nile water budget. This is expected
to grow 4.5 million by the year 2000 A.D. Another 1.5
milliard/yr. ultimately will be consumed by ten new
industrial towns planned for construction around the city
of Cairo (Kinawy, 1978).

3.2.2.6 Water Use Efficiency
Egypt has become somewhat more efficient in its use of
a static “water capital” of 55.5 milliard m\(^3/yr\). In 1966
efficiency was computed to be 66%, 6 years later this had
risen to 75% (Table 3.5), compared with as little as 25%
in some countries (Holly, 1978).

Table 3.5 Balance of Water Budget in Egypt Based on 1972
Records (milliard m\(^3\))

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity (milliard m(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total discharge of the Arwas High Dam</td>
<td>55.190</td>
</tr>
<tr>
<td>Industrial and domestic abstractions</td>
<td>-1.000</td>
</tr>
<tr>
<td>Upper Egypt (UE) irrigation requirements (Table I)</td>
<td>-10.720</td>
</tr>
<tr>
<td>River of drainage water in UE</td>
<td>+4.570</td>
</tr>
<tr>
<td>Losses in UE</td>
<td>-4.420</td>
</tr>
<tr>
<td>Water passing Cairo (measured)</td>
<td>-16.700</td>
</tr>
<tr>
<td>Delta irrigation requirements (Table I)</td>
<td>+3.500</td>
</tr>
<tr>
<td>Spillage into the Mediterranean (measured)</td>
<td>-2.380</td>
</tr>
<tr>
<td>Losses in the Delta</td>
<td></td>
</tr>
<tr>
<td>Overall efficiency of irrigation water</td>
<td>14.420</td>
</tr>
<tr>
<td>Source: Kinawy, 1978</td>
<td></td>
</tr>
</tbody>
</table>
However, the major cause for this rise has been the conversion to cultivation of more water-demanding crops such as rice and sugar, which together consumed 5 milliard m³/yr. more water (Kinawy, 1978).

The obverse of water budget efficiency can be seen in the breakdown of yearly water losses (Table 3.6).

Table 3.6. Nile Water Loss Analysis

<table>
<thead>
<tr>
<th>Losses Description</th>
<th>Volume (milliard m³)</th>
<th>% Quota</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial and domestic use</td>
<td>1.000</td>
<td>3.5</td>
</tr>
<tr>
<td>Excess discharges to secure navigation, and to cover the hydro-power requirements, which finally spill into the sea</td>
<td>3.500</td>
<td>6.5</td>
</tr>
<tr>
<td>Losses due to conveyance, seepage and evaporation in water utilization</td>
<td>9.800</td>
<td>17.5</td>
</tr>
<tr>
<td>Recovered through the reuse of drainage water</td>
<td>18.300</td>
<td>33.0%</td>
</tr>
<tr>
<td>By spill into the sea due to overflow and seepage and recharge in water utilization</td>
<td>- 4.880</td>
<td>- 8.0</td>
</tr>
<tr>
<td>Net losses</td>
<td>13.880</td>
<td>25.0%</td>
</tr>
</tbody>
</table>


Some Measures to Increase Efficiency

(a) Losses from Lake Nasser

Excluded from the tabulations above (Tables 3.5 & 3.6) is the 10 milliard m³/yr. left to compensate for evaporation and seepage from Lake Nasser. As one of the largest losses in the Nile hydrologic system, it is obviously "vital to encourage researches aiming at suppressing the huge evaporation losses" (Kinawy, 1978), a problem easier to control perhaps than the great seepage losses from the dam (1 milliard m³/yr. reaches the aquifer; Wafa, 1977). These latter recharge groundwater supplies, and in this sense the loss is not complete. Little is known about the functioning of Egypt's aquifer systems, however.

(b) Losses from the distribution system

30,000 kms of canals exist in Egypt with differing problems of seepage. Worthington (1978) states that infiltration claims 40-45% of water supplied at the canal head.

0.8 milliard m³/yr. is lost, for example, from the Ismailiya canal due to the fact that a section is unlined,
water seeping through the sandy bottom (clay-lined canals are significantly more efficient, and fine materials deposited on the floor of Lake Nasser are thought to reduce seepage). Losses are greater from canals that are situated high above the surrounding plain. The above-mentioned Ismailiya canal is situated as much as 4.5m above the plain (Kinawy, 1978).

Evaporation from canals can be reduced drastically by converting to piped water distribution (Worthington 1978). This is very costly, however, and not seriously considered on a large scale.

(c) Improvement of irrigation practices

Improvements relate primarily to controlling extravagant irrigation practices. The present system is termed free-of-charge flush irrigation, i.e. arable water is discharged into canals long enough to have an area inundated. Losses are twofold. Firstly, more water than is necessary for a healthy crop is usually used in this flood system, and secondly a certain amount reaches drains at the end of canals resulting in losses estimated at about 2.0 milliard m$^3$/yr. Unnecessary over-irrigation and re-irrigation is common as is the use of water during daylight hours only, allowing nocturnal supplies to reach the drains (Worthington, 1978).

In all, such losses amount to some 9.8 milliard m$^3$/yr. (Table 3.6), or nearly 18% of Egypt's disposable supply. Sprinkler and drip irrigation systems, and charging farmers for the water they use, are methods mentioned to control water use. Major coincident advantages are those of controlling waterlogging and salinization problems.

(d) Cropping pattern

A principal aim in increasing efficiency should be to raise the crop index, especially in newly reclaimed lands. This index has risen from 1.0 crop/feddan/year at the turn of the century to 1.67 in the 1970's. It could be raised further by cultivating crops with lower water requirements, i.e. by giving over rice and sugar cultivation, for example, for maize, wheat, cotton, legumes, etc. (final two columns, Table 3.7), "whatever the value of such crops may be" (Kinawy, 1978).
## Table 3.7: Water Requirements under Flush Irrigation

<table>
<thead>
<tr>
<th>Country</th>
<th>Cropped Area (1000 fed)</th>
<th>Water Requirements (mill. m³)</th>
<th>Total Water Requirements (mill. m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lower Egypt (the Delta)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropped Area</td>
<td>x 1000 fed</td>
<td>Water requirements per fed.</td>
<td>Total water requirements per fed.</td>
</tr>
<tr>
<td>Wheat</td>
<td>725</td>
<td>1600</td>
<td>1200</td>
</tr>
<tr>
<td>Beans</td>
<td>135</td>
<td>1320</td>
<td>1312</td>
</tr>
<tr>
<td>Barley</td>
<td>73</td>
<td>1400</td>
<td>1225</td>
</tr>
<tr>
<td>Fenugreek</td>
<td>1.8</td>
<td>1050</td>
<td>1050</td>
</tr>
<tr>
<td>Lentils</td>
<td>32.2</td>
<td>1070</td>
<td>1070</td>
</tr>
<tr>
<td>Flax</td>
<td>2.5</td>
<td>2280</td>
<td>2280</td>
</tr>
<tr>
<td>Onions</td>
<td>6</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Lupine</td>
<td>3.5</td>
<td>1020</td>
<td>1020</td>
</tr>
<tr>
<td>Chick-peas</td>
<td>1166</td>
<td>3100</td>
<td>3100</td>
</tr>
<tr>
<td>Egyptian clover</td>
<td>903</td>
<td>1730</td>
<td>1730</td>
</tr>
<tr>
<td>Temporary (Berseem)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genie</td>
<td>2.2</td>
<td>1600</td>
<td>1600</td>
</tr>
<tr>
<td>Vegetables</td>
<td>3</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Others</td>
<td>11.3</td>
<td>1900</td>
<td>1900</td>
</tr>
<tr>
<td><strong>Middle Upper Egypt</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropped Area</td>
<td>x 1000 fed</td>
<td>Water requirements per fed.</td>
<td>Total water requirements per fed.</td>
</tr>
<tr>
<td>Wheat</td>
<td>275</td>
<td>1700</td>
<td>1700</td>
</tr>
<tr>
<td>Beans</td>
<td>135</td>
<td>1470</td>
<td>1470</td>
</tr>
<tr>
<td>Barley</td>
<td>73</td>
<td>1470</td>
<td>1470</td>
</tr>
<tr>
<td>Fenugreek</td>
<td>1.8</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>Lentils</td>
<td>32.2</td>
<td>1170</td>
<td>1170</td>
</tr>
<tr>
<td>Onions</td>
<td>2.5</td>
<td>2280</td>
<td>2280</td>
</tr>
<tr>
<td>Lupine</td>
<td>6</td>
<td>2900</td>
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</tr>
<tr>
<td>Chick-peas</td>
<td>3.5</td>
<td>1120</td>
<td>1120</td>
</tr>
<tr>
<td>Egyptian clover</td>
<td>1166</td>
<td>3600</td>
<td>3600</td>
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<tr>
<td>Temporary (Berseem)</td>
<td>903</td>
<td>1730</td>
<td>1730</td>
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<tr>
<td>Genie</td>
<td>2.2</td>
<td>1600</td>
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<tr>
<td>Vegetables</td>
<td>3</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Others</td>
<td>11.3</td>
<td>1900</td>
<td>1900</td>
</tr>
<tr>
<td><strong>Uppermost Egypt</strong></td>
<td></td>
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</tr>
<tr>
<td>Cropped Area</td>
<td>x 1000 fed</td>
<td>Water requirements per fed.</td>
<td>Total water requirements per fed.</td>
</tr>
<tr>
<td>Wheat</td>
<td>275</td>
<td>1700</td>
<td>1700</td>
</tr>
<tr>
<td>Beans</td>
<td>135</td>
<td>1470</td>
<td>1470</td>
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<tr>
<td>Barley</td>
<td>73</td>
<td>1470</td>
<td>1470</td>
</tr>
<tr>
<td>Fenugreek</td>
<td>1.8</td>
<td>1500</td>
<td>1500</td>
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<tr>
<td>Lentils</td>
<td>32.2</td>
<td>1170</td>
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<tr>
<td>Onions</td>
<td>2.5</td>
<td>2280</td>
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<tr>
<td>Lupine</td>
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<td>2900</td>
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<td>Genie</td>
<td>2.2</td>
<td>1600</td>
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<td>Vegetables</td>
<td>3</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Others</td>
<td>11.3</td>
<td>1900</td>
<td>1900</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropped Area</td>
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<td>1000</td>
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<tr>
<td>Others</td>
<td>11.3</td>
<td>1900</td>
<td>1900</td>
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<tr>
<td><strong>Total Cropped Area</strong></td>
<td></td>
<td></td>
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<td>Water requirements per fed.</td>
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<tr>
<td>Others</td>
<td>11.3</td>
<td>1900</td>
<td>1900</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Water requirements shown in this table are according to extensive experiments carried out by the Ministry of Irrigation in pilot units. Total cropped area is 10,837 million feddans as actually surveyed in 1972.

(e) Re-use of drainage water

An estimated 4.5 million m³/yr. of water are re-used for irrigation in Egypt. Re-use furnishes a relatively large proportion (3%) of the total disposable supply and will probably increase with time.

Secondary industrial pollution and salinity in the delta have decreased large-scale water re-use, which is thus mainly practised in Upper Egypt.

(f) Management practices

Optimizing water use at the field scale involves improving the ability to supply no more than critical amounts of water at a critical period or periods of plant growth. Such decisions are made according to crop-type and soil characteristic such as retention capacity and natural water supply. Proper tillage, mulching, weed control, and erection of wind breaks all reduce soil moisture loss.

At the project scale two management problems are critical. Firstly, "avoiding peaks in field water requirements as well as idle periods when the [irrigation] network is undershared" (Worthington, 1978); and secondly, obtaining effective agronomic use of water (i.e. by controlling water supply and hence depth of wetting, and by controlling the period(s) of water supply to comparatively short critical times of need). Crop type and the amount of land under particular crop types need to be built into the management system. "Sophisticated schedules of water delivery" are the ultimate aim (Worthington, 1978).

Worthington (1978) encapsulates the experience of 91 operating irrigation projects from many countries in which improved organization and management practices promote overall efficiency: avoid irrigation projects of less than 1000 ha; divide large irrigation projects into lateral units of between 2000 and 6000 ha, depending on topography; let each lateral unit contain a number of rational units, the size of which should vary between 70 and 300 ha, depending on topography; operate main lateral and sublateral canals on a schedule of continuous flow; within a rotational unit, organize the rotation of water supply to farm inlets or group inlets independently of the distribution in adjacent units; on large irrigation projects of more than 10,000 ha decentralize the project management so that each lateral unit has its own staff. (Worthington, 1978: 16-17)

These measures are believed to cost little to implement while contributing substantially to water use efficiency.
(g) Spillage into the Mediterranean

Canals are closed during the Nile's low January flow, with only enough discharge from Lake Nasser to maintain navigable depths in the major canals, to supply power generation needs and domestic requirements. 3.5 million m$^3$/yr. flows into the Mediterranean as a result. It has been suggested that this substantial quantity be stored either in the coastal lakes or in the Natrun depression for irrigation use (Kinawy, 1978).

3.2.3 Western Desert Oases and the Western Coastal Zone

3.2.3.1 Western Desert Oases:

Two aquifers, a shallow and a deep, supply water to the two major oases of the Western Desert (Kharga and Dakhla—Fig. 2.1) by means of wells (Table 3.8). 31,000 feddans

<table>
<thead>
<tr>
<th>Table 3.8 Kharga and Dakhla Oases Well Yields</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name of well</strong></td>
</tr>
<tr>
<td>Kharga oasis</td>
</tr>
<tr>
<td>Mahariq</td>
</tr>
<tr>
<td>Borg</td>
</tr>
<tr>
<td>Qasr</td>
</tr>
<tr>
<td>Faruqyiya</td>
</tr>
<tr>
<td>Bustan</td>
</tr>
<tr>
<td>Ginah 2</td>
</tr>
<tr>
<td>Ginah 1</td>
</tr>
<tr>
<td>Gomhouria</td>
</tr>
<tr>
<td>Dakhla oasis</td>
</tr>
<tr>
<td>Budkulu</td>
</tr>
<tr>
<td>Qasr 2</td>
</tr>
<tr>
<td>Qasr 1</td>
</tr>
<tr>
<td>Gedida</td>
</tr>
<tr>
<td>Qalunun</td>
</tr>
<tr>
<td>Faruqyiya</td>
</tr>
<tr>
<td>Ismant</td>
</tr>
</tbody>
</table>

| Shallow Wells | | 1953 | |
|----------------|--------|--------|
| **District** | **No. of wells** | **Discharge m$^3$/day** | **No. of wells** | **Discharge m$^3$/day** |
| Kharga oasis | 154 | 123200 | 412 | 125800 |
| Dakhla oasis | 905 | 253500 | |

Note: Data from taxation records.

Source: Seddik et al. 1979.

25
were irrigated in 1976, compared with 15,000 faddans in 1955 (Saddik et al., 1979).

However, recent geophysical exploration reveals that these two cases are underlain by aquifers capable of supplying 750 million m³ of groundwater yearly, sufficient to irrigate 150,000 faddans. Totals for all 6 of the Western Desert cases show 2.5 million m³, sufficient for the irrigation of half a million faddans (Table 3.9).

Table 3.9: Groundwater Supplies Western Desert Cases

<table>
<thead>
<tr>
<th>Area</th>
<th>Available Groundwater million m³</th>
<th>Possible irrigated area 1000's Faddans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shbar Cases</td>
<td>125</td>
<td>25</td>
</tr>
<tr>
<td>Bahariya Cases</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Farasan Cases</td>
<td>700</td>
<td>146</td>
</tr>
<tr>
<td>Dakhla Cases</td>
<td>500</td>
<td>100</td>
</tr>
<tr>
<td>Kharga Cases</td>
<td>250</td>
<td>50</td>
</tr>
<tr>
<td>South Kharga Deg.</td>
<td>675</td>
<td>135</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2500</strong></td>
<td><strong>500</strong></td>
</tr>
</tbody>
</table>

Sources: Saddik et al., 1979.

Piezometric gradient in southwest Egypt (Fig. 3.3) indicates groundwater flow from the south and southwest (Fig. 3.4).

Fig. 3.3: Piezometric Surface in Southwest Egypt
Source: Shata, 1979a.
3.2.3.2 Western Coastal Zone (Saddik et al., 1979)

Rainfall along the coast, insufficient for most kinds of agriculture (150 mm/yr.), is concentrated by 218 wadis drainages sufficiently to supplement irrigation by precipitation in an area of 135,000 feddan. A groundwater supply from Neogene and quaternary aquifers (United Nations, 1973) of 25 million m³/yr is sufficient to irrigate 5,000 feddan of olive, almond and fig trees.

3.2.4 Sinai Peninsula (Said, 1979; Shata, 1979b).

The major drainage feature is Wadi el Arish which drains two thirds of the peninsula and drains into the Mediterranean at El Arish. 200,000 m³/yr could be drawn from this groundwater supply.

Large wadis on the Suez and Aqaba Gulf coasts carry sufficient runoff for planners to consider developing settlements (Shata, 1979) (Fig. 3.5).

Nile water irrigated a small number of feddan near Ismailiya.
before 1967. A scheme envisaged 25 years ago, considered viable, planned the irrigation of 250,000 faddans.

Three major aquifers, almost entirely uninvestigated, underlie the Sinai: Nubian Sandstone, Eocene and Cretaceous rocks, and Quaternary calcarenites (Shata, 1979b).
3.3 SOIL RESOURCES

3.3.1 General Description

Of eighteen soil associations identified in the FAO/UNESCO classification (1970), six account for 85% of the surface area of Egypt (Fig. 3.6).

![Soil Map of Egypt](image_url)

**Fig. 3.6: Soil Map of Egypt.**

The richest soils are those Nile silts (Fluviosols, Fig. 3.6) of the Nile valley and delta and Fayyum depression. These cover a mere 2.5% of Egypt's land area. They comprise mainly a clayey loam with poor permeability (Kinawy, 1978). Since the introduction of perennial irrigation, slow water migration in these soils has caused problems of gleying and salinization.

Soils along the Mediterranean littoral hold the best potential for development outside those of the Nile fluviosols. However, these littoral soils and degraded are display C - horizons only, with ubiquitous strong calcic accumulation in the zonal soils;
accreta soils generally reflect such parent materials as dune sand and marine and alluvial sediments (Hemmat et al., 1972). Saline clays fringe the coast of the delta (Shatas, 1979a).

Rudimentary soil development of the Lithosols and Eremolithosols characterise much of the rest of the country, and are commonly known as "Desert pavement." Soils developed on fixed and shifting dunes, the dynamic Eremosols and semi-stable Eremosols respectively, are similarly useless agriculturally. The depressions of the western Desert contain patches of fluvial and lacustrine silts and clays with varying admixtures of sand. Soil development is poor on these as well, and they will need substantial artificial re-making before being capable of the projected two and three crops per year under irrigation (Shatas, 1979a).

1.3.2 Conversion of Basin to Perennial Irrigation

Egypt's use of its soil resource has become ever more efficient especially since the completion of the High Dam and the introduction of perennial irrigation. In 1960 5.1 million feddan were cultivated. Since then the crop index has risen from 1.0 feddan/year to 1.67 on a total of 6.5 million feddan. Summer cultivation increased from 50% of the total in 1952 (3.12 million feddan) to 80% in 1972 (5.31 million feddan) (Kinaisy, 1978).

Egypt's minister of irrigation has explicated the major advantages of this conversion which (apart from the wider social benefits) are listed as follows (Abul-Ata, 1978):

1. The availability of summer irrigation water, at a low cost for those who use public pumping machines and free for those who employ their own private means.

2. The summer cultivation of vast areas, where cultivation used to be practised only once a year following the discharge of flood waters off the land.

3. The ripening of cotton in the field instead of being early harvested before ripening, as was the case before for fear of the crop being flooded. This increases the cotton yield considerably.

4. Improving the type of cotton as a result of its ripening before harvesting.

5. Saving cotton harvesting costs, at a rate of at least one pound per feddan, since there is no longer urgent demand for harvesting labour before the crop was flooded.

6. Considerable increase of the millet crop, as a result of being supplied with full water requirements. In the past the plants remained unirrigated for long periods, sometimes as much as 50 days.
7. The possibility of early cultivation of clover for cattle feed, thus increasing livestock production.

8. The early cultivation of winter crops without waiting for the draining of flood water.

9. The possibility of harvesting two crops of clover instead of one, before the cultivation of cotton.

10. The possibility of cultivating certain areas three times a year, for example clover followed by summer maize followed by Nili summer millet.

11. The cultivating of gardens in the lands brought under perennial irrigation.

12. Sugar-cane cultivation. The Ministry of Industry's programme has included an expansion of sugar-cane growing areas in the Republic, to cover about 90 thousand feddan in the regions of Kouss, Esna and Dishna, and the factory scheduled to be established in Giza or Balyana.

3.3.3 Reclamation Schemes

It is computed that a total of approximately 10.8 million feddans are irrigable in Egypt with known water resources (Table 3.10)

Table 3.10: Egypt's Cultivable Area

<table>
<thead>
<tr>
<th>Feddans</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,500,000</td>
<td>cultivated till 1952.</td>
</tr>
<tr>
<td>1,300,000</td>
<td>from Aswan High Dam.</td>
</tr>
<tr>
<td>1,000,000</td>
<td>by water from equatorial Nile projects and Bahr El-Jabal water conservation project.</td>
</tr>
<tr>
<td>400,000</td>
<td>by drainage water suitable for irrigation.</td>
</tr>
<tr>
<td>800,000</td>
<td>by good water management.</td>
</tr>
<tr>
<td>150,000</td>
<td>by groundwater in the Nile Valley.</td>
</tr>
<tr>
<td>500,000</td>
<td>by groundwater in desert depressions.</td>
</tr>
<tr>
<td>135,000</td>
<td>by rainfall</td>
</tr>
<tr>
<td>10,785,000</td>
<td>Feddans</td>
</tr>
</tbody>
</table>


This constitutes a more than 50% potential increase on the pre-revolution area of 6.5 million feddans, although only approximately 1 million feddans have been reclaimed from the desert thus far (El Gabaly, 1978) in several parts of the Nile valley and delta. The twelve reclamation schemes in progress (scheduled for completion by 1980) are all in the Nile valley and delta, the seven larger ones in the north and five smaller
in the valley itself (Nos. 1-12, Fig. 1.7; Beaumont et al., 1976).

Fig. 3.7 The 12 Reclamation Areas are Listed and Discussed in the Text.
Source: Beaumont et al. 1976
Salient details of these schemes are listed below:

1. **Tahrir ('Liberation') Province**, one of the earliest large scale settlement schemes in Egypt was begun in 1957. Over 150,000 foddans had already been reclaimed by 1972 and 25,000 people had established in seven villages. A further 50,000 foddans remain to be taken up. Water is obtained from the Nile by canal, but in the southern sector it is also supplemented by local groundwater. A number of problems have arisen in the management of the calcareous soils of this region, which are gradually being overcome.

2. **The Maryut region.** This scheme, eventually covering some 115,000 foddans, includes the draining and reclamation of lake Maryut and adjacent land near Alexandria. A feature of this project is the use of processed sewage water to supplement water from the Nile. The reclamation of 68,000 foddans was completed in 1972.

3. **The Nubariya desert scheme**, southwest of Alexandria, is being undertaken using Nile waters on some 217,000 foddans: 75,000 foddans had been reclaimed by 1970.

4. **The Northern delta**, south of Lakes Idku and Burullus. A vast region of lakes, swamps and lagoons known locally as Barari has been drained and the saline soils reclaimed at great cost, bringing about 120,000 foddans into cultivation.

5. **The desert southwest of Isma'iliya.** This region of perhaps 300,000 foddans could eventually support dozens of new villages; the projected scheme had not begun in 1972.

6. **The region south of Lake Manzala** should yield 135,000 foddans for agriculture when drained and irrigated.

7. **The western Sinai scheme.** Irrigation water was to be conducted to this region by pipeline underneath the Suez Canal. Over 2,000 foddans out of a projected 20,000 foddans had been reclaimed in 1967, but not yet settled.

8. The Faiyum depression - 9,500 foddans
9. El Minya region - 58,500 foddans
10. Kana province - 17,000 foddans
11. Radesia and Wadi Abbady - 13,000 foddans
12. Kom Ombo - 44,000 foddans

The Kom Ombo scheme was primarily for the resettlement of Nubians from Upper Egypt dispossessed of their lands by Lake Nasser; some 115,000 foddans will eventually be reclaimed. (Beaumont et al., 1976)
Best Available Document

Other reclamation schemes in the New Valley of the Western Desert (Fig. 1.7) are in the planning stages.

1.3.4 Damage to the Soil Resource

An important perspective on the soil resource of Egypt is the damage which occurs due to waterlogging and salinization. El Gabaly (1978) notes that 30% of Egypt's cultivable acreage is affected to some degree by these phenomena, which are common to irrigation projects throughout the world. For instance, 50% of Iran's irrigated land is affected, as is 23% of the whole of Pakistan, 80% of the Punjab (Pakistan), 50% of the Almahwara valley in Syria and more than 15% in Iraq (El Gabaly, 1978).

The severity of the problem in some areas can be judged from the situation at Faiyum in the Upper Nile where the ratio of land irrigated to that lost downslope through insufficient drainage is believed to be 1:1 (Wallington, 1978). Nyrop (1976) notes that only 40-50% of the 1 million reclaimed faddans seemed to be cultivated by the end of 1975.

Until very recently reclamation and conversion projects have not incorporated fully-fledged drainage systems, mainly because of lack of funds, engineers, building materials and transport networks. It was also believed that the lower level of the non-flooding Nile would induce sufficient drainage, and also that the policy of "low-lift" irrigation would discourage farmers from over-irrigating in the first place (Abul-Ata, 1978).

It is generally agreed that Egypt's northern coast lands were highly productive from at least classical times through to the 11th century A.D. (Kassas, 1979; Tolba, 1979). Since then they suffered desertification as a result of intensive land use and the fragile, almost rainless environment (Ayyad, 1979). Roman ruins lie great distances from presently inhabited centers attesting to the once productive "granary" of the Roman world.

The present minimal productivity is maintained by continuing pressure to feed existing population.

Attempts to rehabilitate these potentially rich soils are dealt with below (4.2.2). The Sardane workshop (Kassas 1979) looked forward to the coastal zone becoming a major axis of growth in the next 20 years, based partly on recovering Mediterranean coastal soils.

Migrating dunes bury productive soils and buildings, roads and railways (in the western oases and along the western margin of the Nile valley and delta (El Baz, 1979; Tolba, 1979). The exact extent of dune encroachment is not known, although Landsat image analysis has provided preliminary information. Controlling sand movement is examined below (see 4.2.2).
The permanent loss of agricultural land to other land uses, particularly urban sprawl, is an important consideration in the evaluation of Egypt's soil resources. It is reported that more than 600,000 feddans were lost during the decade of Egypt's first two five-year plans (Salah Galal, 1977). Quoting UNEP's 1977 State of the World Environment Report, Al Ahram's Galal (1977) concludes that Egypt's per capita cultivated area is declining, as population increases at 2-5% yearly, as land is lost to other uses, and since the reclamation effort "in practice...has almost come to a standstill."

3.3.5 Examples of Problems in Raising Soil Use Efficiency

3.3.5.1 Cattle, Clover and Canals.

The single most-grown crop in Egypt is Egyptian clover (berseem) (Table 3.11) of which the bulk is used to feed 4.2 million (Nyrop, 1976) cattle and buffaloes (Beaumont et al., 1976). These animals provide milk, meat and animal power particularly for lifting irrigation water from canals.

Table 3.11 Chief Crops and Orchards, 1970

<table>
<thead>
<tr>
<th>Crop</th>
<th>Area in '000s of feddans</th>
<th>Per cent of total area under crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clover (or berseem)</td>
<td>2,734</td>
<td>25.5</td>
</tr>
<tr>
<td>Cotton</td>
<td>1,627</td>
<td>15.2</td>
</tr>
<tr>
<td>Maize</td>
<td>1,509</td>
<td>14.0</td>
</tr>
<tr>
<td>Wheat</td>
<td>1,304</td>
<td>12.2</td>
</tr>
<tr>
<td>Rice</td>
<td>1,140</td>
<td>10.6</td>
</tr>
<tr>
<td>Vegetables</td>
<td>706</td>
<td>6.6</td>
</tr>
<tr>
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<td>501</td>
<td>4.6</td>
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<td>Beans</td>
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<tr>
<td>Barley</td>
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<tr>
<td>Other crops</td>
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<td>1.1</td>
</tr>
<tr>
<td>Other fruit</td>
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<td>1.1</td>
</tr>
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<td><strong>TOTAL:</strong></td>
<td><strong>10,732</strong></td>
<td><strong>100.0</strong></td>
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</tbody>
</table>

This latter aspect often arises in discussion of Egyptian rural economics. The need to improve animal quality as a provider of protein, and the possibility of introducing mechanical pumping of water, leads to speculation on phasing out draft animals (often used purely in irrigation and thereby reducing the significant areas of land needed to feed them).

Camels were specifically designed, in fact, to lie 30–50 cm below field level so that farmers would need to lift the water (thereby, reducing extravagant water use), and so that field drainage would be encouraged (Abul-Ata, 1978).

E.B. Worthington (1978) asks whether this is not a negative position to hold since it encourages farmers to retain their draft animals. He suggests that a gravity system (above-field camels, presumably well insulated against leakage) of water supply, with a small charge for optimum water use, would be the best way to reduce the cattle and buffalo draft animal population and so free acreage for other crops.1

3.3.5.2 Land Reclamation at Kharga

A commonly quoted figure for the amount of reclaimable land in the southern part of Kharga oasis in the Western Desert (South New Valley) is 1,300,000 feddan (Badran et al., 1979) which would constitute an increase of 22% in cultivable land.

El Baz (1979) notes, however, that this area will have to be "confirmed" first, presumably by more detailed soil mapping and classification. He also notes that problems of undulating topography, underground water availability, the need for extensive and efficient drainage systems, and high costs of operation "are likely to reduce this figure to by a factor of ten, to about 130,000 feddans" (El Baz, 1979).

---

1 Nyrop (1976) argues for an increase in fodder acreage, towards a greatly number of protein-producing livestock, which Egypt lacks. Foreign exchange spent importing meat would be saved. In 1974, however, the Government invested heavily in chicken farms to augment protein supplies.
3.4 FLORA

3.4.1 Introduction

The natural vegetation cover of Egypt is sparse because of the desert climate. There are no natural forests. The most widespread indigenous tree is the date palm, although exotics such as eucalyptus, cypress and elm have done well since being introduced. Reclamation and burning of swamp lands has reduced even the papyrus-dominated swamp vegetation in the Delta (Nyrop, 1976).

Natural vegetation ranges from scrub-land in patches along the coast (with 150-200 mm rainfall) to completely unvegetated stony desert and sand dunes. Major plant associations of the desert are listed below.

3.4.2 Plant Associations and Distribution in the Desert (Hassib, 1951)

The following are the major associations (selected by McGinnies, 1970, pp. 408-9):

1) The *Panicum turgidum* association is the most important because of wide distribution; it is found on sandy plains and broad shallow valleys; mixed grasses, herbs, and shrubs occur with it.

2) The *Zilla spinosa* association has wide distribution on deep sandy soils.

3) The *Pithantranthos tortuosus* association covers large areas of sand in the Libyan Desert, often with *Zilla spinosa*.

4) The *Zygophyllum coccineum* association is common on rocky desert plateaus and shallow depressions on the margins of deep valleys; *Reaumuria hirtilla* is often associated with it.

5) The *Haloxylon salicornicum* association is common and widely distributed on the sandy floors of shallow wadis and on small sandy dunes.

6) The *Capparis spinosa* association is found on rocks and high cliffs of deep wadis.

7) The *Odontospermum pygmaeum* association is abundant on loose stony areas or banks of wadis.

8) The *Cormulaca manacantha / Convolvulus lanatus* association is found on sandy soil with the drifting sand collecting around the plants.
9) The Resurrection hirta association is widely distributed in depressions on exposed plateaus; this species forms pure associations and is also common on rocky ground in deep wadis associated with Zygophyllum coerulescens.

10) The Salsola fruticosa association is abundant in the sandy ground of broad shallow wadis.

11) The Cleasus prostratus association is found in broad shallow wadis.

12) The Aristida coerulescens / Danthonia forskalii association accumulates sand, forming small dunes in drifting sand areas.

Benedick (1961) computed that of 755 species identified in the Egyptian desert, 45% are annuals, 7-2% small trees and shrubs, 0-1% succulents, and the rest are low-growing perennial plants.

The SMEBES project is involved in the task of establishing more productive rangelands along the Mediterranean littoral, Egypt's only potential rangeland, which Rattray (1968) has characterized as a Byrsonima hirta - Gryzopus miliaee - Cyperun denseplum grass association. As present it has very little grass due to intensive grazing by camels and sheep, and it "has been reduced to an unpalatable shrub steppe" (Rattray, 1968). Olives and almonds are grown in many localities since government efforts in the early 20th century concentrated on this area. Rattray (1968) quotes a carrying capacity of only 1 sheep/hectare/year on well-managed sandy soils.


Indigenous wildlife is very limited in Egypt. In the delta some wild boars, jungle cats, caracal lynx, and mongoose can still be found. A variety of rodents is common in the valley.

In the desert beyond the Nile ibex inhabit rocky slopes of the Sinai and Eastern Desert. To the south especially, various gazelles, ibex, Barbary stag, leopard, cheetah, striped hyaena, jackals, and wild asses are thought to occur still. A recent report mentions the highly unusual sighting of a family of six cheetah north of the Qattara Depression (Ghabbour, 1973). A variety of snakes, some poisonous (viper, cobra), still occur.

More than 300 species of birds, resident and migratory, are concentrated in the Nile valley and delta.
Egypt's fish resource is the only economically exploitable group other than domestic animals. The catch was primarily offshore and amounted to 100,000 tons yearly in the early 1960's. The sardine catch of 18,000 tons yearly (1962) has disappeared, probably as a result of nutrient supply reduction to the Mediterranean after construction of the High Dam. Figures on the total catch were not available in 1975.

It appears that the potential for 3,000-5,000 tons of surface fish is available along the coast. The size of bottom fish supplies is not yet known.

Fishing in the Nile is said to be excellent, and the Nile perch catch from Lake Nasser has increased rapidly from 750 tons in 1966, to about 11,000 tons in 1975, to nearly 19,000 tons in 1979. Over-fishing has not occurred and development of this resource depends on increasing the number of fishermen around the Lake. On the other hand, capital investment in the marine fishing industry are needed in order to exploit Mediterranean and Atlantic waters.

7.5 million domestic animals provide protein and act as draft animals.
4.0 ENVIRONMENTAL CONSIDERATIONS

This section reviews the major environmental impacts of the manipulation of Egypt's natural resources.

4.1 ENVIRONMENT AND IRRIGATION PROJECTS

The kinds of benefits which have flowed from construction of the High Dam and perennial irrigation system have been recounted (3.3.2 and 3.3.3 above). Many dire predictions about the harmful impacts of the scheme have not materialised. Nevertheless, many related changes in the environment have occurred and the major ones are presented in this section.

HYDRAULIC CONCERNS

4.1.1 Effects of Cumulative High- and Low-Flow Years

A major purpose of the High Dam is to regulate the annual Nile flood. A series of floods would tax the lake's capacity, finally forcing large amounts of water to be released with consequent damage downstream. To obviate this danger an over-flow channel is being excavated to divert accumulated water into the Toshka depression west of the lake (Benedick, 1978).

A series of low rainfall years, on the other hand, immediately reduces the head of water needed for power generation. Over-reliance on Aswan's cheap hydroelectricity may threaten the viability of electrically-powered industry in particular.

4.1.2 Nile Water Quality

One of the most important effects of the High Dam has resulted from the impoundment of water-borne silt in Lake Nasser. 60 million m$^3$/yr of silt are deposited, amounting to a staggering 30 km$^3$ after about 500 yrs.; however, engineers indicate that this is a fraction of the lake's total capacity of 1569 km$^3$ (Hafz and Shanouda, 1978). Fears that the silt delta at the head of the lake in Sudan would cause the Nile to spill out into the desert have proved unfounded. Flood currents appear to be keeping a central channel open through the delta deposit (Benedick, 1978).

Silt starvation of river water below dams induces erosion of the river bed (and banks) and thereby the undercutting of installations situated on the banks, the removal of arable land, and lowering of the water surface, a serious problem where water has to be lifted for irrigation. It appears from a recent study (Abul-Ata, 1979) that original projections of river erosion have been confined to fairly short stretches mainly below the dam and barrages.
Average river bed level dropped 4-5 m below each barrage, with substantial stabilization expected by 1985. A 1977 estimate suggests that average final degradation between Aswan and Assiut will be 1 m and between Assiut and Cairo 2 m. This poses no risk to structures on the banks if discharges of water from the High Dam remain within reasonable limits (Abul-Ata, 1979). Conversely, drainage from the surrounding agricultural lands will not be as vigorous as originally expected (see 4.1.7 below).

Effects of silt starvation have been felt in rural Egypt and along the Mediterranean Coast. 60-180 million tons/year (Sharaf, 1977) were deposited by the Nile in pre-Aswan times. The nutrient value lost to the valley and delta soils (non-silica/aluminum component (Table 4.1) is made up by applying 13,000 tons of calcium nitrate fertilizer per year. Much sediment used to reach the Mediterranean yearly. It appears that, without this supply, winter storms now produce net erosion on the coast although no agricultural land has yet been lost (Benedick, 1978).

The severe industrial and domestic pollution in the Nile from Cairo to Alexandria is discussed below (4.4), as is pollution from agricultural chemicals.

Table 4.1 Chemical Analysis of the Clay Fractions of Nile Sediments for the Flood of 1954.

<table>
<thead>
<tr>
<th>Constituents</th>
<th>%</th>
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<tbody>
<tr>
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<tr>
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<tr>
<td>Carbonates</td>
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</tr>
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</table>

4.1.1 Effects on Groundwater

It has been noted that the Nile's new hydrologic regime will affect the manner in which aquifers are recharged (Espérandieu, 1978c). Year-round irrigation, seepage from canals and drains, and water levels which have risen tens of meters in a few years all affect recharge. Major concerns are to prevent salinization of groundwater bodies and to prevent over-exploitation.

Salinization seems more likely in the case of the Nile valley aquifers than the deep Nubian Sandstone aquifer. Little information is available, but it appears that salinized drainage water has not seriously affected the subterranean water body. Effects have been noticed, however, in the delta, where pumping fresh water to the surface has allowed marine salt water to rise nearer the surface and penetrate inland (Fig. 4.1). It has been suggested that Nile water be diverted into the lakes of the delta coast (instead of being lost to the sea) in order at least to prevent further salt water incursion into the deltaic gravels.

Water in the Nubian Sandstone has been dated by C-14 and argon-argon methods at 10,000 - 1,250,000 years old (Shata, 1979a).

Fig. 4.1: Nile delta fresh water body

Source: Shata, 1979a.
Table 4.2  Monthly Salt Content of Noubaria Canal Water (ppm)

<table>
<thead>
<tr>
<th>Sites</th>
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<th>Mar</th>
<th>Apr</th>
<th>May</th>
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Year 1976

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Year 1978

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</tbody>
</table>

* M-F: Mechanized Farm
** N.Lock: Navigation Lock

Source: Hassan et al., 1979.
It appears that it probably derives from periods of wetter climate in the past. If groundwater supplies are to be maintained, pumping must not exceed recharge. Redman et al. (1979a) nevertheless discuss land reclamation by the exploitation of this vast water body, extracting 3.0 million m$^3$/yr (annual recharge is 185 million m$^3$/yr), thereby reducing the water level by 100 meters in the course of 200 years.

4.1.4 Soil Damage and Irrigation

One of the most critical impacts of the new perennial irrigation has been the waterlogging and salinization (to different degrees) of fully 20% of Egypt's productive land. All reclaimed lands feel these effects (El Gebaly, 1978). Some lands have been abandoned and average yields are depressed by 30% in the affected areas (El Gebaly, 1978).

Irrigation has caused groundwater levels to rise very quickly to the surface. Experience from the Western Desert project (Hababiyah) has shown that waterlogging occurred within 2-5 years as water levels rose from 50 m to 1-1.5 m below the surface (Worthington, 1978).

Soil salinization is a related phenomenon. It is most commonly associated with rising groundwater levels, either because the water is saline or because fresh groundwater dissolves soil salts (Worthington, 1978). Soil salts also accumulate from saline soil water and saline irrigation water. Near-surface water is constantly subject to evaporation and consequent salt enrichment. Thus, fresh irrigation water is significantly more saline by the time it drains from farmland.

Such effects have been carefully monitored along the 100 km Nubariya Canal which was constructed to reclaim large areas on the west delta fringing (Nubariya Schema, Table 3.10, Fig. 3.7). Drains leading drainage water back into the Nubariya Canal are contaminating the canal with water of salinities around 4500 ppm (Hassan et al, 1979). Furthermore, salinity in areas downstream (sites 175 D3 through N. Lock, Table 4.2) rises as saline effluent is added. Table 4.2 shows that salinity in the canal is increasing from year to year, almost doubling between 1975 and 1978 (May/June figures at Nasr (ppm): 390 and 425 in 1975, versus 640 and 736 in 1975, 40 km downstream at Mariut: 580 and 430 in 1975 versus 992 and 832 in 1978).

Irrigation with slightly salinized water can cause salt build-up with time. Sophisticated models exist (Kovda, 1978) to predict whether or not soils will be damaged. With very good drainage and sufficient water, the salt balance in the soil can be maintained at non-toxic levels even using water too saline for less well drained soils.
The effects of saline groundwater have been monitored in many areas. In the Noubaria area, irrigation of lands 30 m above sea level has caused saline groundwater to drain back into irrigation canals at 3-6 m above sea level.

Attempts are now under way in Egypt to recover lost and damaged soils by further modifying the hydrologic environment. The largest capital expenditure will be devoted to construction of tile drainage below field level in order to lower high water levels, or to prevent them rising to the surface. US $500 million has been earmarked in the decade 1975-1985 for this vast programme (El Gabaly, 1978). In fact, the Minister of Irrigation suggests that Egypt's priority has shifted from the basin conversion problem to the recovery of damaged lands by the tiling of fields (Abul-Ata, 1978).

Kovda (1978) stresses the fragility and integrated nature of the soil-water system, and indeed Egypt has extensive plans not only to improve drainage but also to improve soil quality by subsiding with gypsum, the use of fertilizers, new methods of irrigation and water distribution, the application of optimum amounts of irrigation water, and the consolidation of crops (El Gabaly, 1978).

Russian experience has shown that lining canals is a major component in lowering water levels, and in reclaiming naturally saline soils for agriculture (Kovda, 1978). There seems to be little emphasis on this aspect in Egyptian plans. It is apparent too that local surveys of soil type, topography and hydrology need to be conducted since so many variables are involved, and improvement schemes are likely to produce best results if constructed for each specific area.

Tolba (1979) reports that incursions of blown desert sand appear to be encroaching actively on the Nile's western fringe soils since the High Dam was built. Annual mixing of such sands with flood silts from the Nile used to maintain productivity of the fringe soils.

SOCIAL IMPACTS

4.1.5 Population Movements

A number of Nubians were resettled (50,000-Hafez and Shanouda, 1978; 60,000-Benedick, 1978; 100,000-Johnson and Johnson, 1977) from the flooded parts of the Nile valley, many to the Kom Ombo plain downstream.

Now fishing communities (5,000 individuals-Benedick, 1978) have occupied points on the 1400 km perimeter of the lake. Conversely, fishing communities at the coast have been adversely affected by the drop in fishing which has resulted, at least partly, from the lower Nile sediment discharge into the Mediterranean.

45
The town of Aswan has increased from 30,000 to 170,000 as a result of new tourist, fish processing and fertilizer industries, and related growth of commerce and banking (Benedick, 1978).

Social impacts associated with these range from the benefits in training and employment to the thousands who worked on the High Dam and associated irrigation systems, the lifestyle changes involved in producing 2 or 3 instead of one crop per year (encouraging people to stay on the land), to the equivocal effects on the resettled Nubians (Barker and Sheruda, 1978; Johnson and Johnson, 1977).

4.1.6 Water Supply and Industry

While providing a constant water supply for industry, the existence of the Dam has not led to the development of heavy industry in southern Egypt. Reasons include distance from raw materials and other major centers, and the uncertainty of power supply. This may seem surprising, but outflows from the Dam are primarily geared to the needs of irrigation, so that more water is released in spring and summer then can be used by Aswan’s turbine generators, and less than necessary during the higher demands of fall and winter.

This is highlighted by the fact that, despite general under-utilization of the power-generation plant, thermal power stations are being built in Egypt.

The rural brickmaking industry has suffered from the absence of flood silt deposits since the Dam was built. Silt was dredged from canals and used widely to make mud bricks. Prices have risen sharply as brick production decreased. The government advocates the use of sand for brickmaking (Benedick, 1978) since there is no lack of this resource.

4.1.7 Aswan High Dam and the Fishing Industry

Siltation in Lake Nasser has reduced greatly the supply of phytoplankton in the Mediterranean off the delta coast. Schools of sardine are less in evidence. From processing a catch of 18,000 tons in 1962, the sardine fisheries have disappeared (Benedick, 1978). Benedick (1978) cautions, however, that declines in the fish yield also may have resulted partly from over-fishing and offshore pollution.

4.1.8 Health Considerations

There is little doubt that a sufficient supply of good water has beneficial effects on the general health of populations; the incidence of certain sanitation-related diseases is known to have declined in many arid areas (Worthington, 1978).
Nevertheless many diseases are directly waterborne or transmitted by hygrophilous organisms. These diseases are controlled to a large degree during seasonally dry periods. Perennial irrigation and permanent water supplies to villages very frequently provide year-round habitats for diseases and their vectors. It is argued that the mere existence of an irrigation system need not increase the incidence of water-related disease if basic sanitary principles are observed, especially in (a) hydrological engineering design and (b) upkeep of the water supply system to reduce bodies of open water and the vegetation associated with it. Worthington (1978) thus concludes:

"Everything points to one cardinal concept. The public health problems that arise from an irrigation project are not solely medical problems. Their medical aspects are often not the most important, they do not govern the epidemiology of the disease or the control strategy. They are a matter of environment, associated with the far-reaching changes made by man in the environment. This underlines the necessity of integrating the health component to the project as a whole: technically, financially and administratively."

Schistosomiasis is a major endemic disease in Egypt (Hafez and Shenouda, 1978). Its incidence has increased in places since the introduction of perennial irrigation, before which the snail vector was killed off during the dry season, and mollusc habitats partially cleared by the flood. Although it has always existed in Egypt, the disease has been noted migrating south from the delta (Benedick, 1978).

Attack on the snails appears to hold the best possibilities of breaking the life cycle of the parasitic schistosomiasis fluke. Cleaning out canals periodically and using molluscicides has been highly successful in a test area in the Fayyum where incidence of the disease dropped from 46% to 9% between 1969 and 1974. Transmission of the disease was practically halted. Unfortunately re-infection of individuals by contact of contaminated water is very easy (World Bank 1977; Benedick 1978). Chemotherapy is effective, especially in the early stages of the disease.

36% of the population suffers from the disease Egypt, 1978d but the proportion is much higher among rural people who regard it as an occupational hazard (Johnson and Johnson, 1977). The disease costs Egypt US $560 million yearly (Farooq, 1967).
Biotic changes


Several changes have been reported resulting from the introduction of perennial irrigation to the Nile.

The crocodile population (Crocodylus niloticus) has increased in Lake Nasser area, as have herds of gazelle (Gazella leporina and G. dorcas), ibex (Capra nubicar) and barbary sheep (Ammotragus lervia) have reappeared.

The Niles grass rat (Ammotragus lervia) has begun to invade villages, whereas Antius spp., no longer invade higher ground as they used to when their burrows were submerged during the flood.

Economic insect pests (the grape moth Polyvixnus bostrica, the corn stalk borer Chilo argeston, and the cotton leafworm Spodoptera littoralis) are on the increase, apparently migrating progressively southwards up the Nile valley. Two bird pest species, the desert sand grouse Gerrois and Ploostris hispaniolensis have also increased.

Many plants have disappeared since the annual flood ceased, e.g., Caldesia reniformis, Aliensa plantago-aquatica, Riccia spp., and Glinus littorlalis. The latter has appeared on the shores of Lake Nasser, however. Fourteen original species of rice—1946 have disappeared from rice fields to be replaced by ten new species, some particularly harmful. These changes have accompanied the change to the summer "Seifl" rice-type in the Fayyum.

Aquatic weeds are no longer flushed away by floods, especially floating weeds. The notorious water hyacinth appeared in large numbers immediately after the damming of the Nile in 1965. A control program started then was ultimately unsuccessful, but another was begun in 1975, by which time more than 80% of the waterways in Egypt were infested. Lake Nasser is still free of the weed.
Strong weed growth in delta canals has occurred with the new perennial water supply. Mechanical cutting, herbicides and introduction of carp fish are being used to control the weeds.

IRRIGATION AND FOREIGN AID

4.1.10 Criteria for Funding Irrigation Schemes

Worthington (1978) notes that existing technical knowledge concerning irrigation is glaringly underused. Whereas problems facing integrated planning are rooted in governmental structures and procedures, international action is also responsible. Apart from assuring a wide, rapid flow of available information to government and private project planners, international action can simply and directly improve planning by insisting on careful consideration of a few environmentally-oriented criteria, apart from the usually well-investigated economic costs and benefits, time periods and project feasibility (Worthington, 1978).

Worthington (1978) therefore suggests the following questions should be asked concerning environmental impacts of irrigation schemes:

1. Has adequate provision been made for drainage and leaching so as permanently to maintain the quality of soil and water in the root zone?

2. Has the full range of alternative measures for achieving efficiency in water use been appraised?

3. Has the project study examined the probable effects upon aquatic and adjoining terrestrial ecosystems of changing the hydrological and soil regime in the area?

4. Has the study canvassed and assigned costs to the social, health and economic measures which would be required to assure that anticipated benefits from crop growth and social stability are realized?

5. Has the well-being of the population been taken into account?
4.2 SOIL PRODUCTIVITY OVER THE NILE VALLEY AND DELTA

4.2.1 Reclamation of Agricultural and Rangeland

The narrow (50 km) coastal strip which comprises Egypt’s slightly better-watered (100–150 rainfall) semi-desert area is classed as “reversely desertified” (U.N. Conference on Desertification, 1977/R/Conf. 74/31). In Graeco-Roman times this area was agriculturally highly productive (Kassas, 1979; Tolba, 1975).

Various attempts have been made this century to improve the low productivity of the coastal zone. Sultan figs (Ficus carica) were successfully introduced on the coastal dunes from 1948 onwards. Shortly after chimally olives (Olea europaea) from Tunisia were also cultivated successfully. Experiments in barley and other field crops were carried out but these have not been widely grown, suggesting to one authority that development in the coastal world should be based rather on horticulture (Des Closemen, 1965).

The coastal area were also expected to support 100,000 Bedouins in settlement schemes involving 17,000 feddans. It was hoped that irrigated pastures could be developed and rangeland so much improved that it could be “grazed as an efficient highly productive livestock unit by 1963” (Pearse, 1953). Despite this potential, however, irrigation from many windmills caused soil salinization and finally, by 1959, the whole scheme collapsed (Kassas, 1979).

The research station and experimental area associated with the scheme produced valuable data on animal breeding, vegetation (Tables 4.3 and 4.4) and soil, geology and land units. A subsequent large-scale livestock improvement and range management project was instigated in 1963 with international aid. It too failed to achieve the greatly increased productivity which had been earlier so confidently predicted for the area (Kassas, 1979).

Despite these setbacks it has been stated recently that the “coastal belt will, within the next 20 years, regain its ancient status as one of the areas of development and habitation in Egypt” (Kassas, 1979). This vision appears to rely less on range improvement and irrigated agriculture and more on mineral extraction (gypsum deposits, on- and offshore oil and gas), the associated port facilities at Marsa Matruh and transportation lines along the coast, hydro-electric power from the “Qattara Lake” scheme to the south, and tourism.

Perry notes that the technology exists, generally speaking, for successfully rehabilitating and managing fragile, arid range lands; by contrast, the economic, social and political aspect
of the process are far less tractable (Perry, 1979). The SAMDENE (Systems Analysis of Mediterranean Desert Ecosystems of Northern Egypt, 1974-1978) and REMDENE (Regional Environmental Management of Mediterranean Desert Ecosystems of Northern Egypt, 1979-1981) Projects will provide land use capability maps and other data which show optimum range-carrying capacities and irrigation regimes (Nile irrigation water has already been channeled 60 km west of Alexandria) (Kassas, 1979).

It appears, therefore, that the superior technical data of the 1930's will be available for future range improvement and agricultural reclamation schemes.

Table 4.3 The Most Promising Forage Plants Introduced into the Western Desert of Egypt.

| Agropyron elongatum | Medicago arborea |
| " trichophorum | " sativa |
| Atriplex numularia | " nanus |
| " canescens | " coruscans |
| " semibicostata | " holospermos |
| " viscarium | " cinersissimum |
| Bromus catharticus | " antitheta |
| Cichorium intybus | " coloratum |
| Cynodon dactylon | " maximum |
| Ehrharta calacina | " tuberosum |
| " longifolia | Prosopis juliflora |
| Festuca elatior | Salsolaria minor |
| Erodium coronarium | Sorghum halipense |
| Hordeum bulbosum | Stipa pulchra |
| | Chloris gayana |

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Family</th>
<th>Season of grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agropyron elongatum</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>* juvencum</td>
<td></td>
<td>w + sp.</td>
</tr>
<tr>
<td>Cynodon dactylon</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Dactylis glomerata</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Stipa lessaea</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Ehrnus lotus</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Scleria hirta</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Lotus polyphyllus</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>* coriaceus</td>
<td>Poaceae</td>
<td>all the year</td>
</tr>
<tr>
<td>Medicago sativa</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Chenopodium album</td>
<td>Chenopodiaceae</td>
<td>sp + sm.</td>
</tr>
<tr>
<td>Chenopodium frutescens</td>
<td>Chenopodiaceae</td>
<td>sp + sm.</td>
</tr>
<tr>
<td>* sanguineum</td>
<td>Chenopodiaceae</td>
<td>sp + sm.</td>
</tr>
<tr>
<td>Atriplex halimus</td>
<td>Chenopodiaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Convolvulus lineatus</td>
<td>Convolvulaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Halimium sp.</td>
<td>Cistaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Heliocandria nitens</td>
<td>Cruciferae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Polygynus tractus</td>
<td>Orchidaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Plantago aegyptiaca</td>
<td>Plantaginaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Stipa spartea</td>
<td>Poaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Polygonum aspratifolium</td>
<td>Polygonaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Potentilla rectica</td>
<td>Rosaceae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Salvia lavandula</td>
<td>Labiatae</td>
<td>w + sp.</td>
</tr>
<tr>
<td>Cnidosoria sativa</td>
<td>Labiatae</td>
<td>w + sp.</td>
</tr>
</tbody>
</table>

Critical to the success of any range improvement plan will be the response of livestock owners, as recognised in FAO reports on range management (FAO, 1974, 1975). However, this aspect appears to be peripheral to the admittedly technical SARDENE and REMBENE Projects.

Egypt is signatory, with Tunisia and Libya, to the "Protocol on cooperation among North African countries in the fight against desertification" (U.N. Conf. on Desertification, 1977, A/Conf. 74/3/Add. 1:23). The Protocol proposes the establishment of a Transnational Green Belt, embracing Morocco, Algeria, Tunisia, Libya and Egypt. The Green Belt is described by the U.N. Conference on Desertification as:

An interconnected belt across the five countries at the fringes of the areas where rainfall ranges from 150 to 250 mm per year. The green belt should not be conceived as a wall of trees grown perpendicular to the wind direction in order to reduce its velocity. It is a zone comprising a variety of devices for the prevention of further degradation of the ecosystem and the creation of an improved habitat. Soil stabilization, moisture conservation, afforestation, range improvement, appropriate plant and animal husbandry and dryland farming are among these devices. These need to be integrated within the green belt. The width of the green belt will depend upon local climatic and topographic conditions. It may vary between a few to tens of kilometers. The exact location in each country will be determined after further study. Existing and ongoing national schemes will be taken into consideration. Within the proposed green belt there may exist farms, shelterbelts, woodlands, ranges and other forms of land use. Each type should be treated separately and there may be variations in structure and composition from one location to another. (U.N. Conf. on Desertification, 1977, A/Conf. 74/3/Add.1:art. 78)

The primary aim of the transnational project is to co-ordinate the constituent national initiatives, and to set up intergovernmental machinery to aid this. The stress appears to be mainly on monitoring effects of desertification, sharing multidisciplinary data, and on intergovernmental co-operation. It may be noted again that the thorny problem of range improvement vis a vis present range users is underplayed.
Table 4.5 Species Recommended for Dune Stabilization

Grasses

a. *Atriplex nummularia* (nummular grass)
b. *Lupinus arborescens* (Lupin)
c. *Sesbania* spp. (*S. rostrata, S. aegyptiaca*)

The nummular grasses are drought-resistant species, followed by lupins. Lupin is recommended even when mixed with other species, as its roots fix atmospheric nitrogen which leads to the enrichment of the sand and improves the growth of other species.

 Shrubs

a. *Pomatia* spp.: some introduced members of this genus can be used for fodder as well as for sand fixation. This may cover the fixation costs within a few years.
b. *Asteriscus* spp.
c. *Halophyton* spp.: members of this genus and other succulent chenopods are drought and salt-tolerant and can be used in saline areas.

Trees

a. *Acacia cyanophylla*
b. *Acacia seyal*
c. *Acacia longifolia*
d. *Euclea frutescens*
e. *Eucalyptus camaldulensis*
f. *Eucalyptus simplex-christi*

Xerophytic pines such as *Pinus pinea* can also be used in areas where precipitation exceeds 300 mm rainfall per year.

Source: U.N. Conference on Desertification, 1977, A/Conf. 74/25
4.2.2 Stabilization of Wind-Blown Materials

Dust storms and shifting dunes pose a variety of problems in Egypt. The latter, in particular, remove productive soils from use or disrupt their use, as is the case of small fast-moving dune bodies. Dune encroachment occurs along the coast and on oasis margins in the Western Desert. Most seriously it occurs at points along the western windward margins of the Nile Valley and delta where satellite photography has documented dunes migrating at a speed of up to eight miles per year (Anon, 1977).

A great dune chain, the Ghard Abu Muhariq, moves south across the Western Desert directly towards the large oasis of Kharga. Here the sand cascades over the northern scarp onto the oasis floor, forming small dunes which engulf villages, installations and soils. El-Baz (1979) quotes the example of Ginah village, which was abandoned in 1970 when dunes overran it. Moving sand also threatens the oasis' single land connection with the Nile valley at Assiut. Other oases are affected to a lesser degree.

A recent work has examined the problem of stabilizing dunes in the Kharga area, mentioning such techniques as fencing, surface stabilizing sprays, and biological stabilization (Hagedorn, et al., 1977).

Windbreaks and shelterbelts are extensive in Egypt and are the best in the Middle East (Oedekoven, 1970). They serve mainly to reduce sand movement and the amount of dust in the air. The threat of the creeping desert sand nevertheless remains, and indeed appears to have increased on the Nile margins as a result of the cessation of the annual flood (Tolba, 1979).

The most successful shelterbelt trees have proved to be limited in number: Casuarina spp., Eucalyptus spp., Dalbergia sissoo, Poplar spp., Eucalyptus spp., Tamarix articulata, Albizia lebbeck, Prosopis juliflora, Khaya senegalensis, Acacia spp., and Brachychiton populneum (Oedekoven, 1970).

Grasses, shrubs and trees suited to very sandy soils for primary dune stabilization projects are listed in Table 4.5. Stabilization can be expected within 3-4 years of planting (U.N. Conference on Desertification, 1977, A/Conf. 74/25).

Trees not only stabilize surface materials, but also provide a much-needed source of fuel. In fact, Oedekoven (1970) reports that the greatest obstacle preventing trees reaching maturity is the fact that they are stripped of bark and branches for fuel.
4.1 ENVIRONMENTAL CHANGES AND FAUNA

4.1.1 Historical Background

There seems no doubt that increasing populations in the Nile Valley and delta have taken their toll of whatever indigenous wildlife existed there. However, it is not certain what the exact "natural" composition would be. Burrett (1976) has argued that the Nile was probably very similar in ecology to other rivers which flow away from the well-watered central African Rift Valley. One may envisage a fauna therefore not unlike that of present-day Omo River which leads through arid areas into Lake Rudolf.

Burrett (1976) shows that elephant, rhinoceros, giraffe and gazelle gazella are recorded pictorially until 2,980 B.C. By 2,400 B.C. these disappeared from the Nile north of Asuan and from the Red Sea Hills. They became restricted ever more to the southern fringes of the Sahara. Camels became extinct, and Barbary sheep, lion and leopard became very scarce in Egypt.

Elephant, giraffe and rhinoceros may have been eliminated by man and his beast in the Nile Valley. Later, between 2400 and 1900 B.C., addax, ibex and oryx became scarce, leaving only dorcas gazelle and bubaline hartebeast in the desert. Burrett (1976) concludes that there was a climatic influence at least partly involved in these decimations—the Egyptian deserts were becoming distinctly drier.

4.3.2 Wildlife Protection

Although wildlife has been meagre in Egypt for four millennia, several species have felt more recent pressure on their habitats, to the point of being designated endangered species (Table 4.6) by the International Union for the Conservation of Nature and Natural Resources (IUCN).

It should be noted that crocodile populations are expanding along the shores of Lake Nasser.
Table 4.6
Endangered Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Varanus griseus</em></td>
<td>Desert monitor</td>
</tr>
<tr>
<td><em>Acinonyx jubatus</em></td>
<td>Cheetah</td>
</tr>
<tr>
<td><em>Oryx dammah</em></td>
<td>Scimitar-horned oryx</td>
</tr>
<tr>
<td><em>Addax nasomaculatus</em></td>
<td>Addax</td>
</tr>
<tr>
<td><em>Alcelaphus buselaphus tora</em></td>
<td>Tora hartbeest</td>
</tr>
<tr>
<td><em>Gazella gazella arabica</em></td>
<td>Arabian gazelle</td>
</tr>
<tr>
<td><em>Gazella leptoceros</em></td>
<td>Slender-horned gazelle</td>
</tr>
<tr>
<td><em>Crocodylus niloticus</em></td>
<td>Nile crocodile</td>
</tr>
</tbody>
</table>


No areas in Egypt at present qualify as "national parks" under these internationally agreed criteria (Johnson and Johnson, 1977):

a. permanent legal protection by the highest competent authority,
b. effective protection,
c. size (at least 1000 ha)
d. prohibition of exploitation (Ghabbour, 1979)

The old royal hunting grounds at Wadi Rishrash 80 km south of Cairo appear not to be maintained as a protected area, although they once were (Johnson and Johnson, 1977).

Nevertheless, legal protection of bird life is enunciated in three Acts (Appendix 1), two of which are directed specifically at the protection of birds useful to agriculture. Hunting by any means of any bird type (except poultry) is prohibited. Even the cultivation of birdlime trees (the glutinous gum of which is used to snare roosting birds) is prohibited except by license.
Article II of Act 53 of 1966 extends protection to wild fauna, and administration of the Act falls under the Ministry of Agriculture.

Several schemes (e.g., Chabour, 1978; Hassam, 1979) have been suggested recently for suitable sites, acreages and modes of administration for a national park system. Chabour (1978) has examined the problem thoroughly in relation to the development of Egypt's coastal areas. He suggests the establishment of two parks, one near El Alamein and one near Marsa Matruh. These are envisaged not only as tourist attractions and research and educational areas, but very much as havens for the threatened species mentioned above (Table 4.5). Further, Chabour argues against the notion that the desert is empty and worthless fauna and vegetation. He argues for a program of stocking such reserves with non-threatened species such as wild sheep, wild goats, addax and oryx.

There have also been calls for the establishment of protected areas as intervals along the Nile, which acts as a critical resting area for migratory bird species (U.S. Fish and Wildlife Service, 1977).
4.4 POLLUTION

4.4.1 Water Pollution

Water is polluted from several sources. Salinity and agricultural chemicals are the pollutants of rural areas, with raw sewage and industrial effluent predominant from the cities. Re-use of water is curtailed by pollution. It has been noted (3.2.2.6 (a) above) that re-used water is a significant proportion of the country's water budget. More seriously is the damaging effect on health of unsanitary water supplies and poor sanitation (see 4.4.2 below).

The Nile is severely polluted from the apex of the delta at Cairo northwards (Costello, 1978) where the majority of Egypt's cities lie. Lake Maroosis, the end point of several canals, is severely eutrophied from influxes of agriculturally-derived phosphates (Saad, 1973), industrial wastes and raw sewage from the city of Alexandria on the north shore. This has resulted in an 85% drop in the fish catch (Saad, 1973).

Legislation on water quality appears to be based on monitoring pollutant levels in effluent (see Appendix III: Water) rather than being based on the quality of water in the Nile.

As yet Egypt has no unified environmental policy (U.S.A.I.D., 1979). Although such a development seems important to improve water quality it appears that even the legislation which does exist is ignored (U.S. Dept. of Energy, 1978).

4.4.2 Health and Pollution (Nyrop, 1976)

In general terms the health of Egypt's population has improved since the early 1950's. Life expectancy has increased from 42 to 53 years, and the number of people per doctors has fallen from 4,300 to 2,000.

Nevertheless health hazards related to pollution remain severe. Schistosomiasis and malaria have been mentioned in relation to irrigation schemes. Diseases related to poor sanitation are rife. Only about 25% of Cairo and Alexandria had sewage systems in the mid-70's. Half of Cairo's raw sewage is carried to the sea in open sewers. Of Egypt's approximately 120 towns, more than 100 entirely lacked sewer systems. Overcrowding exacerbates the problems. Egypt has one of the highest population densities in the world (2,400 people per square mile). Urban densities rise to 70,000 p.p. sq. mile in Cairo, and this will increase as Cairo's population doubles in the next 20 years.
Poor sanitation results in endemic diseases and dysenteries which alone are probably the major cause of death. Diarrhea apparently accounts for more than half of the deaths of rural infants. Typhoid, paratyphoid and hepatitis are endemic.

Unsanitary conditions have caused more than half the population to be afflicted by bloodworm parasites. Roundworm parasites are common in the delta, and in the northern delta near saline water; intestinal flukes are very common. Amoebiasis occurs widely throughout the country.

Diphtheria is known, and respiratory ailments (pneumonia, bronchitis and tuberculosis) are common. Respiratory irritation is related directly to atmospheric dust and low humidity, which also cause chronic eye infections among children and a high rate of blindness. It is reported that as many as 80% of the rural population suffer impaired vision. Leishmaniasis is endemic in parts of the delta. Other significant diseases are Leper- and flea-borne typhus, leprosy (insufficient facilities exist to treat the numbers), and rabies.

Various laws exist to regulate water pollution (Appendix III).

4.4.3 Agricultural Chemicals

Egypt uses pesticides heavily, especially in protecting the cotton crop. Egypt's single largest export earner (Table I, Appendix II). It has been noted that a general trend exists to over-use chemicals (USAID, 1979). Misapplication of a chemical recently caused many livestock and some human deaths (Anon., 1977). It has been noted that Lake Marocis is polluted by high concentrations of agriculturally derived phosphates.

Agricultural chemicals are required by law to be tested before use. It has been noted that testing facilities seem to be insufficient to the task (Anon, 1977). It has also been observed that pesticide control legislation is practically ignored (U.S. Dept. of Energy, 1978).

4.4.4 Air Pollution

All the larger cities experience air pollution problems. Cairo's has been described as "extreme" (USAID, 1979). Insufficient paving and combustion products combine to produce high particulate and chemical concentrations in the urban atmosphere. It has been noted that, although legislation to control air pollution was introduced in 1971, it is not enforced (Anon, 1977).
4.4.5 Marine Pollution

Circulation in the Mediterranean water body is slower and less thorough than in the oceans. In addition nutrient and oxygen supply is lowest in the eastern Mediterranean where terrestrial runoff is low compared to the northern shores. Therefore, although pollution is lower off Egypt's shores than France's, for example, the marine ecology is more fragile (Le Lourd, 1977). It has been noted (4.1.7 above) that the sardine industry off the delta was disrupted, probably as a result of a stoppage in nutrient supply from the Nile. For these reasons concern is expressed in many quarters about the steady build-up of pollution, and the increasing inability of marine systems to absorb it without severe or permanent damage. Major contributions are dredge spoils from the Suez Canal and ports, offshore drilling, oil tanker traffic, and urban-industrial sewage (Osterberg and Keckes, 1977).

Coastal zones are most threatened and it appears that raw sewage poses the most immediate threat to the health of those who come in contact with seawater. Chemical pollutants affect health far less (Brisou, 1977).

It appears that little is known of the longer term effects of pollution on marine biology either near the shore or out to sea.

Egypt is one of 9 signatories of the 15 Mediterranean States which has signed (1977) 3 agreements approved at a UNEP conference in Barcelona 1976:

"Convention for the Protection of the Mediterranean Sea Against Pollution"
"Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft"
"Protocol concerning Cooperation in Combating Pollution of the Mediterranean Sea by Oil and Other Harmful Substances in Cases of Emergency"
5.0 HUMAN ENVIRONMENTAL PROBLEMS AND NATURAL RESOURCES

5.1 WATER POLLUTION

Polluted surface water is a most direct threat to health and general re-usability in the delta. Salinization and agricultural chemicals are less serious rural equivalents. Improved sewage disposal systems for Egypt's cities are critical to improving urban health. Enforcement of existing water quality regulations, preferably under an integrated environmental policy, is also necessary. Control of the use of agricultural chemicals needs to be attempted, perhaps by educational programs. Drainage water quality is a significant contributor to salinity in irrigation water.

Pollution of groundwater is most serious in the delta where pumping has allowed saline seawater to encroach inland and contaminate the shallow delta aquifer. The effect of localized salinization of groundwater on the wider groundwater bodies, both shallow and deep (Nubian Sandstone), needs investigation. Similarly, groundwater bodies beneath the Western Desert cases need to be better understood before they are exploited, and before possible agriculture and its salinizing influence begin to have impacts. Transactional concerns for maintaining the regional aquifer will encourage a broad overview.

5.2 SOIL QUALITY

Major environmental problems to be corrected are waterlogging and salinization of otherwise productive soils, both of which affect almost 30% of Egypt's agricultural land and severely reduce productivity. A major national effort is in progress to drain hundreds of thousands of feddans of waterlogged land. It appears that this effort may not be sufficient without programs to prevent seepage from the distribution canals and overuse of irrigation water. It is unclear whether the drainage program of tiling the fields includes lining of canals and the prevention of over-irrigation. Funds allocated to the drainage program seem inadequate for these attendant, but critical, aspects of de-waterlogging soils.

Flushing salinized soils of accumulated salts can be accomplished if basic surveys of water quality, soil characteristics and crop needs have been performed, since locally unique combinations of factors appear to be involved. Highly regulated systems of water delivery are needed to prevent re-salinization and re-waterlogging.

It is not clear whether the water and soil surveys are complete or whether sufficient trained personnel are available to complete the ambitious schemes to rehabilitate either damaged agricultural soils.
or areas being newly reclaimed. The latter effort is insignificant at present, however.

Rangeland improvement, traditionally a difficult problem, appears to occupy an inferior position in plans for the development of the Mediterranean coast.

The outright removal of productive land from use by urban encroachment is a serious and apparently unchecked assault on Egypt's restricted but critical soil resource.

5.3 HEALTH

Most people are affected by one or more of the water-related diseases which are rife in Egypt. Overpopulation in parts and related insanitary conditions of water supplies and effluents result in enteric diseases and dysenteries which are probably the major causes of death. Schistosomiasis affects 30-50% of the population.

Improved water supply and sewage systems in addition to better irrigation practices would do much to control these diseases. The interrelatedness of health control measures with other human activities makes health problems often intractable. Successes in controlling schistosomiasis have been spectacular, but few.

5.4 PESTS

Pests destroy much of the country's various crops and have increased since the introduction of perennial irrigation. Although generally under control at present, the spread of pests needs to be carefully monitored in order to detect and prevent epidemic outbreaks.

5.5 WILDLIFE

The establishment of protected areas seems highly desirable, firstly to provide sanctuaries for Egypt's several endangered species, and secondly as recreation/tourism attractions. Several sites have been advocated.

5.6 AN INTEGRATED ENVIRONMENTAL POLICY

It is obvious that many of the salient environmental problems faced by Egypt are often interrelated. Therefore it seems imperative that environmental quality be as vigorously planned for as are Egypt's soil and water resources. This calls for an environmental policy to integrate existing environmental law.
LITERATURE CITED


Best Available Document


Hassib, M. 1951. Distribution of plant communities in Egypt. Fouad University, Cairo, Faculty of Science, Bulletin 29:60-261.


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APPENDIX I

Population Statistics

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1. Table 1: Demographic Indicators
2. Table 2: Population and Growth Rates
3. Figure 1: Population by Age and Sex
4. Table 3: Sectoral Distribution of Work Force
5. Table 4: Economically Active Population by Occupational Group and Sex
### Table 1: Egypt, Demographic Indicators, Selected Years, 1897-1975

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Population (in millions)</th>
<th>Growth Rate (in percent)</th>
<th>Urban Population</th>
<th>Birthrate (per thousand)</th>
<th>Death Rate (per thousand)</th>
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<tr>
<td>1897</td>
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<td>n.a.</td>
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<td>41.6</td>
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<td>1970</td>
<td>33.33</td>
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<td>42.1</td>
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<td>n.a.</td>
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<td>n.a.</td>
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### Table 2: Population and Rates of Growth of the Arab Republic of Egypt In Census Years

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<thead>
<tr>
<th>Census Year</th>
<th>Population (Thousands)</th>
<th>Average Annual Intercensal growth rate (%)</th>
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<tr>
<td>1897</td>
<td>9,715</td>
<td>-</td>
</tr>
<tr>
<td>1907</td>
<td>11,287</td>
<td>1.51</td>
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<tr>
<td>1917</td>
<td>12,751</td>
<td>1.23</td>
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<td>1927</td>
<td>14,218</td>
<td>1.09</td>
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<tr>
<td>1937</td>
<td>15,933</td>
<td>1.15</td>
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<tr>
<td>1947</td>
<td>19,022</td>
<td>1.79</td>
</tr>
<tr>
<td>1960</td>
<td>26,085</td>
<td>2.46</td>
</tr>
<tr>
<td>1966</td>
<td>30,076*</td>
<td>2.90</td>
</tr>
<tr>
<td>1976</td>
<td>38,228</td>
<td>2.31</td>
</tr>
</tbody>
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Source: Barks et al. 1978.
Figure 1: Egypt, Population by Age and Sex, 1966

Table 3: Egypt, Sectoral Distribution of the Work Force, Fiscal Years 1968-1973 (in thousands)

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<td>Commodity Sectors:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>3,592.4</td>
<td>3,349.9</td>
<td>4,048.3</td>
<td>4,056.9</td>
<td>4,094.7</td>
</tr>
<tr>
<td>Industry</td>
<td>867.3</td>
<td>890.7</td>
<td>916.1</td>
<td>1,052.8</td>
<td>1,094.3</td>
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<tr>
<td>Electricity</td>
<td>16.5</td>
<td>22.3</td>
<td>22.8</td>
<td>30.4</td>
<td>33.9</td>
</tr>
<tr>
<td>Construction</td>
<td>256.8</td>
<td>338.0</td>
<td>367.9</td>
<td>365.9</td>
<td>359.7</td>
</tr>
<tr>
<td>Total</td>
<td>4,088.0</td>
<td>5,219.0</td>
<td>5,375.1</td>
<td>5,505.9</td>
<td>5,532.6</td>
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<tr>
<td>Distribution Sectors:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport and comm.</td>
<td>220.4</td>
<td>335.7</td>
<td>347.2</td>
<td>374.5</td>
<td>398.5</td>
</tr>
<tr>
<td>Trade and finance</td>
<td>735.6</td>
<td>794.3</td>
<td>801.7</td>
<td>815.6</td>
<td>829.9</td>
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<tr>
<td>Total</td>
<td>1,116.2</td>
<td>1,130.0</td>
<td>1,148.9</td>
<td>1,190.1</td>
<td>1,217.4</td>
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<tr>
<td>Service Sectors:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td>134.3</td>
<td>138.8</td>
<td>133.3</td>
<td>137.0</td>
<td>137.4</td>
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<tr>
<td>Public utilities</td>
<td>22.2</td>
<td>32.4</td>
<td>33.7</td>
<td>33.5</td>
<td>37.1</td>
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<tr>
<td>Other services</td>
<td>1,506.9</td>
<td>1,539.1</td>
<td>1,550.7</td>
<td>1,556.9</td>
<td>1,710.0</td>
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<tr>
<td>Total</td>
<td>1,873.4</td>
<td>1,873.3</td>
<td>1,750.7</td>
<td>1,329.4</td>
<td>1,584.5</td>
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<tr>
<td>TOTAL</td>
<td>7,327.6</td>
<td>8,051.2</td>
<td>8,274.7</td>
<td>8,322.4</td>
<td>8,654.3</td>
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<table>
<thead>
<tr>
<th>Occupational Group</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Percent of Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional, technical, and related workers</td>
<td>279,238</td>
<td>37,704</td>
<td>316,942</td>
<td>1.4</td>
</tr>
<tr>
<td>Administrative, executive, managerial, and clerical workers</td>
<td>506,927</td>
<td>58,003</td>
<td>564,930</td>
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<tr>
<td>Sales workers</td>
<td>449,492</td>
<td>38,034</td>
<td>487,526</td>
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<tr>
<td>Farmers, fishermen, hunters, loggers, and related workers</td>
<td>3,676,891</td>
<td>125,778</td>
<td>3,802,669</td>
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</tr>
<tr>
<td>Transport and communication workers</td>
<td>245,556</td>
<td>1,505</td>
<td>247,061</td>
<td>3.0</td>
</tr>
<tr>
<td>Craftsmen, production process-workers, and laborers; miners, quarrymen, and related workers</td>
<td>1,330,857</td>
<td>42,189</td>
<td>1,373,046</td>
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<tr>
<td>Service, sport, and recreation workers</td>
<td>500,481</td>
<td>78,472</td>
<td>578,953</td>
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<tr>
<td>Workers not classifiable</td>
<td>723,788</td>
<td>207,543</td>
<td>931,331</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>7,711,840</td>
<td>621,893</td>
<td>8,333,733</td>
<td>100.0</td>
</tr>
</tbody>
</table>

APPENDIX II

Economic Characteristics

CONTENTS

1. Table 1: Production of Main Crops
2. Table 2: Imports and Exports
3. Table 3: Direction of Foreign Trade
Table 1: Egypt, Production of Main Crops, Selected Years, 1952-73 (in thousands of metric tons).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton (cottonseed)</td>
<td>1.265</td>
<td>1.268</td>
<td>1.415</td>
<td>1.422</td>
<td>1.365</td>
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<tr>
<td>Rice (paddy)</td>
<td>517</td>
<td>2,279</td>
<td>2,344</td>
<td>2,357</td>
<td>2,374</td>
</tr>
<tr>
<td>Wheat</td>
<td>1,081</td>
<td>1,291</td>
<td>1,729</td>
<td>1,616</td>
<td>1,637</td>
</tr>
<tr>
<td>Corn</td>
<td>1,308</td>
<td>2,163</td>
<td>2,342</td>
<td>2,417</td>
<td>2,507</td>
</tr>
<tr>
<td>Miller (sorghum)</td>
<td>522</td>
<td>381</td>
<td>554</td>
<td>631</td>
<td>853</td>
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<tr>
<td>Sugarcane</td>
<td>3,258</td>
<td>5,237</td>
<td>7,488</td>
<td>7,701</td>
<td>7,276</td>
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<tr>
<td>Onions</td>
<td>243</td>
<td>587</td>
<td>571</td>
<td>487</td>
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<tr>
<td>Other vegetables</td>
<td>1,610</td>
<td>4,429</td>
<td>5,171</td>
<td>5,333</td>
<td>n.a.</td>
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<tr>
<td>Fruits</td>
<td>594</td>
<td>1,338</td>
<td>1,658</td>
<td>1,744</td>
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Table 2: Imports and Exports

**PRINCIPAL COMMODITIES**

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<tr>
<td>Cereals and Milling Products</td>
<td>68.2</td>
<td>286.9</td>
<td>256.6</td>
<td>221.0</td>
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<tr>
<td>Animal and Vegetable Oils</td>
<td>10.3</td>
<td>135.2</td>
<td>15.0</td>
<td>31.2</td>
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<td>General Grocery</td>
<td>4.6</td>
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<td>Tobacco</td>
<td>12.8</td>
<td>35.9</td>
<td>41.8</td>
<td>55.4</td>
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<td>Textiles and Textile Articles</td>
<td>6.6</td>
<td>5.0</td>
<td>14.9</td>
<td>20.2</td>
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<td>Paper and Paper Products</td>
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<td>12.1</td>
<td>21.1</td>
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<td>Pottery and Glassware</td>
<td>7.3</td>
<td>20.8</td>
<td>43.9</td>
<td>63.2</td>
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<td>Clocks, Watches, Scientific Apparatus</td>
<td>33.6</td>
<td>122.2</td>
<td>197.3</td>
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<td>Mineral Products (excl. Crude Petroleum)</td>
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<td>56.4</td>
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<td>Chemical Products</td>
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<td>Wood, Hides and Rubber</td>
<td>3.6</td>
<td>4.6</td>
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<tr>
<td>Machinery and Electrical Apparatus</td>
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<td>78.6</td>
<td>169.8</td>
<td>280.1</td>
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<tr>
<td>Transport Equipment</td>
<td>45.3</td>
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<td>113.1</td>
<td>115.6</td>
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<th>Exports</th>
<th>1974</th>
<th>1975</th>
<th>1976</th>
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<tr>
<td>Cotton, raw</td>
<td>232</td>
<td>279.2</td>
<td>185</td>
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<tr>
<td>Cotton yarn</td>
<td>37</td>
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<td>Cotton piece goods</td>
<td>9</td>
<td>20.1</td>
<td>9</td>
</tr>
<tr>
<td>Rice</td>
<td>136</td>
<td>39.7</td>
<td>104</td>
</tr>
<tr>
<td>Potatoes</td>
<td>100</td>
<td>7.6</td>
<td>45</td>
</tr>
<tr>
<td>Onions</td>
<td>104</td>
<td>6.0</td>
<td>70</td>
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<td>Edible Fruits</td>
<td>189</td>
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<td>123</td>
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<td>Minerals and phosphates</td>
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<td>195</td>
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<tr>
<td>Crude Petroleum</td>
<td>940</td>
<td>23.9</td>
<td>923</td>
</tr>
<tr>
<td>Benzene, kerosene and naphtha</td>
<td>23</td>
<td>5.7</td>
<td>23</td>
</tr>
<tr>
<td>Cement</td>
<td>22</td>
<td>1.3</td>
<td>10</td>
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Table 3: Egypt, Direction of Foreign Trade, Selected Years, 1962-73 (in millions of Egyptian pounds)

<table>
<thead>
<tr>
<th>Area</th>
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<th>1963</th>
<th>1972</th>
<th>1973</th>
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<td>Import</td>
<td>Export</td>
<td>Import</td>
<td>Export</td>
</tr>
<tr>
<td>Communist Countries</td>
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<td></td>
<td></td>
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<tr>
<td>Soviet Union</td>
<td>75</td>
<td>49</td>
<td>122</td>
<td>45</td>
</tr>
<tr>
<td>Czechoslovakia</td>
<td>14</td>
<td>7</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>People’s Republic of China</td>
<td>7</td>
<td>9</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>43</td>
<td>55</td>
<td>54</td>
<td>51</td>
</tr>
<tr>
<td>Total Communist Countries</td>
<td>137</td>
<td>120</td>
<td>190</td>
<td>114</td>
</tr>
<tr>
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<td>Export</td>
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<td>Western Europe</td>
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<tr>
<td>West Germany</td>
<td>11</td>
<td>19</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>Italy</td>
<td>29</td>
<td>16</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Other</td>
<td>34</td>
<td>17</td>
<td>24</td>
<td>21</td>
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<tr>
<td>Total Western Europe</td>
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<td>52</td>
<td>51</td>
<td>49</td>
</tr>
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<td>Arab League Countries</td>
<td>27</td>
<td>12</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Export</td>
<td>Import</td>
<td>Export</td>
<td>Import</td>
</tr>
<tr>
<td>Asia (noncommunist)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>10</td>
<td>5</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>India</td>
<td>200</td>
<td>11</td>
<td>196</td>
<td>27</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>6</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Total Asia (noncommunist)</td>
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<tr>
<td>Western Hemisphere</td>
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<td>United States</td>
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<td>14</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Total Western Hemisphere</td>
<td>8</td>
<td>15</td>
<td>5</td>
<td>24</td>
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<tr>
<td>Africa and Oceania</td>
<td>6</td>
<td>8</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Export</td>
<td>Import</td>
<td>Export</td>
<td>Import</td>
</tr>
<tr>
<td>TOTAL</td>
<td>270</td>
<td>280</td>
<td>331</td>
<td>342</td>
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<tr>
<td>Convertible currency area</td>
<td>83</td>
<td>129</td>
<td>75</td>
<td>154</td>
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<tr>
<td>Bilateral agreement area</td>
<td>187</td>
<td>181</td>
<td>225</td>
<td>173</td>
</tr>
</tbody>
</table>

APPENDIX III

Natural Resource and Environment Related Legislation

CONTENTS

1. Water
2. Fauna
3. Flora
4. Radioactive Effluents and Pesticides

Sources: Food and Agriculture Organization (FAO). undated: preliminary material prepared for eventual inclusion in works on Water Laws in Moslem Countries


1. Water

- Order of 13 October 1924: Cairo Governorate, prescribing measures intended to prevent the pollution of water intended for drinking purposes.

- Order of 3 April 1935: Moudir of Kenesh, concerning the closure of wells and the removal of pumps.

- Law No. 35 of 1946: concerning the discharge of wastewater from public toilets and industrial establishments into public sewers, as amended by Law No. 645 of 1954.

- Law No. 196 of 30 April 1953: concerning the discharge of waters from public, commercial, and industrial establishments into watercourses, as amended by Law No. 35 of 1954.

- Order No. 56 of 11 January 1962: protection of harbor and territorial waters against oil spills.

- Law No. 93 of 1962: disposal of liquid wastes


- Decree No. 2703 of 1966: establishing the Higher Commission on Waters.

- Decree No. 649 of 1967: embodying regulations for the implementation of Law No. 93 of 1962 on the disposal of liquid wastes.

- Law No. 74 of 1971: irrigation and drainage.

- The Oil Pollution Regulations (undated)

- Circular No. 1 of the General Department for Urban Environmental Health (undated)

2. Fauna

- Act No. 13 of 1922: regarding the protection of birds.

- Act No. 134 of 1946: restricting importation of ornamental birds.

- Act No. 53 (Article 117) of 1966: concerning the protection of birds and wild fauna.

Law No. 144 of 1969 (Section 12): regarding fisheries, especially preventing use of explosives.
3. Flora

- Act No. 61 of 1955: protection of flora against exotic pests and diseases.

4. Radioactive effluents and pesticides

- Law No. 59 of 1960: the control of the use of ionizing radiation and protection against its hazards

- Decree No. 170 of 1960: promulgating Law No. 59


- Republican Act No. 16 of 1962: concerning pesticide control.

- Republican Act No. 50 of 1967: concerning pesticide control.

5. Air

- Executive order of 1971 on prevention of air pollution (Ministry of Health)
APPENDIX II

Governmental Structure
Fig. 1 Egypt, Government Structure, April 1975
## APPENDIX V

### List of Organizations ¹/²

#### CONTENTS

1. Government Organizations
2. Agricultural Organizations
3. Universities
4. Libraries, Archives and Statistical Organizations
5. Other Organizations
6. International Organizations

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¹Sources:


1. Government Organizations

Name: MINISTRY OF AGRICULTURE AND LAND RECLAMATION
Dokki, Cairo

Affiliates: Animal Production Research Institute
Dokki, Cairo

Desert Institute
El-Matara, Cairo
Subjects: desert development, water and soil resources, plant and animal production, solar and wind energy.
Publication: Desert Institute Bulletin
Includes: Plant Pathology Research Institute

Egyptian Authority for the Utilization and Development of Reclaimed Lands (EAUDRL) formerly Land Reclamation Authority

Herbarium, Agricultural Research Centre
Dokki, Cairo

Plant Protection Research Institute
Madi Elseid Street
Dokki, Giza

Soils and Water Research Institute
Cairo University Street
Giza

Name: MINISTRY OF HOUSING AND RECONSTRUCTION

Name: MINISTRY OF IRRIGATION

Affiliates: Hydraulics and Sediment Research Institute
Delta Barrage
Publication: Technical Report (annual)

Name: MINISTRY OF MARITIME TRANSPORT

Affiliate: National Committee for the Combatting of Marine Pollution
MINISTRY OF MINERALS AND METALLURGY

Affiliate: Geological Survey and Mining Authority
Ministry P.O.
Cairo

Subject: Regional geologic mapping, mineral prospecting, evaluation of mineral deposits, preparation of techno-economic reports, mine and quarry design and granting mineral exploration and exploitation rights. 280 research workers.

MINISTRY OF PUBLIC HEALTH

Affiliate: Public Health Laboratories
19 Sharia Sheikh Rashid, Cairo
2. **Agricultural Organizations**

Name: **AGRICULTURAL ECONOMICS RESEARCH INSTITUTE**
Dokki, Cairo

Name: **AGRICULTURAL RESEARCH CENTER**
Desert Institute
Mataria, Cairo

Affiliate: Plant Pathology Research Institute Giza

Name: **BAHTIM AGRICULTURAL RESEARCH STATION**
Bahtim
Kaliobeya Governorate

Name: **COTTON RESEARCH INSTITUTE**
Experimental Agricultural Research Center
Giza

Name: **EGYPTIAN AGRICULTURAL ORGANIZATION**
P.O. Box 63
Exhibition Grounds
Gezira, Cairo

Name: **EGYPTIAN HORTICULTURAL SOCIETY**
P.O. Box 46
Cairo

Publication: **Horticultural Magazine**

Name: **FIELD CROPS RESEARCH INSTITUTE**
Agricultural Research Center
Giza

Name: **GEMMEZA AGRICULTURAL RESEARCH STATION**

Name: **MATANA AGRICULTURAL RESEARCH STATION**
Matana
Isna District
Qena Governorate
Name: MUBARAKA RESEARCH STATION
   Al-Masseer
   North Takrit
   Takrit Province:

Name: SIKHA AGRICULTURAL RESEARCH STATION
   Saleha
   Rafir Al-Sheikh Governorate:

Name: SHEMBWHEL AGRICULTURAL RESEARCH STATION
   Geziret
   Shubay Governorate:

Name: SIDS AGRICULTURAL RESEARCH STATION
   Sids
   Bashi Staif
3. Universities

Name: AIN SHAMS UNIVERSITY
Kasr-el-Zaafra
Abassia
Cairo

Affiliates: Department of Zoology
Subjects: ecology, taxonomy, physiology of desert animals, parasitology of desert reptiles, birds, and mammals
Publications: Ain Shams Science Bulletin

Faculty of Agriculture

Faculty of Medicine

Name: UNIVERSITY OF ALEXANDRIA
22 Al-Gueish Avenue
Shatby, Alexandria

Affiliates: Department of Botany, Ecology Unit
Moharram Bey
Alexandria
Subject: ecology of Mediterranean coastal desert west of Alexandria
Publications: Bulletin of the Faculty of Science

Faculty of Medicine

Faculty of Agriculture

Institute of Medical Research

Higher Institute of Public Health
Publication: Bulletin

Name: AL-AZHAR UNIVERSITY
Cairo

Affiliates: Faculty of Agriculture

Faculty of Medicine
Affiliates: Faculty of Agriculture

Faculty of Medicine

Faculty of Science

Faculty of Veterinary Medicine

Affiliates: Department of Botany
Subjects: taxonomy, survey of desert vegetation, environmental studies, ecology of coastal and saline deserts, microflora of desert soils.
Publications: herbarium publications

Department of Natural Resources, Institute of African Research and Studies
33 Misaha Street
Dokki, Giza
Subjects: ecology of desert plants and soil fauna, physics and chemistry of desert soils, establishment of national desert parks and nature preserves.
Publications: African Studies Review

Soil and Water Research Institute

Affiliates: Agriculture Branch
Moshtohor
Name: MUNICIPAL UNIVERSITY
Munsar
Affiliates: Faculty of Agriculture
Faculty of Science

Name: MUNICIPAL UNIVERSITY
Munsar
Affiliates: Faculty of Agriculture
Faculty of Medicine

Name: TUSKAR UNIVERSITY
Tuskar
Affiliates: Faculty of Agriculture
Faculty of Agriculture (at Kafr el Sheikh)
Faculty of Medicine
Faculty of Science

Name: ZAGAZIG UNIVERSITY
Zagazig
Affiliates: Faculty of Agriculture
Faculty of Veterinary Medicine
4. Libraries, Archives and Statistical Organizations

Name: AL-AZHAR UNIVERSITY LIBRARY
Cairo

Name: ALEXANDRIA MUNICIPAL LIBRARY
18 Sharia Menasce
Moharrem Bey,
Alexandria

Name: ALEXANDRIA UNIVERSITY LIBRARY
22 Al-Gusish Ave.
Shatby, Alexandria

Name: AMERICAN CENTER LIBRARY
4 Ahmed Ragheb St.,
Garden City, Cairo

Name: AMERICAN UNIVERSITY IN CAIRO LIBRARY
113 Sharia Kasr
El-Aini, Cairo

Name: ARAB LEAGUE LIBRARY
Midan Al-Tahrir, Cairo

Name: ASSIUT UNIVERSITY LIBRARY
Assiut

Name: BRITISH COUNCIL LIBRARY
192 Sh. El-Nil, Agouza,
Cairo

Name: CAIRO UNIVERSITY LIBRARY
Orman, Giza

Name: CENTRE OF DOCUMENTATION AND STUDIES
ON ANCIENT EGYPT
4 Sharia Ramses,
Cairo

Name: DAMANHOUR MUNICIPAL LIBRARY
Damanhour
Names: EGYPTIAN ASSOCIATION FOR ARCHIVES AND LIBRARIANSHIP
26 El-Matben Al-Ahli, Bagdad
Cairo

Names: EGYPTIAN LIBRARY
Abdlin Palace,
Cairo

Names: EGYPTIAN NATIONAL LIBRARY
Hidwa Ahmed Maher
Rab El-Khalil
Cairo

Names: INDIGO OBSERVATORY LIBRARY
Hebrew

Names: INSTITUTE OF NATIONAL PLANNING
Salah Salam St., Nasr City, Cairo

Names: LIBRARY OF THE BANK OF EGYPT
151 Sharia Mohammad Farid,
Cairo

Names: LIBRARY OF THE GREEK ORTHODOX
Patriarchate of Alexandria
P.O.B. 2006
Alexandria

Names: LIBRARY OF THE INSTITUT D'EGYPTE
13 Sharia Shaik Rihane
Cairo

Names: LIBRARY OF THE MINISTRY OF AGRICULTURE
Giza-Orman

Names: LIBRARY OF THE MINISTRY OF COMMERCE
AND INDUSTRY
Sharia Ismail Abaza Pasha,
Cairo

Names: LIBRARY OF THE MINISTRY OF EDUCATION
16 Sharia El-Falaki,
Cairo
Name: LIBRARY OF THE MINISTRY OF HEALTH
Sharia Sultan Hussein, Cairo

Name: LIBRARY OF THE MINISTRY OF JUSTICE
Midan Lazogli, Cairo

Name: LIBRARY OF THE MINISTRY OF WAQFS
Qubbih al-Ghoury, Cairo

Name: LIBRARY OF THE MONASTERY OF ST. CATHERINE
Mount Sinai

Name: LIBRARY OF THE SOCIETE ENTOMOLOGIQUE D'EGYPTE
14 Sharia Ramses
P.O.B. 430, Cairo

Name: MANSOURA MUNICIPAL LIBRARY

Name: NATIONAL ARCHIVES
Al-Qalcah, Cairo

Name: NATIONAL ASSEMBLY LIBRARY
Palace of the National Assembly, Cairo

Name: NATIONAL INFORMATION AND DOCUMENTATION CENTRE
Al-Tahrir St.
Dokki, Cairo

Name: SHARQIA PROVINCIAL COUNCIL LIBRARY
Zagazig

Name: TANTA MUNICIPAL LIBRARY
5. Other Organizations

Name: ACADEMY OF SCIENTIFIC RESEARCH AND TECHNOLOGY
101 Kasr El Aini Street
Cairo

Affiliates: Institute of Oceanography and Fisheries

Institute of Astronomy and Geophysics:
Egyptian Observatories
Helwan, Cairo

Council of Environmental Research

Red Sea Institute of Oceanography and Fisheries
Al-Ghandaqa

Petroleum Research Institute
Medinat Nasser, Cairo

Name: AERIAL SURVEY OF EGYPT
308 El-Haram Street
Giza

Name: ALEXANDRIA INSTITUTE OF OCEANOGRAPHY AND FISHERIES
Kayed Bey
Alexandria

Name: AMERICAN RESEARCH CENTER IN EGYPT, INC.
2 Midan Kasr el Doubara
Cairo

Name: ATOMIC ENERGY ESTABLISHMENT
Dokki
Cairo

Name: BIOMEDICAL RESEARCH CENTER FOR INFECTIOUS DISEASE
Cairo

Name: COASTAL CONSERVATION COMMISSION

Name: EGYPTIAN GEOGRAPHICAL SOCIETY
Sharia Kasr El-Aini (Jardin du Ministere du Irrigation)
P.O. Garden City
Cairo
Name: EGYPTIAN REMOTE SENSING CENTRE (ERSC)  
Cairo

Name: EGYPTIAN SOCIETY OF MEDICINE AND TROPICAL HYGIENE  
2 Shetiee Mosad I  
Alexandria

Name: ENTOMOLOGICAL SOCIETY OF EGYPT  
14 Shetia Ramadan  
P.O. Box 430  
Cairo

Publications: Bulletin of the Entomological Society of Egypt

Name: GENERAL ADMINISTRATION FOR REHABILITATION AND AGRICULTURAL PROJECTS

Name: GENERAL PETROLEUM COMPANY  
Dr. Mustafa Abu Zahra Street  
New City, Cairo

Name: HEMATOLOGICAL RESEARCH STATION  
Karmat-al-Khadyria Barrages  
Cairo

Name: INSTITUTE OF ARAB RESEARCH AND STUDIES  
1 Tolombat St.  
Garden City, Cairo

Name: INSTITUT D'EGYPTE  
13 Shetia Sheikh Rihane  
Cairo

Subjects: Literary, artistic and scientific questions relating to Egypt and neighboring countries.

Name: INSTITUTE OF FRESHWATER FISHERY BIOLOGY  
10 Hassan Sabry St. (Fish Garden)  
P.O. Zamalik  
Cairo

Name: MINING AND WATER RESEARCH EXECUTIVE ORGANIZATION  
Dokki, Cairo
Name: NATIONAL COMMITTEE FOR MAN AND THE BIOSPHERE PROGRAM (MAB)
c/o National Committee for Unesco
17 Ismail Abul-Futuh St.,
Dokki, Cairo

Subject: for Unesco's MAB Program

Name: NATIONAL COMMITTEE FOR SCOPE
c/o Academy of Scientific Research and Technology
101 Kasr el-Aini St.,
Cairo

Subject: for the Scientific Committee on Problems of the Environment (SCOPE) of the International Council of Scientific Unions (ICSU)

Name: NATIONAL RESEARCH CENTRE
Al-Tahrir St.
Dokki, Cairo

Subject: research in pure and applied sciences. Staff of 1199 scientists and 133 technicians.
Includes: Applied Organic Chemistry Dept. (Pesticide, Biochemical and Microbiology Labs.)
Biology and Agriculture Dept. (Pests and Plant Protection Lab.)
Medicine and Pharmacy Dept. (Public Health Lab.)

Affiliates: Medical Research Executive Organization
Includes: Bilharziasis Research Institute, Giza
The Medical Research Institute, Alexandria
Nutrition Research Institute
Ophthalmological Research Institute
Memorial Institute for Ophthalmic Research, Giza
Ophthalmological Society of Egypt
Research Institute and Hospital for Tropical Diseases
10 Sharia Kasr el-Aini, Cairo

Name: SURVEY DEPARTMENT
20 Baghdad Street
Giza, Cairo
6. International Organizations

Name: THE AMERICANS CENTER
4 Ahmed Roshab St.
Gandasa City, Cairo

Subjects: Library of 10,000 vols., 240 periodicals, 15,000 microfiches

Name: ARAB LEAGUE EDUCATIONAL, CULTURAL, AND SCIENTIFIC
ORGANIZATION (ALESCO)
109 Tahiri St.
Dakka
Cairo

Subjects: promote intellectual unity of the Arab countries

Name: ASSOCIATION OF ARAB UNIVERSITIES
Scientific Computation Centre
Thamil Street
Orman P.O.
Cairo

Publications: Bulletin, Directory of Arab Universities, Directo
of Teaching Staff of Arab Universities, Proceedin
of Seminars.

Name: BOARD FOR THE UTILIZATION OF THE RIVER JORDAN AND ITS
TRIBUTARIES
Cairo

Subjects: regulates water activities in the River Jordan basin;
activities have been interrupted since Israeli occupation

Name: BRITISH COUNCIL
192 Sh. El-Nil
Agouza, Cairo

Subjects: 32,900 vols., 111 periodicals

Name: FAO REGIONAL OFFICE FOR THE NEAR EAST
Box 2223
General Cooperative Society for Agrarian Reform Building
Dokki, Cairo

Affiliates: FAO Commission on Horticultural Production in
the Near East and North Africa
Subjects: promotion of international collaboration in the study of technical problems and the establishment of a balanced program of horticultural research at an interregional level.

Name: INSTITUT D'EGYPTE
13 Sharia Sheikh Rahan, Cairo

Subjects: literary, artistic and scientific questions relating to Egypt and neighboring countries.

Name: INTERNATIONAL METEOROLOGICAL INSTITUTE
Cairo
Type: Regional, World Meteorological Organization

Subjects: meteorological research and training for Middle Eastern and African personnel engaged in meteorological work

Name: MIDDLE EASTERN REGIONAL RADIOISOTOPE CENTRE FOR THE ARAB COUNTRIES
SL. Malaeb El Gamaa
Dokki, Cairo

Subjects: train specialists in the applications of radioisotopes, particularly in the medical, agricultural, and industrial fields; conduct research in hydrology, tropical and subtropical diseases, fertilizers, and entomology; promote the use of radioisotopes in Arab countries.

Name: NEAR EAST FORESTRY COMMISSION
c/o FAO Regional Office for the Near East
P.O. Box 2223
Cairo

Subjects: forest policy preview and coordination of its implementation on a regional level; information exchange and advice on suitable practices and action on technical problems; make appropriate recommendations to the twenty-one member countries.

Name: NEAR EAST PLANT PROTECTION COMMISSION
c/o FAO Regional Office for the Near East
P.O. Box 2223
Cairo

Subjects: matters relating to the protection of plant resources in the region; fifteen member countries.
APPENDIX VI

Recent USAID Projects\footnote{Source: USAID's prefunding project design documents, 1974-, from computer information system "TEXT," a component of computer information system "INQUIRE."}
PROBLEM: A BASIC SET OF TECHNOLOGICAL INSTITUTIONS EXISTS TO SERVE EGYPT'S AGRICULTURAL SECTOR, THE OVERALL PLANNING AND COORDINATING STRUCTURES ARE WEAK. THE LARGE NUMBER OF AUTONOMOUS OR SEMI-AUTONOMOUS SUB-UNITS WITH WEAK LINES OF COMMUNICATION RESULTS IN SCATTERED AND COMPETING CLAIMS TO RESOURCES AND AN INADEQUATE TRANSFER OF TECHNOLOGY, INFORMATION, AND SERVICES TO THE FARMER.

PROJECT: 2620 C1 SUB-PROJECT: CO

INITIAL FY: 77  FINAL FY: 83

* TITLE: AGRICULTURAL MECHANIZATION

* TITLE: ALEXANDRIA PORT EQUIPMENT
**TITLE: ALEXANDRIA WASTEWATER SYSTEM EXPANSION**

**PROBLEM:** The components of Alexandria's existing wastewater collection and disposal system are inadequate for a city of its size and growth rate. The collection system is often overwhelmed during times of wet weather; many sewage pumping stations are outdated in design and inefficient, and much of the disposal system is in a state of disrepair. As a result, much untreated sewage is directly discharged into area waterways through overflow and little breaks or simply out of efficiency.

**PROJECT:** 262016C SUB-PROJECT: C0

**INITIAL FY:** 79 **FINAL FY:** 85

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**TITLE: APPLIED SCIENCE AND TECHNOLOGY RESEARCH**

**PROBLEM:** Egypt is considering scientific & tech resources are directed toward basic rather than applied research. Research personnel often lack experience & training, and executive skills are required to formulate policy. As a result, scientific research has little effect upon increasing the impact of science & technology in industry or national-level projects.

**PROJECT:** 262016B SUB-PROJECT: C1

**INITIAL FY:** 77 **FINAL FY:** 80

---

**TITLE: APPLIED SCIENCE AND TECHNOLOGY RESEARCH**

**PROBLEM:** A quickly accessible & nation-wide information system providing the latest scientific & tech inputs is not yet available to Egyptian researchers. Research institutions lack facilities & adequate resources, materials & trained personnel to operate a computer-oriented storage & retrieval system. Without such a system, the Egyptian scientific community cannot keep abreast of the latest scientific/technological innovations, and their possible application in solving national-level problems is inhibited.

**PROJECT:** 202016B SUB-PROJECT: C2

**INITIAL FY:** 77 **FINAL FY:** 80
Problem: Population growth in conjunction with increases in per capita income has generated an increasing demand for fish protein files in Egypt. Although fish is traditionally an important fish protein food staple in Egypt, consumption is limited by supply shortages. Present demands (much less future demands) cannot be met by natural fisheries and existing fish farms. As a result, the demand for fish is being met by imports—placing an additional strain on the nation's balance of payments.

Project: Z030000  Sub-project: 00

Initial FY: 78  Final FY: 83

Problem: The rapid population & industrial growth of Alexandria, Egypt has resulted in a serious waste-water collection & disposal problem. The present sewage pumping & treatment facilities are inadequate or obsolete and the collection system (sewer lines, drains) is in a state of disrepair and/or badly in need of cleaning. The Egyptian agency responsible for rectifying this problem, the General C.R.G. for Sewerage & Sanitary Drainage, lacks the funding & technical expertise to be able to undertake a sewer system expansion project of the necessary magnitude in Alexandria.

Project: Z030038  Sub-project: 00

Initial FY: 77  Final FY: 82

Problem: The unified power system (UPS), Egypt's electrical network, consists of 3,000 megawatts of hydropower from the generation stations, 1,500 megawatts of thermal power from 12 generation stations, plus 420 km of 220 kilovolt lines, 760 km of 400 kilovolt lines, and 24 major substations. Variations in power available from the hydro sites, the distance between stations and load centers, and the 16% annual system growth rate have rendered the present manual voice-controlled patch dispatch system useless.

Project: Z030023  Sub-project: 00

Initial FY: 78  Final FY: 82
**TITLE: EGYPT: GRAIN SILOS LOAN**

PROBLEM: Egypt lacks efficient system to receive, store, and distribute imported wheat, corn, and flour. Egypt needs grain handling equipment and silos to reduce grain waste and speed up grain marketing.

PROJECT: 2630022  SUB-PROJECT: 00

INITIAL FY: 75  FINAL FY: 75

**TITLE: EGYPT: URBAN HEALTH DELIVERY SYSTEM**

PROBLEM: Poor environmental sanitation, inadequate water and sewage facilities, and cultural practices contribute to a low level of health in Egypt, where the infant mortality rate exceeds 150 per 1000 and incidence of gastroenteritis and bronchial disorders exceeds minimally acceptable levels. While the Government has developed a health care system, the system has not functioned to its full potential because of fragmentation of services, poorly maintained facilities, and low public acceptance of peripheral health care units.

PROJECT: 2630062  SUB-PROJECT: 00

INITIAL FY: 79  FINAL FY: 83

**TITLE: FAMILY PLANNING**

PROBLEM: Egypt, with 90% of its population crowded onto 4% of the land, has a population density twice that of the Netherlands and an annual population growth rate of 2.5%. In 1969 the UCE established a system providing family planning information and services, and as of 1977 between 15 and 20 percent of Egypt's married couples of reproductive age were using modern contraceptive methods. The participation rate, however, will have to at least double and be maintained.

PROJECT: 2630029  SUB-PROJECT: 01

INITIAL FY: 77  FINAL FY: 81
**TITLE:** FEASIBILITY STUDIES

**Problem:** The government of Egypt has very little domestic capability for producing acceptable feasibility studies and therefore lacks a portfolio of acceptable development projects ready for financing. There are projects which have been thoroughly studied and have proven to be technically and economically feasible. Moreover, Egypt faces a balance of payments crisis which precludes the use of foreign exchange for required tech assist. Consequently, GCE is unable to utilize financial assistance offered by Arab oil countries and other foreign lenders.

**Project:** 26200053 **Sub-Project:** C0

**Initial FY:** 79  **Final FY:** 79

**Title:** FOOD GRAIN/VEG OIL & CRF. AND DISTR. FAC.

**Problem:** Imports of tallow, oils and fats (TCF) provide a substantial portion of Egypt's supply for the manufacture of vegetable oils, shortening and soap. Because storage and distribution systems for grains and TCF are inefficient, large losses result from waste, spoilage and pest infestation.

**Project:** 2630037  **Sub-Project:** C0

**Initial FY:** 77  **Final FY:** 81

**Title:** GROUNDWATER INVESTIGATIONS - WEST DESERT

**Problem:** With population density of over 2000 per sq. mi in favorable areas, United Arab Republic (UAR) needs to expand available arable land to feed and employ its growing population. Without water for irrigation or industry, this is not possible. Although groundwater is known to exist in western desert areas, basic data do not exist for adequate appraisal of groundwater potential. Actual location of water, its quantity, its quality are uncertain, making rational development planning impossible.

**Project:** 2650253  **Sub-Project:** C0

**Initial FY:** 87  **Final FY:** 89
PROBLEM: BECAUSE OF THE STRONG BIAS IN THE EGYPTIAN MEDICAL SYSTEM TOWARDS URBAN POPULATIONS WITH EMPHASIS ON CURATIVE CARE, RURAL HEALTH WORK HAS EMPHASIZED ON PREVENTIVE MEASURES AND RECEIVES COMPARATIVELY FEW (10%) OF THE GOVERNMENT'S ALLOTMENT FOR HEALTH CARE. CONSEQUENTLY, THERE EXIST VERY FEW TELECOMMUNICATIONS SYSTEMS BETWEEN RURAL HEALTH SERVICE ELEMENTS. SERIOUS SHORTCOMINGS IN MEDICAL AND AUXILIARY HEALTH PERSONNEL TRAINING AND INCENTIVES REMAIN INCENTIVES TO MOTIVATE HEALTH PERSONNEL-ESPECIALLY TO ENTER RURAL HEALTH SERVICE AND TO PERFORM WELL IN RURAL AND PARA-MEDICAL JOBS.

PROJECT: 2436415  SUB-PROJECT: 00

INITIAL FY: 76  FINAL FY: 81

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PROBLEM: THE AVERAGE YEARLY RAINFALL ALONG THE NILE IN MIDDLE AND UPPER EGYPT IS PRACTICALLY NULL. FARMERS IRRIGATE THEIR FIELDS WITH EITHER DIESEL OR ELECTRIC PUMPS OR BY TRADITIONAL MEANS SUCH AS DRAFT ANIMAL AND MANE-OPEPATED WATER WHEELS AND SPONDBELS (COUNTERCLOCKWISE SWEEPS). THESE METHODS DO NOT SUPPLY ENOUGH WATER TO THE FIELDS, RESULTING IN SUBSTANTIAL LOSS IN CROP YIELD.

PROJECT: 2036046  SUB-PROJECT: 00

INITIAL FY: 77  FINAL FY: 81

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PROBLEM: CEREAL CROPS IN EGYPT CONSTITUTE THE MOST IMPORTANT GROUP OF FIELD CROPS IN CASH VALUE. THIS GROUP INCLUDES WHEAT, BARLEY, MAIZE, RICE, AND SUGARHUM. HOWEVER, BECAUSE OF A LACK OF A PROPERLY FUNDED, PROFESSIONALLY CRAFTED RESEARCH ORGANIZATION, LACK OF A PROPERLY STAFFED AND FUNDED EXTENSION SYSTEM, GOOD QUALITY, SMALL QUANTITY AND INADEQUATE DISTRIBUTION OF HIGH QUALITY SEEDS, AND INABILITY TO QUICKLY AND EFFECTIVELY DISSEMINATE APPROPRIATE RESEARCH INFORMATION TO FARMERS, CEREAL PRODUCTION IS CONstrained.

PROJECT: 2036047  SUB-PROJECT: 00

INITIAL FY: 74  FINAL FY: 79
**Problem:** Construction of the Aswan Dam enabled the year-round & through irrigation of farmlands in Upper Egypt. However, the absence of adequate drainage facilities to complement the increased use of irrigation water has resulted in ground waterlogging & increased soil salinity & consequent diminished land fertility. Egypt lacks sufficient financial resources, technical expertise, equipment & materials (especially piping) to undertake construction of an extensive drainage system to reduce waterlogging.

**Project:** 20:00:39  **Sub-project:** C0

**Initial FY:** 76  **Final FY:** 01

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**Problem:** Salt is a basic chemical in almost all industries-its historical rate of consumption in all countries parallels the rate of increase of the GNP. Egypt's El Nasr Salines Co is responsible for providing both edible & industrial salt for domestic use & is the sole exporter of salt in Egypt. El Nasr's Port Said plant was partially destroyed in the 1967 & 1973 wars with the result that salt exports decreased to only 24, sharply decreasing foreign exchange earnings from this source.

**Project:** 20:00:72  **Sub-project:** C0

**Initial FY:** 77  **Final FY:** 80

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**Problem:** Expansion of poultry production in Egypt is limited by: 1) A shortage of poultry feed; 2) Inadequate supplies of vaccines & medicines; 3) A shortage of foreign exchange for importing feeds, feed ingredients & other critical items; 4) A shortage of day-old chicks for earlier production; 5) The unknown size of the total market.

**Project:** 10:00:50  **Sub-project:** C0

**Initial FY:** 77  **Final FY:** 81
PRIVATE INVESTMENT ENHANCEMENT FUND

**Problem:** With nationalization in the early 1970s, Egypt's public industrial/financial sector became the major source of mobilizing and allocating domestic resources for economic development. More recently, the government of Egypt (GEO) has adopted a more liberal economic policy aimed at stimulating the private industrial/financial sector. GEO has now requested aid assistance in providing medium to long-term credit to finance foreign-exchange costs of larger-sized private sector enterprises. In order to improve private sector productivity:

**Project:** 2606697 **Sub-Project:** CO

**Initial FY:** 79 **Final FY:** 84

**Title:** Rice Research

**Problem:** Egypt's present stagnated & sub-optimal rice productivity can be traced to inefficient farm management, lack of suitable farm machinery, incomplete rice mills & milling technology, and the lack of right producing rice varieties suitable for Egyptian soils. A well-organized rice training force of rice production and processing researchers & extension trainers still not exist in Egypt. Therefore, there is no means for developing the needed technology and disseminating it to technology to farmers; the above constraints are perpetuated.

**Project:** 2530027 **Sub-Project:** CO

**Initial FY:** 77 **Final FY:** 83

**Title:** Suez Canal El Kafrina Thermal Power Plant FUND

**Problem:** Egypt's existing electrical generating capacity is only sufficient to meet the country's needs through 1983. Thus, the increased demands for electricity increased by developing industrial, agricultural, and private consumer markets during the 1980s cannot be met and the energy-elastic growth potential of the country not utilized.

**Project:** 2530110 **Sub-Project:** CO

**Initial FY:** **Final FY:**
**TITLE: SLEZ CEMENT PLANT**

**PROBLEM:**
EGYPT CURRENTLY HAS ONLY GOVERNMENT-OWNED COMPANIES TO SUPPLY CEMENT. SHORTAGES OF CEMENT HAVE BECOME CHRONIC AND AGRICULTURAL FOREIGN EXCHANGE IS NOT AVAILABLE TO PURCHASE IMPORTS. WITHOUT RELATIVELY LOW-COST AND EASILY AVAILABLE SOURCES OF CEMENT THE IMPLEMENTATION OF VITAL NATIONAL DEVELOPMENT PROGRAMS SUCH AS CONSTRUCTION OF CEMENT AND PORTS AND CONSTRUCTION RELATD TO AGRICULTURAL AND INDUSTRIAL INVESTMENTS HAS BEEN SLOWED.

**PROJECT:** 203001Z  **SUB-PROJECT:** 60  
**INITIAL FY:** 76  
**FINAL FY:** 81

**TITLE: TECHNICAL AND FEASIBILITY STUDIES II**

**PROBLEM:**
EGYPTIAN MINISTRIES GENERALLY LACK FULL UNDERSTANDING OF THE TRUE NATURE OF A FEASIBILITY STUDY AND HAVE ONLY LIMITED CAPABILITY TO MEET THE QUALITATIVE STANDARDS ROUTINELY EXPECTED BY INTERNATIONAL LENDING ORGANIZATIONS. EGYPTIAN FEASIBILITY STUDIES OFTEN HAVE ADEQUATE TECHNICAL CONTENT BUT LACK ESSENTIAL COST ESTIMATION AND ECONOMIC EVALUATION ELEMENTS; LACK OF THESE ELEMENTS HINDERS THE IDENTIFICATION, EVALUATION, AND EXECUTION OF PRIORITY RECONSTRUCTION AND DEVELOPMENT PROJECTS.

**PROJECT:** 2030025  **SUB-PROJECT:** 60  
**INITIAL FY:** 77  
**FINAL FY:** 80

**TITLE: WATER USE AND MANAGEMENT**

**PROBLEM:**
AVERAGE AGRICULTURE PRODUCTION IN EGYPT, ALTHOUGH 
LESS IS 50% LESS YIELD YIELDS OBTAINED IN 
EGYPTIAN EXPERIMENT STATIONS. THE PRESENT WATER 
MANAGEMENT SYSTEM USES TOO MUCH WATER AND OVERALL 
WATER EFFICIENCY IS LOW. FOR CROP PRODUCTION.

**PROJECT:** 2030017  **SUB-PROJECT:** 60  
**INITIAL FY:** 70  
**FINAL FY:** 82
APPENDIX VII

Bibliography

CONTENTS

1. General Bibliographic Sources for Africa
2. Geology, Geomorphology and Mineral Development
3. Energy
4. Water (water budget, irrigation and reclamation hydrology, and ecological impacts of these)
5. Soils and Dune Stabilization
6. Biological Sciences and Agriculture
7. Environmental Modification and Conservation
8. Health
9. Development Issues, Plans and Reclamation Schemes