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SINAI DEVELOPMENT STUDY, PHASE I

FINAL REPORT

VOLUME VII

SINAI DATA BOOK

SUBMITTED TO:

THE ADVISORY COMMITTEE FOR RECONSTRUCTION
MINISTRY OF DEVELOPMENT
ARAB REPUBLIC OF EGYPT

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FINAL REPORT

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VOLUME VII

SINAI DATA BOOK

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FOREWORD

The Sinai Data Book, Volume VII of the Final Report of the Sinai Development Study-Phase I (SDS-1), is presented in response to suggestions by the Ministry of Development. Both the Consultant and the Ministry view the Data Book as an early step in the creation of an information system. The Data Book is designed to serve those responsible for managing Sinai's development and to assist the planning and follow-up processes employed to integrate the people and places of Sinai with those of the Nile Valley.

Users of this volume are encouraged to participate in the refinement of a Sinai Information System by suggesting new or different categories for the presentation of data, and by collecting their own data and presenting it in a compatible form to be incorporated in future editions of The Sinai Data Book. Thus, additional information will be available to all who are concerned with development in Sinai.

Eventually, as settlement activities expand, available data will increase to the point where such information requires full-time active management by whichever agency ultimately holds overall responsibility for the development effort. Efficient data management will also require computerization; interim data collection efforts can help prepare for that conversion process if the capabilities and constraints of computers are kept in mind from the beginning.

INTRODUCTION

1.0 ORIGIN OF THE DATA BOOK

The concept of a Data Book of Sinai information grew from two perceived needs. First, the professional team responsible for designing an appropriate development strategy for Sinai wanted a single desk-top source document in which various data were accumulated. In some areas of concern very little data existed; these "gaps" needed to be brought to the attention of the team in the hope that some gaps could be filled during the course of the Study. In other areas data existed but were imprecise, unverified, based on "guesstimates", and not adequately referenced. Bringing all available data together facilitated substantial cross-checking and validation even within the constraints of this reconnaissance study. Second, it was foreseen that similar difficulties with data would continue indefinitely to plague those charged with development of Sinai to build a Sinai Information System.

During preparation of tables, figures and other information for inclusion in the Data Book, it became clear that a third benefit would emerge. Many categories of data generally presumed to be of value to development planning simply do not exist for Sinai. These gaps became the subject of recommendations for several important immediate action projects in the form of studies needed to further the development process. For example, the original outline of the Data Book included categories for Manufacturing and Trade. Since there have been few such activities in Sinai to date, there are also next to no data available. But, as development proceeds, these economic sectors will increase dramatically; a system for collecting and recording relevant information is best initiated now, at the beginning of a large-scale settlement and economic development program. Such information is certain to be of increasing value to planners and officials as the years go by.

2.0 ORGANIZATION OF THE DATA BOOK

The general categories of data presentation begin with the Land, Water, and Environment--displaying the resource base and land capability of Sinai (reference Volumes IV and V). The next section--Population--introduces the existing and potential human resource base. A fifth section describes Infrastructure and Community Services (reference Volume VI). The sixth section presents interactions among all the preceding topics, insofar as that interaction is expressed in Economic Activities (reference Volume III). This is followed by information concerning the organization of the administrative and planning institutions within Egypt and Sinai, which will bear major responsibility for decision-making and implementation related to development (Volume II). The final section of the Data Book presents information about the Recommended Strategy prepared by the Consultant as a final step in the Sinai Development Study--Phase I, linking analysis to objectives (Volume I). Within each category of data, organization proceeds from the more general to the more specific, from larger to smaller geographical areas.

3.0 ORGANIZATION OF THE DATA

The data have been organized so that the Volume can function as a "relational data base". Each "field" and "branch" has been given a two-letter alphabetical code. The branch, the "cost" (or investment), and the "bibliography", amongst the fields, are suggested as interfaces or "keys" to other data bases (Table 3-1).

Access to the data is also proposed to be by geographic area (Table 3-2). "Geocodes" are suggested at three levels (or in three fields): political, planning and map/grid. The political field includes Governorates and settlements. Data interface is suggested at the Governorate level and at the level of Egypt's Planning Region Three. The planning field consists of the study's five subregions and zones within them. The map field should be arranged in accordance with whatever standard map grid is used by the Planning Ministry and others.

The relational data base summarized in Table 3-1 and presented in the topical sections of this Volume can be initiated on a micro-computer (desk-top or portable) costing less than $5,000 and later transferred to a mini-computer. The data can be stored and copied onto 5¼-inch (13 cm) floppy disks and easily used at several different locations (for instance, in the offices of the five concerned governors as well as in Cairo) at the same time.

There are many data-base software programs on the market for under $500, some in Arabic. The software selected should have at least the following characteristics:

- 50 or more fields
- 50 or more branches per field
- Multiple field selection and sorting
- Mathematical and string selection and comparison
- User-formatted output
- Interface with word processor
- Interface with spread sheet
- Interface with graphics and maps
- Interface with other data bases and mainframes.

As a planning tool, the Sinai data base needs to be more flexible than most government and business data bases. It is particularly important to have convenient interfacing with spread-sheet analysis and map analysis. Patented or copyrighted planning models that can carry out specific sets of analyses should be considered before purchasing hardware or software.

4.0 PROBLEMS OF LANGUAGE

As is often the case, transliteration from Arabic to English creates some problems with data. Throughout this volume, a strong attempt has been made to maintain consistent spelling in English of Arabic place names. In one or two cases, however, no consensus could be obtained from Arabic sources and a confusion remains. The prime example of this is Ras El Naqb, the airport northwest of Ras Taba in the Southeast Sub-

List of Topics in the Sinai Data Base
(Fields, Branches and Codes)

Field	Code	Branch	Code	Key (Y/N)
Land	LA			Y
		Geology	ge	n
		Soils	so	n
		Minerals	mi	n
		Use	us	n
		Costs	l$	y
		Other	ot	n
		Bibliography	bi	y
Environment	EN			Y
		Climate	cl	n
		Flora	fl	n
		Fauna	fa	n
		Landscape	ls	n
		Costs	E$	y
		Other	ot	n
		Bibliography	bi	y
Water	WA			Y
		Surface	su	n
		Ground	gr	n
		Use	us	n
		Costs	W$	y
		Other	ot	n
		Bibliography	bi	y
Population	PO			Y
		Demography	de	n
		Migration	mi	n
		Costs	P$	y
		Other	ot	n
		Bibliography	bi	y
Infrastructure	IN			Y
		Social	so	n
		Utilities	ut	n
		Water	wa	n
		Transport	tr	n
		Costs	I$	y
		Other	ot	n
		Bibliography	bi	y
Economics	EC			Y
		Agriculture/F	ag	n
		Mining	mi	n
		Manufacturing	ma	n
		Tourism	to	n
		Service	se	n
		Costs/Investment	F$	y
		Other	ot	n
		Bibliography	bi	y
Public Administration	PA			Y
		Organization	or	n
		Budget	A$	y
		Other	ot	n
		Bibliography	bi	y
Recommended Strategy	RS			Y
		Economic	ec	n
		Spatial	sp	n
		Social	so	n
		Infrastructure	in	n
		Management	ma	n
		Costs/Investment	S$	y
		Alternatives	al	n
		Other	ot	n
		Bibliography	bi	y

List of Geographic Units in the Sinai Data Base
(Political, Planning and Map Fields, Branches and Geocodes)

Field	Code	Branch	Code	Key (Y/N)
Political	PO			Y
		World	01	n
		Mideast	02	n
		Egypt	03	n
		Sinai	04	n
Governorates:		Port Said	05	y
		North Sinai	06	y
		South Sinai	07	y
		Suez	08	y
		Ismalia	09	y
Settlements: *		NW Subregion	11-25	n
		NE Subregion	26-40	n
		UP Subregion	41-55	n
		SW Subregion	71-85	n
		SE Subregion	86-99	n
Planning	PL			Y
		Region Three	A	y
		Sinai Peninsula	B	y
		Mediterranean Sea	C	n
		Red Sea	D	n
		Suez Gulf	E	n
		Aqabah Gulf	F	n
Subregions/Zones:		Northwest/NW	G	y
		NW/N (PS)	G.a	n
		NW/M (ISM)	G.b	n
		NW/S (SZ)	G.c	y
		Northeast/NE	H	y
		NE/W	H.a	n
		NE/E	H.b	n
		Uplands/UP	I	y
		UP/W	I.a	n
		UP/E	I.b	n
		Southwest/SW	J	y
		SW/N	J.a	n
		SW/S	J.b	n
		Southeast/SE	K	y
		SE/N	K.a	n
		SE/S	K.b	n
Maps	MA			Y
		Grid Coordinates:		y
		5 Digits North to South		
		5 Digits West to East		

* The 37 principal settlements referred to most frequently in this Report are listed by subregion in Table 3-3 in order of projected Year 2000 population (but roughly from North to South and from East to West within each size group). Geocodes for these settlements are listed but not incorporated in the statistical presentations that make up the main body of this volume.

region, an area not part of the study zone until after April, 1982. Various spellings of this place include the one given above, Ras Neqb, Ras Al Neqb, Ras Nabq, etc. Another example is the case of Aqabah; the prevailing wisdom seems to indicate that within Egypt the spelling includes the final "h," whereas for the Jordanian city it is without a final "h".

5.0 CONTENTS OF THE DATA BOOK

The Sinai Data Book contains a variety of forms of data. In some cases identical information appears in the other volumes of the report, collected here in one place to serve as a handy desk-top reference text. In other cases only a summary of the data was presented in other volumes, the version in the Data Book being more inclusive. The third category is information which does not appear elsewhere in the report but which gives useful detail and was found valuable by the Study Team.

Some SDS-I data and information are not included in the Data Book in order to keep it to manageable size.

- A list of major projects is Appendix B in Volume I; other project information was included in Working Paper 42.
- A fairly complete list of place names with Arabic (and in many cases alternative English) spellings is included in Working Paper 43.
- A card file (with grid coordinates) about groundwater is in Working Paper 34.
- An extensive map file along with other project files was turned over to the Ministry of Development in 1983.
- Several bibliographies are also in the project files.

These sources are referenced in the relevant Volumes of the Report. To be included in the Data Book, data generally had to meet the following criteria:

- Be of direct relevance to Sinai
- Be of background to tables and charts in other Volumes
- Avoid duplication of the results of analysis or recommendations
- Be internally consistent
- Be sourced
- Be geocoded.

It is intended that with the submittal of this Volume those responsible for planning and administering development in Sinai will have convenient access to relevant data and a handy reference guide leading them to further information.

Table 3-3

List of Principal Sinai Settlements in the Year 2000, by Subregion, Classification and Geocode

Subregion/Name	Classification[a]	Geocode PL	Geocode PO
Northwest Subregion:		G	--
El Qantara	Large Town	G.b	11
Baloza	Small Town	G.a	12
Gilbana	Small Town	G.a	13
El Tina (New)	Small Town	G.a	14
New Mit Abul Kom	Small Town	G.b	15
Ayun Musa[b] (New)	Small Town	G.c	16
Firdan East (New)	Settlement	G.b	17
Hamdi East (New)	Settlement	G.c	18
Northeast Subregion:		H	--
El Arish	City	H.b	26
Rafah	Large Town	H.b	27
Bir El Abd	Large Town	H.a	28
Sheikh Zuwayid	Small Town	H.b	29
Romana	Small Town	H.a	30
El Mazar	Settlement	H.a	31
Negila	Settlement	H.a	32
Rahaa	Settlement	H.a	33
Abu Aweigila (New)	Settlement	H.b	34
Uplands Subregion:		I	
Bir El Thamada (New)	Large Town	I.a	41
Gifgafa	Small Town	I.a	42
El Quseima	Settlement	I.b	43
El Kuntilla	Settlement	I.b	44
El Themed	Settlement	I.b	45
Nakhl	Settlement	I.b	46
El Hasana (New Site)	Settlement	I.b	47
El Sirr (New)	Settlement	I.b	48
El Maghara (New)	Settlement	I.a	49
Southwest Subregion:		J	
Abu Rudeis (New Site)	City	J.a	71
Ras Sudr	Small Town	J.a	72
El Tor	Small Town	J.b	73
Abu Zenima	Settlement	J.a	74
Feiran Oasis	Settlement	J.b	75
St. Catherine	Settlement	J.b	76
Southeast Subregion:		K	
Sharm El Sheikh	Large Town	K.b	86
Ras Taba (New)	Small Town	K.a	87
Nuweiba	Small Town	K.a	88
Dahab	Settlement	K.b	89
Nebq	Settlement	K.b	90

a/ City (also called growth pole) with over 50,000 population in Year 2000; large town (growth point) with 25,000-50,000 population; small town (service center) with 5,000-25,000 population; and settlement (market center) with Year 2000 population under 5,000.

b/ For most purposes in this study, the Ayun Musa area includes El Shatt to the north and Ras Misalla to the south.

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EC-3	EC-F$-3	Data on Some Businesses in El Arish, 1982	06	H.b
EC-4	EC-AG-1	Agricultural Organizations in Northern Sinai, 1981	06	G, H, I
EC-5	EC-AG-2	Irrigated Crops in Sinai	06	G, H
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EC-8	EC-AG-5	Approximate Quantities of Vegetables Consumed in El Arish, 1980	06	H.b
EC-9	EC-F$-4	Prices of Vegetables Consumed in El Arish (pt/kg)	06	H.b
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EC-19	EC-AG-13	Enterprise Budget: Okra--El Arish, 1981	06	H.b
EC-20	EC-AG-14	Enterprise Budget: Peppers--El Arish, 1981	06	H.b
EC-21	EC-AG-15	Enterprise Budget: Cucumbers--El Arish, 1981	06	H.b
EC-22	EC-AG-16	Enterprise Budget: Tomatoes--El Arish, 1981	06	H.b
EC-23	EC-AG-17	Enterprise Budget: Date Palm -El Arish 1981	06	H.b
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EC-29	EC-F$-9	Development and Cost/Benefit Forecast for Sinai Minerals, 1982 to 2000	04	B
EC-31	EC-MA-1	Recommended Refinery and Chemical Products Development in the Southwest Subregion	07	J
EC-32	EC-TO-1	Major Tourism Landmarks of Sinai with Descriptive Commentary	04	B
EC-36	EC-TO-2	Estimated Existing Tourism Facilities	04	H, J, K

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EC-38	EC-TO-5/6	Gulf of Aqabah: Estimated Tourism Capacity and Use Potential: Achievable Capacity and Usage Targets	06	H
EC-39	EC-TO-7	Projected Sinai Cultural/Sightseeing Tourism Markets Potential, 1985-2000	04	B
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Page Number	Entry ID Number	Entry Title	Geocode PO	Geocode PL
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Page Number	Entry ID Number		Geocode PO	Geocode PL
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Page Number	Entry ID Number	Entry Title	Geocode PO	Geocode PL
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APPENDIX: Lists of Reports, Maps and Figures

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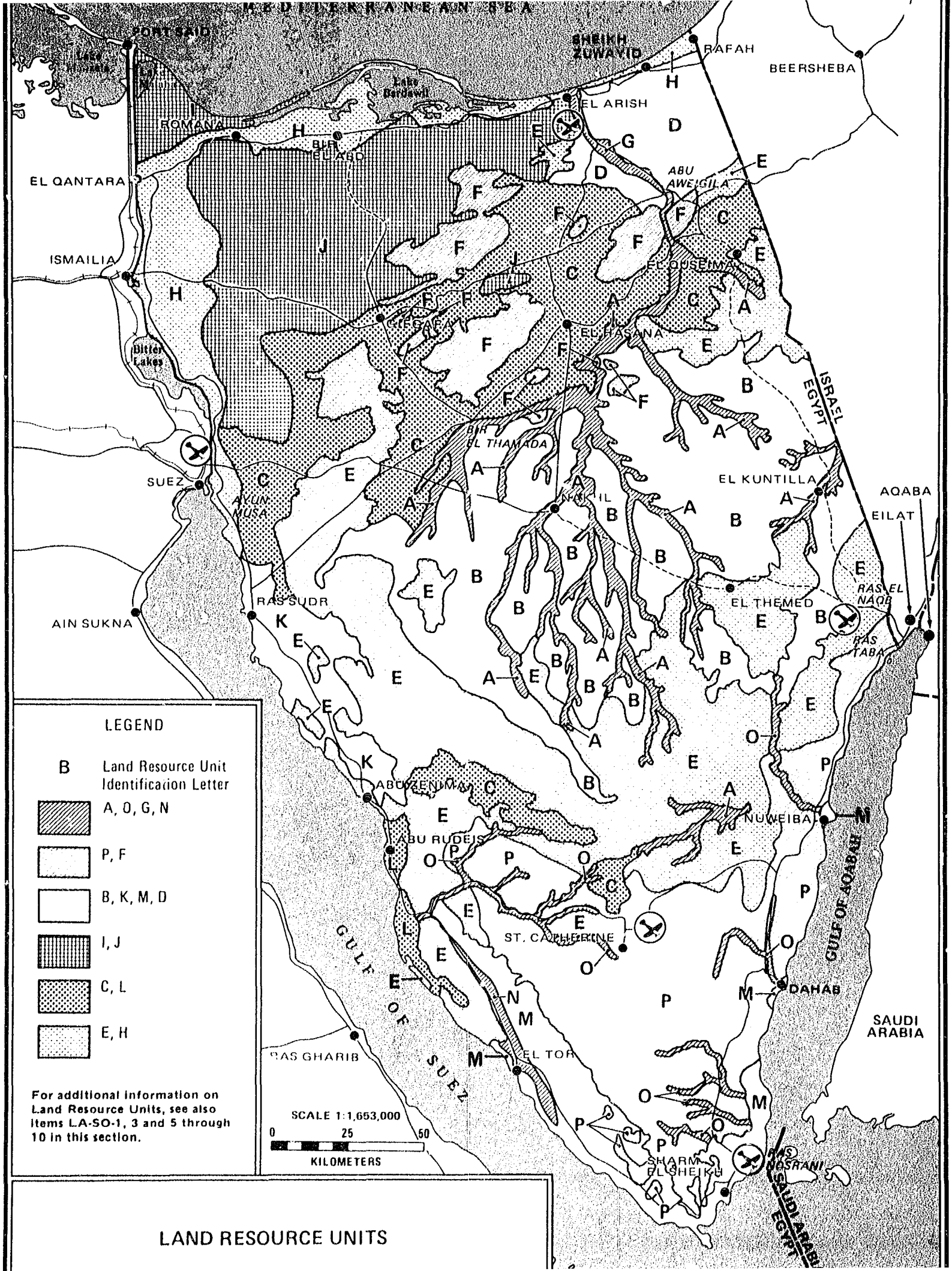
A. LAND (LA)

Explanatory Note on the Land Resource Units of Sinai

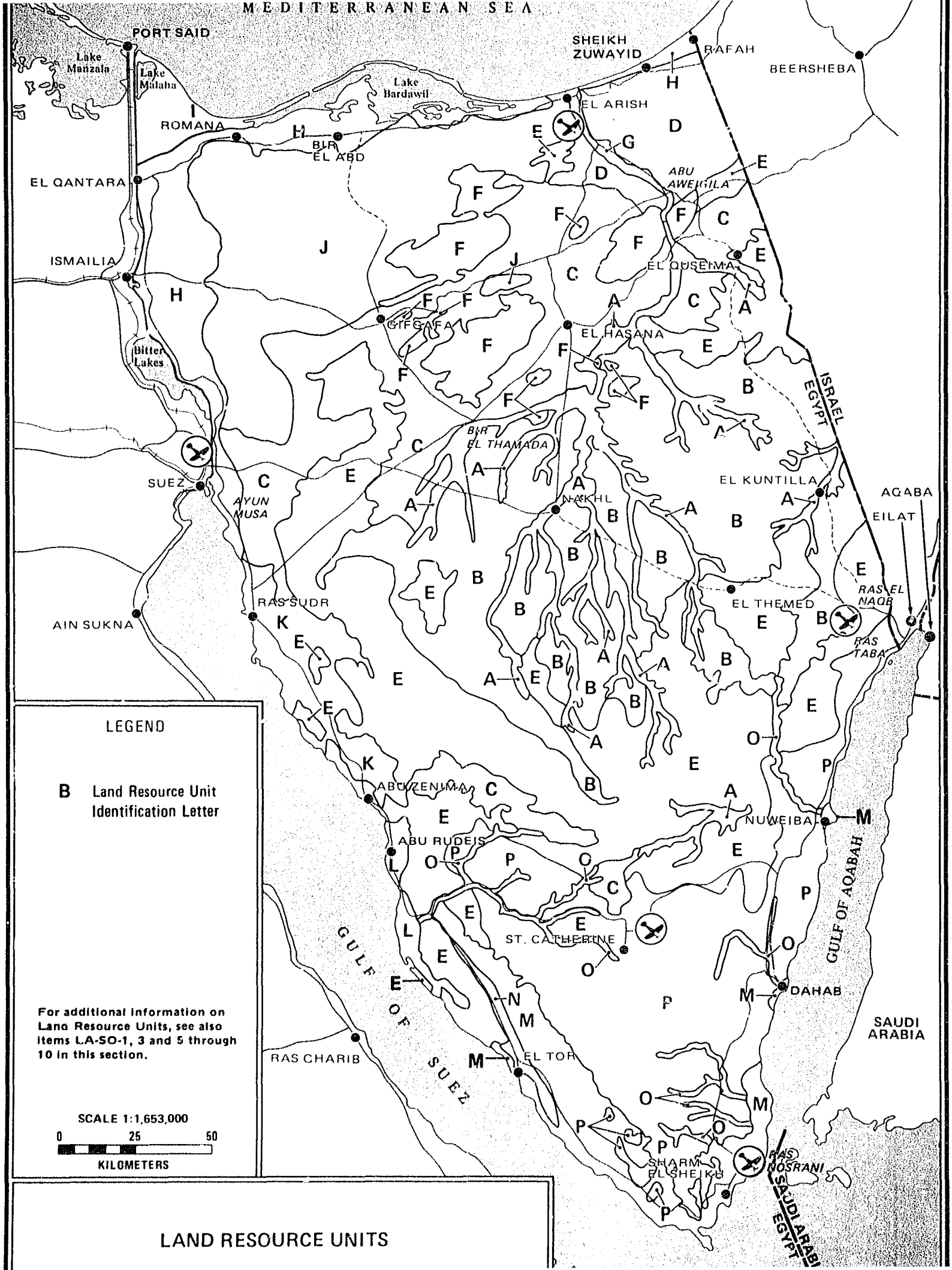
The Land Resource Units and their component landforms were identified in accordance with procedures described in a technical annex to Volume IV of the Final Report of the Sinai Development Study-Phase I (Appendix A entitled "Reconnaissance Soil Capability Assessment for Irrigated Agriculture on the Sinai Peninsula"). Total areas of Land resource units were measured directly from maps on a scale of 1,750,000 by planimeter. Percentages in the component landforms were estimated on the basis of field surveys and by using the maps of the SDS-I Working Paper 45 (especially Plate 2-4 on landforms). Areas of the component landforms were calculated by taking the appropriate percentage of the total area of the Land Resource Unit.

The soils of the component landforms were assessed for capability to support irrigated agriculture. Those soils having limitations that are nearly impossible to remedy (such as exposed bedrock or shallow depth to bedrock) or highly impractical to remedy (such as extremely saline soils, shallow depth to a saline water table, or mobile dunes) were set aside from further consideration in the near future. The remaining soils were assessed in terms of characteristics important to irrigation capability (such as texture, salinity, calcium carbonate, exchangeable sodium, flood hazard, and presence of gravel or surface stones). For each characteristic, an acceptable level was set, beyond which the soil was assessed as having a limitation in that characteristic. The number of limitations for irrigated agriculture are shown for each landform with usable soils (those with manageable limitations--not impossible or impracticable to remedy). In general, the greater the number of limitations, the more costly the reclamation and sustained irrigation of the soil. Soils with four or fewer limitations are considered as candidates for further investigation. (LA-SO 4 lists limitations.)

The map of land resource units was superimposed on the maps of groundwater availability (Plates 6-1 and 6-2 of SDS-I Working Paper 45) to estimate the amount of groundwater available in each Land Resource Unit. The maximum safe yields of all underlying aquifers were summed. Water from those aquifers, or groundwater availability areas, with a median estimated salinity value less than 3000 mg/l was classified as "low salinity." Water with 3000 mg/l or greater total dissolved solids was classed as "high salinity." The summed yields of low and high salinity groundwater are shown for each Land Resource Unit.



LAND RESOURCE UNITS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EL QANTARA
ABU AWEIGILA
ISMAILIA
EL QUSEIMA
GIFGAFA
EL HASANA
Bitter Lakes
ISRAEL
EGYPT
BIR EL THAMADA
SUEZ
AYUN MUSA
EL KUNTILLA
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NUWEIBA
ABU RUDEIS
GULF OF AQABAH
ST. CATHERINE
DAHAB
SAUDI ARABIA
GULF OF SUEZ
RAS CHARIB
EL TOR
SHARM EL SHEIKH
RAS NOSRANI
SAUDI ARABIA
EGYPT
LEGEND
B Land Resource Unit Identification Letter
For additional information on Land Resource Units, see also items LA-SO-1, 3 and 5 through 10 in this section.
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KILOMETERS
LAND RESOURCE UNITS

Land Resource Units of the Sinai Peninsula - Landforms and Soil Characteristics

LRU	Component Landforms	Slope	Texture	Salinity	$CaCO_3$	Sodium	Gypsum	Special Problems
A	floodplain (80%)	0-2	medium	high	high	--	trace	wind erosion
	active wadi beds (20%)	0-2	medium	low	high	--	trace	wadi flooding
B	alluvial plain (35%)	0-8	coarse	high	high	high	nil	shallow to bedrock
	alluvial plain (eroded) (25%)	8-30	coarse	high	high	high	low	shallow to bedrock
	small swales and wadis (20%)	0-8	coarse	high	high	--	low	shallow to hardpan and flooding
	rock outcrop (20%)	15-80	bedrock	--	--	--	--	rock outcrop
C	alluvial plain (40%)	0-8	coarse	high	low	low	nil	shallow to bedrock
	sand sheet (40%)	0-2	coarse	low	low	low	nil	wind erosion
	active wadi beds (20%)	0-8	medium	low	low	low	trace	wadi flooding
D	alluvial sand deposits (40%)	0-8	medium	low	high	--	--	wind erosion
	sand dunes (30%)	2-15	coarse	low	low	--	--	mobile dunes
	alluvial plain (15%)	0-8	medium	high	high	--	--	shallow to bedrock
	active wadi beds (15%)	0-8	medium	low	high	--	--	floods/surface stones
E	rock outcrop (70%)	8-25	bedrock	--	--	--	--	rock outcrop
	residual soil (20%)	0-25	medium	high	high	high	--	shallow to bedrock
	small swales and wadis (10%)	0-8	coarse	high	high	--	--	shallow to bedrock
F	rock outcrop (90%)	>15	bedrock	--	--	--	--	rock outcrop
	aeolian sand (10%)	8-25	coarse	low	low	low	nil	shallow to bedrock
G	aeolian sand sheet and dunes (40%)	0-8	coarse	low	low	low	nil	mobile dunes
	alluvial soil on lower terraces (40%)	0-8	medium	high	low	--	--	erodible soil (but good drainage
	alluvial soil on higher terraces (20%)	0-2	medium	high	low	--	--	extremely saline soil

LRU	Component Landforms	Slope	Texture	Salinity	$CaCO_3$	Sodium	Gypsum	Special Problems
H	aeolian sand sheet (30%)	0-8	coarse	low	low	low	nil	wind erosion
	mobile sand dunes (30%)	8-30	coarse	low	low	low	nil	mobile dunes
	coastal beach and wet sabkha (25%)	0-2	coarse	high	low	--	low	shallow to saline water table
	sandy dry sabkha (10%)	0-2	coarse	high	low	--	high	shallow to saline water table
	lagoonal sediments (5%)	0-8	medium	high	low	--	--	extremely saline soil
I	deltaic and lacustrine deposits (very poorly drained (40%)	0-2	medium	high	low	--	--	very shallow to saline water table, tidal and seasonal flooding
	deltaic and lacustrine deposits (poorly drained) (30%)	0-2	medium	high	low	--	--	very shallow to saline water table
	wet sandy sabkha (20%)	0-2	coarse	high	low	--	low	shallow to saline water table
	dry sandy sabkha (10%)	0-2	coarse	high	low	--	high	shallow to saline water table
J	mobile dune and inter-dune sand (100%)	8-30	coarse	low	low	low	nil	mobile dunes
K	alluvial plains (50%)	8-30	coarse	high	high	high	low	gravel and surface stones
	active wadi beds (40%)	0-8	medium	high	high	low	low	shallow to water table & flooding
	wet sabkha on wadi deltas (10%)	0-2	medium	high	high	low	nil	shallow to water table & flooding
L	alluvial plains and active wadi beds (60%)	0-8	coarse	low	low	high	nil	surface stones and flooding
	coastal plain (40%)	0-2	coarse	high	low	high	nil	gravel and surface stones
M	mountain front alluvial fans (50%)	0-25	coarse	low	low	high	nil	gravel and surface stones
	alluvial plains (30%)	0-8	coarse	high	low	high	nil	gravel and surface stones
	active wadi beds (15%)	0-8	coarse	low	low	high	nil	gravel, surface stones & flooding
	coastal strip (5%)	0-2	coarse	high	low	high	nil	gravel and surface stones

LRU	Component Landforms	Slope	Texture	Salinity	$CaCO_3$	Sodium	Gypsum	Special Problems
N	alluvial plain (45%)	0-2	coarse	high	low	high	low	gravel
	playa (45%)	0-2	medium	high	low	high	low	shallow to hardpan & erodible
	active wadi beds (10%)	0-2	coarse	high	low	high	nil	flooding
O	active wadi beds (90%)	0-8	coarse	low	low	high	nil	gravel, surface stones & flooding
	terraces (10%)	0-8	medium	high	low	low	nil	hardpan at 150-300 cm depth
P	rock outcrop (98%)	>8	bedrock	--	--	--	--	rock outcrop
	active wadi beds (2%)	0-30	coarse	low	low	high	nil	gravel, surface stones & flooding

Source: Appendix A to Volume IV, The Land and The Environment of Sinai. This analysis was prepared by the Office of Arid Land Studies of the University of Arizona largely from soil survey and other data collected by the Desert Institute (1981), REGWA (1981) and the Enterprise for Applied Physics (1963). A full list of references is on page A-12 of Volume IV.

Limitations for Crop Cultivation Under Irrigation[a]

First Class Soil Limitations: (Nearly impossible to remedy)	-- Exposed bedrock
	-- Shallow depth (less than 1 meter) to bedrock
Second Class Soil Limitations: (Impractical or Costly to remedy[b])	-- Mobile dunes
	-- Shallow depth (less than 1 meter) to good quality water table
	-- Shallow depth (less than 3 meters) to saline water table
	-- Extremely saline soil (greater than 100 mmhos/cm)
Third Class Soil Limitations: (Manageable with standard techniques)	-- Slope (8-30%)
	-- Gravel (more than 20% through profile)
	-- Surface stones, including boulders (covering more than 10% of soil surface)
	-- Hardpan (less than 3 meters below surface)
	-- Flooding likely following rain
	-- Coarse texture (rapid permeability throughout profile)
	-- High salinity (10 mmhos/cm or greater)
	-- High calcium carbonate (30% or greater)
	-- High exchangeable sodium (20% or greater)

[a] For greater detail about limitations and possible remedies, see Appendix B, Soil Properties Relevant to Irrigated Agriculture in Sinai, of Volume IV.

[b] El Tina Plain is recommended for reclamation despite second class soil limitations because of ready access to Nile water, good highway access, and techniques, well established in Egypt, for overcoming those specific limitations.

Source: Appendix A to Volume IV, The Land and the Environment of Sinai. This analysis was prepared by the Office of Arid Land Studies of the University of Arizona largely from soil survey and other data collected by the Desert Institute (1981), REGWA (1981) and the Enterprise for Applied Physics (1963). A full list of references is on page A-12 of Volume IV.

Land Resource Units of the Northwest Subregion, Groundwater, Landforms, Area and Limitations
(6,656 square kilometers total)

Land Resource Unit	Groundwater Available Low Salinity ($000m^3$/day)	Groundwater Available High Salinity ($000m^3$/day)	Component Landforms	Area Percent	Area Sq Km	Agricultura Limitations
C	3.6	7.0	Total	100	1,270	-
			Alluvial plain	40	508	*
			Sand sheet	40	508	1
			Active wadis	20	254	1
E	6.4	3.0	Total	100	658	-
			Rock outcrop	70	460	*
			Residual soil	20	132	*
			Small swales & wadi;	10	66	*
H	0	2.5	Total	100	1,936	-
			Aeolian sandsheet	30	581	1
			Mobile sand dunes	30	581	*
			Coastal beach wet subkha	25	483	*
			Sandy dry sabkha	10	193	*
			Lagoonal sediments	5	98	*
I	0	0	Total	100	541	-
			**Deltaic & lacustrine deposits (very poorly drained)	40	215	2
			**Deltaic & lacustrine deposits (poorly drained)	30	161	2
			Wet sandy sabkha	20	110	*
			Dry sandy sabkha	10	55	*
J	0	7.8	Mobile dune and interdune sand	100	2,251	*
			Total Northwest Subregion		6,656	

* Set aside from further consideration for irrigated agriculture due to limitations considered impossible or highly impractical to remedy.

** Subject to poldering or other process to manage shallow saline water table.

SOURCE: Prepared by the University of Arizona Team for the Sinai Development Study, Phase I, February, 1983. Appendix A of Volume IV provides further detail.

Land Resource Units of the Northeast and Uplands Subregions, Groundwater, Landforms, Area and Limitations
(31,630 square kilometers total)

Land Resource Unit	Groundwater Available Low Salinity (000m³/day)	Groundwater Available High Salinity (000m³/day)	Component Landforms	Area Percent	Area Square Kilometers	Agricultural Limitations
A	26.8	2.8	Total	100	2,216	-
			Floodplain	80	1,768	2
			Active wadi beds	20	448	2
B	155.6	1.6	Total	100	10,883	-
			Alluvial plain	35	3,807	*
			Eroded alluvial plain	25	2,720	*
			Small swales & wadis	20	2,178	5
			Rock outcrop	20	2,178	*
C	49.7	3.0	Total	100	4,920	-
			Alluvial plain	40	1,968	*
			Sand sheet	40	1,968	1
			Active wadi beds	20	984	1
D	19.8	10.0	Total	100	2,027	-
			Alluvial sand deposits	40	811	2
			Sand dunes	30	610	*
			Alluvial plain	15	303	*
			Active wadi beds	15	303	3
E	82.8	5.2	Total	100	4,556	-
			Rock outcrop	70	3,189	*
			Residual soil	20	912	*
			Small swales & wadis	10	455	*
F	70.2	42.8	Total	100	2,011	-
			Rock outcrop	90	1,810	*
			Aeolian sand	10	201	*
G	12.3	0	Total	100	143	-
			Aeolian sand sheet	40	57	*
			Alluvial soil on lower terraces	40	57	1
			Alluvial soil on higher terraces	20	29	*
H	0	8.1	Total	100	1,013	-
			Aeolian sand sheet	30	304	1
			Mobile sand dunes	30	304	*
			Coastal beach and wet sabkha	25	253	*
			Sandy dry sabkha	10	101	*
			Lagoonal sediments	5	51	*
I	-	-	(See Northwest Subregion)	100	24	2
J	14.1	27.4	Mobile dune & interdune sand	100	3,830	*
P	-	-	(See Southwest Subregion)	100	7	*
			Total Northeast and Uplands Subregions		31,630	

* Set aside from further consideration for irrigated agriculture due to limitations considered impossible or highly impractical to remedy.

SOURCE: Prepared by the University of Arizona Team for the Sinai Development Study, Phase I, February, 1983. Appendix A of Volume IV provides further detail.

Land Resource Units of the Southwest Subregion, Groundwater, Landforms, Area and Limitations
(12,826 square kilometers total)

Land Resource Unit	Groundwater Available Low Salinity (000m³/day)	Groundwater Available High Salinity (000m³/day)	Component Landforms	Area Percent	Area Square Kilometers	Agricultural Limitations
B	5.8	0	Total	100	386	-
			Alluvial plain	35	123	*
			Eroded alluvial plain	25	105	*
			Small swales/wadi beds	20	79	5
			Rock outcrop	20	79	*
C	9.2	0.4	Total	100	915	-
			Alluvial plain	40	366	*
			Sandsheet	40	366	1
			Active wadi beds	20	183	1
E	43.9	1.9	Total	100	4,617	-
			Rock outcrop	70	3,232	*
			Residual soil	20	924	*
			Small swales/wadi beds	10	461	*
H	0	0.5	Total	100	51	-
			Aeolian sand sheets	30	15	1
			Mobile sand sheets	30	15	*
			Beach wet sabkha	25	13	*
			Sandy dry sabkha	10	5	*
			Lagoonal sediments	5	3	*
K	4.3	10.5	Total	100	1,516	-
			Alluvial plains	50	758	7
			Active wadi beds	40	606	*
			Wet sabkha on deltas	10	152	*
L	1.6	0.3	Total	100	348	-
			Alluvial plains & active wadi beds	60	209	4
			Coastal plain	40	139	5
M	82.5	0.2	Total	100	1,644	-
			Mountain front alluvial fans	50	820	5
			Alluvial plains	30	493	5
			Active wadi beds	15	248	5
			Coastal strip	5	83	5
N	16.5	0	Total	100	208	-
			Alluvial plain	45	94	4
			Playa	45	94	3
			Active wadi beds	10	20	4
O	6.3	0.1	Total	100	254	-
			Active wadi beds	90	229	5
			Terraces	10	25	2
P	12.8	0	Total	100	2,887	-
			Rock outcrop	98	2,830	*
			Active wadi beds	2	57	6
			Total Southwest Subregion		12,826	

* Set aside from further consideration for irrigated agriculture due to limitations considered impossible or highly impractical to remedy.

SOURCE: Prepared by the University of Arizona Team for the Sinai Development Study, Phase I, February, 1983. Appendix A of Volume IV provides further detail.

Land Resource Units of the Southeast Subregion, Groundwater, Landforms, Area and Limitations
(9,895 square kilometers total)

Land Resource Unit	Groundwater Available: Low salinity (000m³/day)	Groundwater Available: High salinity (000m³/day)	Component Landforms	Area: Percent	Area: Square Kilometers	Agricultural Limitations
A	2.8	0.3	Total	100	150	-
			Floodplain	80	123	2
			Active wadi beds	20	27	2
B	5.1	2.2	Total	100	249	-
			Alluvial plain	35	99	*
			Eroded Alluvial plain	25	54	*
			Small swales & wadis	20	48	5
			Rock outcrop	20	48	*
C	0.7	0	Total	100	48	-
			Alluvial plain	40	20	*
			Sand sheet	40	20	1
			Active wadi beds	20	8	1
E	18.5	21.4	Total	100	3,450	-
			Rock outcrop	70	2,415	*
			Residual soil	20	690	*
			Small swales & wadis	10	345	*
M	5.0	0.6	Total	100	555	-
			Mountain front alluvial fans	50	277	5
			Alluvial plains	30	166	5
			Active wadi beds	15	84	5
			Coastal strip	5	28	5
O	6.6	0.3	Total	100	290	-
			Active wadi beds	90	262	5
			Terraces	10	28	2
P	22.2	2.6	Total	100	5,153	-
			Rock outcrop	98	5,050	*
			Active wadi beds	2	103	6
			Total Southeast Subregion		9,895	

* Set aside from further consideration for irrigated agriculture due to limitations considered impossible or highly impractical to remedy.

SOURCE: Prepared by the University of Arizona Team for the Sinai Development Study, Phase I, February, 1983. Appendix A of Volume IV provides further detail.

LAND AND WATER USE CATEGORIES

A. Agriculture: Crops (including cultivated trees)

1. Irrigated

   a. Method: flood
   b. Method: sprinkler
   c. Method: drip
   d. Source: Nile water (canal/pipe)
   e. Source: groundwater (pumped)
   f. Source: runoff water (stored)
   g. Controlled environment (greenhouses, etc.)
   h. Oasis (modified micro-climate)

2. Rainfed (dry farming)

   *a. Direct rainfall
   *b. Waterharvesting from catchment areas
   c. Water table shallow below surface - within root zone

B. Agriculture: Livestock

1. Grazing

   *a. Natural vegetation (grasses, forbs, shrubs)

2. Feeding

   a. Feeding with forage crops
      i. Irrigation
      *ii. Rainfed
   b. Controlled environment (small animal)

C. Fish, water birds and aquatic crops

1. Open water fishing

   a. Offshore
   b. Lagoon (saline water)
   c. Canal
   d. Coral Reef

2. Aquaculture

   a. Ponds (filled with ground or transported water)
   b. Canals (built for irrigation water transport)
   c. Controlled environment (cement ponds, etc.)
   d. Open water (cages, etc.)

3. Mariculture

   a. Salt marsh
   b. Coral reef
   c. Open water (cages, etc.)
   d. Mangrove swamp

4. Conservation

   a. Multiple use management
   b. Preservation

*Subject to further study.

D. Trees, shrubs, and other natural vegetation

*1. Exploitation of natural stands of trees and shrubs for fuel and construction materials

*2. Exploitation of natural stands of shrubs, forbs and grasses for livestock forage

3. Conservation

a. Multiple use management
b. Preservation

E. Wildlife

*1. Exploitation by hunting and trapping

2. Conservation

a. Multiple use management
b. Preservation

F. Tourism

1. Beach and water sports

2. Coral reef diving/snorkeling/glass bottom boats

3. Cultural/historical sightseeing

4. Landscape/wildlife sightseeing

5. Health (hot springs, etc.)

G. Minerals, oil, and construction materials

1. Metals and other minerals mining

a. Underground mines
b. Open-pit mines
c. Seabed harvesting

2. Oil and gas

a. Drilling and pumping - onshore
b. Drilling and pumping - offshore

3. Construction materials

a. Sand and gravel quarrying
b. Limestone/dolomite quarrying
c. Brick-making materials
   i. Clay excavation
   ii. Shale quarrying
d. Building stone quarrying

H. Water management
   1. Dams and dikes
   2. Aquifer recharge areas
   3. Flood protection areas

I. Transportation and Utilities
   1. Roads
   2. Pipelines and canals
   3. Air and sea ports
   4. Electric lines

J. Settlements
   1. Large
   2. Small

K. Institutions
   1. Military bases
   2. Universities
   3. Research facilities
   4. Other

L. Industry
   1. Heavy manufacturing
   2. Minerals and oil processing
   3. Light manufacturing
   4. Agricultural product processing

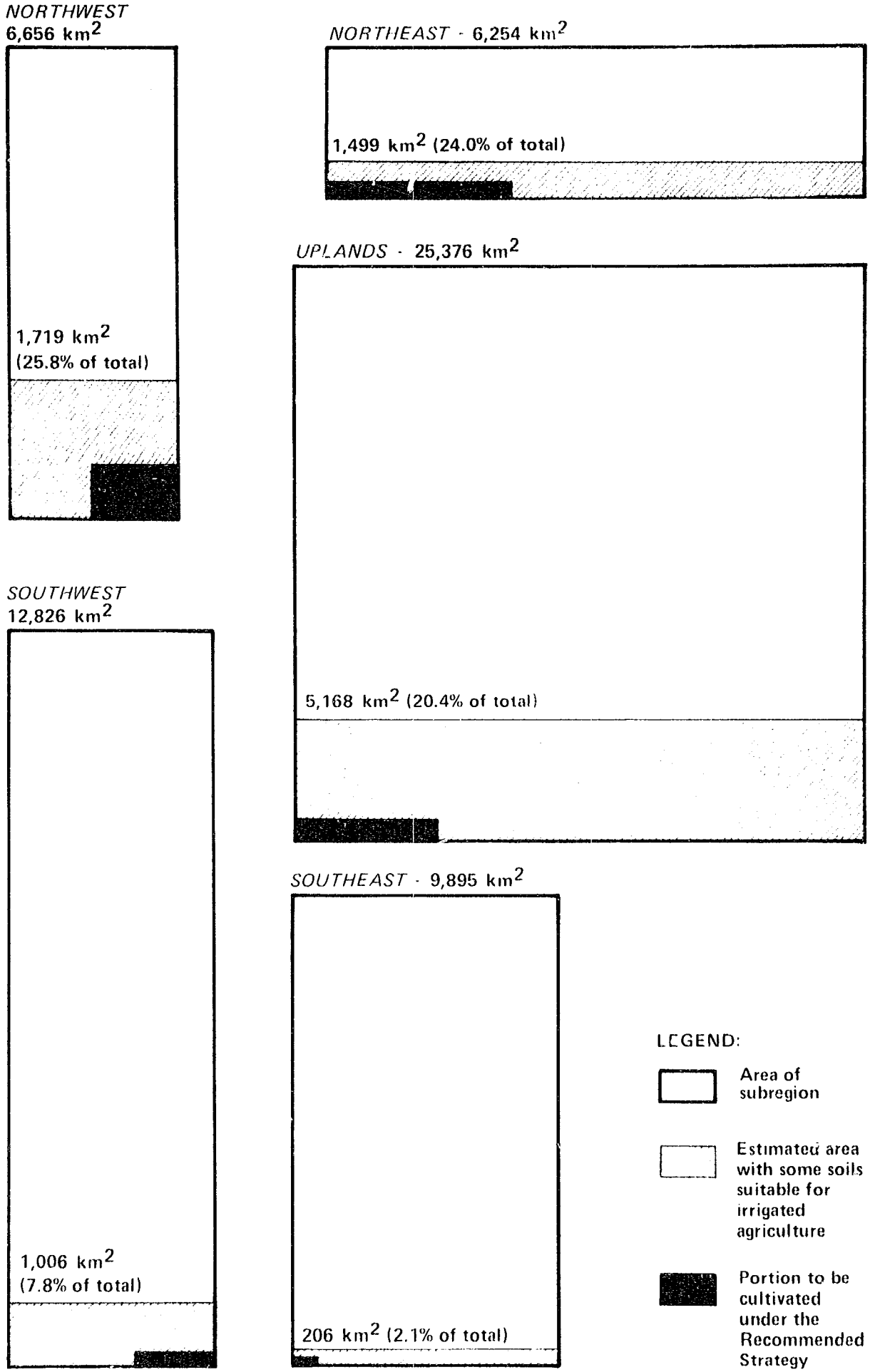
Approximate Size of Areas with Irrigable Soils, by Subregion
(in square kilometers)

Subregion	Area[a]	
	(km^2)	(Percent)
Three Northern subregions, subtotal	8,386	87.4
Northwest	1,719	17.9
Northeast	1,499	15.6
Uplands	5,168	53.9
Two Southern subregions, subtotal	1,212	12.6
Southwest	1,006	10.5
Southeast	206	2.1
TOTAL	9,598	100.0

[a] Areas have been estimated by measuring with a planimeter on maps at a scale of 1,750,000.

Source: Derived from Tables 3-3 through 3-6 of Volume IV, prepared by the Office of Arid Land Studies of the University of Arizona using field reports of the Desert Institute.

Irrigable soils are defined as those having four or less manageable limitations for agriculture. On average perhaps 30 percent will be found suitable on all criteria for irrigated cultivation; however, the scarcity of local water and the expense of bringing Nile water to these soils led the Consultant to recommend a smaller area for irrigation by the year 2000.



PICTOGRAM SHOWING AREA OF EACH SUBREGION
WITH SOILS SUITABLE FOR IRRIGATED AGRICULTURE

Candidate Areas for Irrigated Agriculture

Subregion (Subtotal)	Description	Estimated Net Area That Can Be Reclaimed[a] (000 feddans)
Northwest (71.0)	1. El Tina	20.0
	2. Qantara-Baloza	16.0
	3. East Bitter Lakes	30.0[b]
	4. East of Suez (joins SW-1)	5.0
Northeast (52.0)	1. Romana-El Mazar	20.0
	2. Sheikh Zuwayid-Rafah	15.0
	3. Lower Wadi El Arish: LRU G	7.0
	4. Lower Wadi El Arish: LRU D	10.0
Uplands (156.0)	1. Gifgafa	16.0
	2. Wadi El Bruk: LRU C	47.0
	3. Wadi El Bruk: LRU A	21.0
	4. El Sirr Plain	10.0
	5. Wadi El Hema	5.0
	6. El Hasana	20.0
	7. Middle Wadi El Arish	25.0
	8. Wadi El Gayifa/El Quseima	5.0
	9. Wadi El Gerafi	7.0
Southwest (48.0)	1. East of Suez (joins NW-4)	1.0
	2. Hosh El Bagar/Ramlet Himeiyer Plain	8.0
	3. Abu Rudeis	6.0
	4. Wadi Feiran Delta	8.0
	5. El Qaa Plain	25.0
Southeast (1.7)	1. Wadi Watir, northwest from Nuweiba	0.6
	2. Wadis El Ghaib and Nasb, north and west of Dahab	0.4
	3. Three Wadis west of Nebq	0.7
	TOTAL	328.7[c]

LRU = Land Resource Unit as defined in Volume IV.

[a] The precise number and location of feddans most suitable for major reclamation and irrigation projects will be more clearly defined when REGWA and other soil surveys, now in process, and detailed feasibility studies have been completed.

[b] Including 14,000 feddans already being developed.

[c] In the Recommended Strategy about 10,900 feddans of this total are proposed for irrigation with local groundwater, provided availability is verified. These areas include 4,000 feddans in the northeast subregion, 2,900 feddans in the Uplands, 4,300 feddans in the Southwest and 1,700 feddans in the three wadi systems of the Southeast subregion shown in this table and Figure 2.12.

SOURCE: Derived from SDS-I land capability analysis, summarized in Volume IV, The Land and the Environment of Sinai, especially Chapter 3.

LA-OT 1

Summary of Land Capability by Sector, Subregion, and Land Resource Unit

Land Resource Unit	Agriculture	Minerals	Fishing	Tourism	Conservation	Construction Materials
	NORTHWEST SUBREGION					
C	LC	--	--	--	--	--
E	--	--	--	LC	--	LC
H	LC	LC	LC	LC	--	--
I	LC	LC	LC	--	LC	--
J	--	--	--	--	--	--
Offshore	--	LC	LC	--	--	--
	NORTHEAST AND UPLANDS SUBREGIONS					
A	LC	--	LC	--	--	--
B	--	--	--	--	--	--
C	LC	--	--	--	--	--
D	LC	LC	LC	--	--	--
E	--	--	--	LC	LC	LC
F	--	LC	--	--	LC	LC
G	LC	--	--	--	--	--
H	LC	LC	--	--	--	--
J	--	--	--	LC	LC	--
Bardawil	--	LC	LC	LC	LC	--
Offshore	--	LC	LC	--	--	--
	SOUTHWEST SUBREGION					
B	--	--	--	--	--	--
C	LC	--	--	--	--	--
E	--	LC	--	LC	--	LC
H	LC	LC	--	LC	--	--
K	--	LC	--	LC	--	LC
L	LC	LC	--	--	--	LC
M	--	LC	--	--	LC	LC
N	LC	--	LC	--	--	--
O	LC	--	--	LC	--	LC
P	--	LC	--	LC	LC	LC
Offshore	--	LC	LC	--	--	--
	SOUTHEAST SUBREGION					
A	LC	--	LC	--	--	--
B	--	--	--	--	--	--
C	LC	--	--	--	--	--
E	--	--	--	--	--	LC
M	--	LC	LC	LC	LC	LC
O	LC	--	--	--	--	LC
P	--	LC	--	LC	LC	LC
Offshore	--	--	LC	--	--	--

LC = Some significant land capability potential.

NOTE: Agriculture = irrigated cultivation of food, fiber, and forage crops;
Minerals = minerals, oil, gas, coal, and salt;
Fishing = marine fishing, mariculture, and aquaculture;
Construction Materials = gravel, limestone/dolomite, and building stone.

Feddans Included in the Plan of the Ministry of Development

Location	Feddans already reclaimed	Total	82/83	83/84	84/85	85/86	86/87
TOTAL	11,450	28,200	10,000	2,700	1,500	2,500	11,500
Wadi El Arish	550	1,000	-	-	-	1,000	-
Rawfah Dam	-	2,000	-	-	-	1,000	1,000
East of El Arish	-	3,000	1,000	1,000	1,000	-	-
Wadis Sudr, Feiran and El Qaa	400	1,500	-	-	500	500	500
East of the Bitter Lakes	10,500	10,700	9,000	1,700	-	-	-
El Tina Plain	-	10,000	-	-	-	-	10,000

Source: Dr. Ali Zeid, head of the Sinai Development Authority, describing Ministry of Land Reclamation plans under the current Five Year Plan; Rehabilitation of Sinai, Sinai Symposium, May 1982.

LA-US 3

COMPARISON OF RECLAMATION AREAS EAST AND WEST OF THE SUEZ CANAL 1981

Project	Gross Area (feddans)	Average Altitude (meters)	Ranking Among 63 Reclamation Projects	
			ERR	Water
East Bitter Lakes	30,000	8	51	36
Salhia Desert (alternative)	120,000	14	54	45
Youth Province (alternative)	100,000	50	55	46
East of Suez	55,000	23	56	44
West of Suez (alternative)	40,000	10	36	28

Note: The considerations shown in the table are especially applicable to the approximately 220 center-pivot sprinkler systems recently purchased by The Arab Contractors.
These systems (with drip systems to fill the spaces among the circles) are sufficient to irrigate about 40,000 gross feddans. Of this area, current planning calls for about 12,000 feddans (70 irrigation units) to be located in the Salhia Desert, 10,000 feddans east of the Bitter Lakes, and 18,000 feddans in Youth Province. The relative advantage of the area east of Bitter Lakes over the high-altitude (40- to 70-meter) Youth Province indicates the desirability of postponing the Youth Province reclamation and greatly intensifying activity east of the Bitter Lakes to use the equipment there for accelerated development of the entire 30,000-feddan area.

Source: "Economic Evaluation of Land Reclamation," Master Plan for Water Resources Development and Use (Cairo: Ministry of Irrigation, March 1981).

El Tina Plain -- Key Land Characteristics

Land Resource Unit	Component Soil	Depth (cm)	USDA Texture	Salinity (mmhos/cm)	Permeability	Water Table (meters)
I	1. deltaic and lacustrine deposits (very poorly drained)	0-15	sandy loam	143	moderately rapid	0.4-0.8
		15-35	sandy clay loam	115	moderate	
		35-50	silty clay	115	slow	
I	2. deltaic and lacustrine deposits (poorly drained)	0-30	sand	187	rapid	1.0-2.0
		30-50	loam	176	moderate	
		50-140	sandy clay loam	187	moderate	
		140-300	clay loam	143		
I	3. wet sandy sabkha	0-20	sand	89.3	rapid	0.4-0.8
		20-40	sand	73.3	rapid	
I	4. dry sandy	0-30	sand	4.9	rapid	0.8-1.2
		30-50	sand	8.3	rapid	
		50-90	sand	18.6	rapid	

Source: Analysis by Office of Arid Land Studies, University of Arizona, based on field reports from REGWA.

Potential Reclamation Areas, Using Mainly Nile Water, and Estimated Water Duty

Subregion/reclamation area	Candidate Area[a] (000 Feddans)	Recommended Strategy Feddans (000)	Recommended Strategy Water Duty[b] (Million m^3/Year)
Northwest, Subtotal	71.0	71.0	544.8
1. El Tina	20.0	20.0	
2. Qantara-Baloza	16.0	16.0	
3. East Bitter Lakes[c]	30.0	30.0	
4. East of Suez (Joins SW-1)	5.0	5.0	
Northeast, Subtotal	52.0	52.0	372.8
1. Romana-El Mazar	20.0	20.0	
2. Sheikh Zuwayid-Rafah	15.0	15.0	
3. & 4. Lower Wadi El Arish	17.0	17.0	
Uplands, Subtotal	156.0	51.0	411.3
1. Gifgafa	16.0	16.0	
2. & 3. Wadi El Bruk	68.0	25.0	
4. El Sirr Plain	10.0	10.0	
5. Wadi El Hema	5.0	d/	
6. El Hasana	20.0	d/	
7. Middle Wadi El Arish	25.0	d/	
8. Wadi El Gayifa/El Quseima	5.0	d/	
9. Wadi El Gerafi/El Kuntilla	7.0	d/	
Southwest, Subtotal	48.0	15.0	170.6
1. East of Suez (Joins NW-4)	1.0	1.0	
2. Ramlet Himeiyir Plain	8.0	d/	
3. Abu Rudeis	6.0	6.0	
4. Wadi Feiran Delta	8.0	8.0	
5. El Qaa Plain	25.0	d/	
Southeast, Subtotal	d/	d/	-
TOTAL	327.0	189.0[e]	1,499.5[e]

a/ The precise number and location of feddans most suitable for major reclamation and irrigation projects will be more clearly defined when REGWA soil surveys (now in progress) and detailed feasibility studies have been completed

b/ Calculations assume a combination of irrigation methods appropriate to each area and estimated evapotranspiration rates based on climatic data for each area. Imported (Nile) water only; groundwater usage (and feddanage) shown on Table 4-5, Volume III.

c/ Includes 14,000 feddans already under development.

d/ Development to be initiated with local groundwater and "managed" runoff.

e/ An additional 10,900 feddans are recommended as the initial target for irrigation with groundwater, including 1,700 feddans in the Southeast subregion. Another 2,000 feddans will be cultivated with "managed runoff", mainly in the Uplands. The total water duty for these 12,900 feddans is estimated at 90.5 million cubic meters per year. (See Table A-8, Volume V.)

SOURCE: Calculations by the Consultant. See also the land capability analysis, summarized in Volume IV, The Land and the Environment of Sinai (especially Chapter 3), and the water resources analysis in Volume V, Water Supplies and Costs (especially Table A-8).

Areas Recommended for Agricultural Development Using Local Groundwater Supplemented by Runoff a/

Number	Area b/	Estimated Groundwater c/ (000 m^3/day)	Supplemental Runoff Potential d/	Agricultural Soil Quality d/	Estimated Feddans Cultivated e/ (000)
	Northwest f/	--	n.a.	n.a.	--
	Northeast, subtotal	55.0	n.a.	n.a.	4.0
1.	Rafah Strip	30.0	--	+++	2.0
2.	Wadi El Arish Delta	25.0	--	++	2.0
	Uplands, subtotal	222.0	n.a.	n.a.	2.9
6+40.	Gebel El Maghara (also 5)	56.0	+++	+++	0.9
7.	Gebel El Halal (also 15+42)	15.0	+++	+++	0.5
8.	Gebels Yelleq + Fallig	20.0	+++	+++	0.6
11.	Gebels Burga + Taliat El Bedan	12.0	+++	+++	*
12.	Central Sinai (also 44)	55.0	+++	+++	0.2
13+16.	El Quseima (also 44)	6.0	+++	+++	0.1
17.	El Kuntilla (also 12+44)	15.0	+++	+++	0.6
23.	South Central Sinai (also 45)	43.0	+++	+++	*
	Southwest, subtotal	180.0	n.a.	n.a.	4.3
21+22.	Wadis Sudr + Wardan Deltas	10.0	--	+	*
26.	Wadi Gharandal	2.0	--	+	*
24.	Gebel Somar-Gebel Igma	37.0	+	+++	*
33.	El Qaa Plain	110.0	-	++	4.0
28-30.	Abu Rudeis	8.0	-	++	*
31.	Wadi Feiran	10.0	-	++	0.3
32.	Gebel Katherina	3.0	-	+	*
	Southeast, subtotal	17.6	n.a.	n.a.	1.7
39.	Wadi Watir (Nuweiba)	3.9	+++	++	0.6
37+38.	Wadis Ghaib + Nasb (Dahab)	6.6	+++	++	0.4
36.	Wadi Kid + Umm Adawi (Nebq)	4.6	+++	++	0.7
35.	Sharm El Sheikh	2.5	+	++	--
	Totals	474.6 g/	n.a.	n.a.	12.9

a/ Table illustrates the type of analysis which can be refined after more detailed soil and groundwater studies are completed.

b/ Areas very broadly defined. See Volume V, Figures 2.5 to 2.7 for locations. Other areas may be selected as more promising after results of detailed groundwater and soil studies are available.

c/ See Tables 2-12 (Case II) and A-4 for details; all estimates very rough until aquifers are studied thoroughly.

d/ Evaluation by Consultant based on reconnaissance studies. "+" indicates positive indication; "++" more promising, etc. "-" indicates no significant runoff potential foreseen. See Volumes IV and V for analysis of soil quality and groundwater availability.

e/ Preliminary estimates. See also Table 4-5 of Volume III and A-7 of Volume V.

f/ Development foreseen mainly with Nile water until exploration verifies reliable sources of groundwater.

g/ Total/days differs from annual equivalent in Tables A-7 of Volume V because of additional allowance for runoff and differences in days-pumping each year. Similarly, total differs from Table 2-9 of Volume V, where recharge (not availability) is estimated.

n.a. Not applicable.

* Small areas to be developed as groundwater availability close to suitable soils at reasonable cost is verified.

Source: Estimates by the Consultant.

SINAI'S IRRIGATED AGRICULTURE POTENTIAL BASED UPON SOILS RECONAISSANCE STUDIES

Land Resource Unit	Landform Component	Candidate Area for Cultivation (feddans) (000)	Limitations	Prime Crops	Preferred Method of Irrigation
A. Higher elevation wadis, including El Bruk, El Arish, El Gayifa, and El Gerafi	Flood plain	139	High salinity	Olives, almonds, grapes, dates, pomegranates, figs, kale, tomatoes, peppers, spinach	Drip
	Active wadi beds	35	High $CaCO_3$	Barley, cotton	Sprinkler
	Active wadi beds	35	High $CaCO_3$	Barley, cotton	Sprinkler
C. Upland plains, including Remlet Himeiyir and parts of middle Wadi El Arish	Sandsheet	210	Coarse	Figs, olives, citrus, tomatoes, carrots, beets, onions	Drip
	Active wadi beds	105	Steep slopes Flood risk	Deciduous fruits, nuts, avocado, beans	Drip
D. Northeast corner, south of Rafah Strip; part of Lower Wadi El Arish	Alluvial sand	59	High $CaCO_3$	Olives, grapes, almonds	Drip
	Active wadi bed	22	High $CaCO_3$ Flood risk Stoney	As above, especially on margins	Drip
G. Part of Lower Wadi El Arish	Alluvial soil on lower terraces	4	High salinity	Dates, vegetables, figs, olives	Drip
				Barley, cotton, wheat, sorghum, alfalfa, berseem	Sprinkler
H. East of Suez Canal, North Coast west of El Arish	Aeolian Sandsheet	66	Coarse	Vegetables	Drip
I. El Tina Plain (between Port Said and El Qantara)	Deltaic and lacustrous deposits	29	Salinity High water table	Wheat, rice, vegetables, fodder, root crops	Drip
L. Abu Rudeis; mouth of Wadi Feiran	Alluvial plain and active wadi bed	15	Coarse, High sodium Stoney Flood risk	Tomatoes, beets	Drip
N. El Qaa Plain	Alluvial plain	7	Coarse Gravel High salinity High sodium	Dates, figs, olives, pomegranates	Drip
	Playa	7	High salinity High sodium Shallow	Dates, figs, olives, beets, pomegranates, tomatoes, peppers	Drip
	Active wadi bed	2	Coarse High salinity High sodium Flood risk	Wheat, cotton, alfalfa, barley, tomatoes, beets	Sprinkler and Drip
O. Aqabah Wadis	Terraces	4	High salinity Shallow	Figs, pomegranates, olives, tomatoes, peppers, beets	Drip
TOTAL		704			

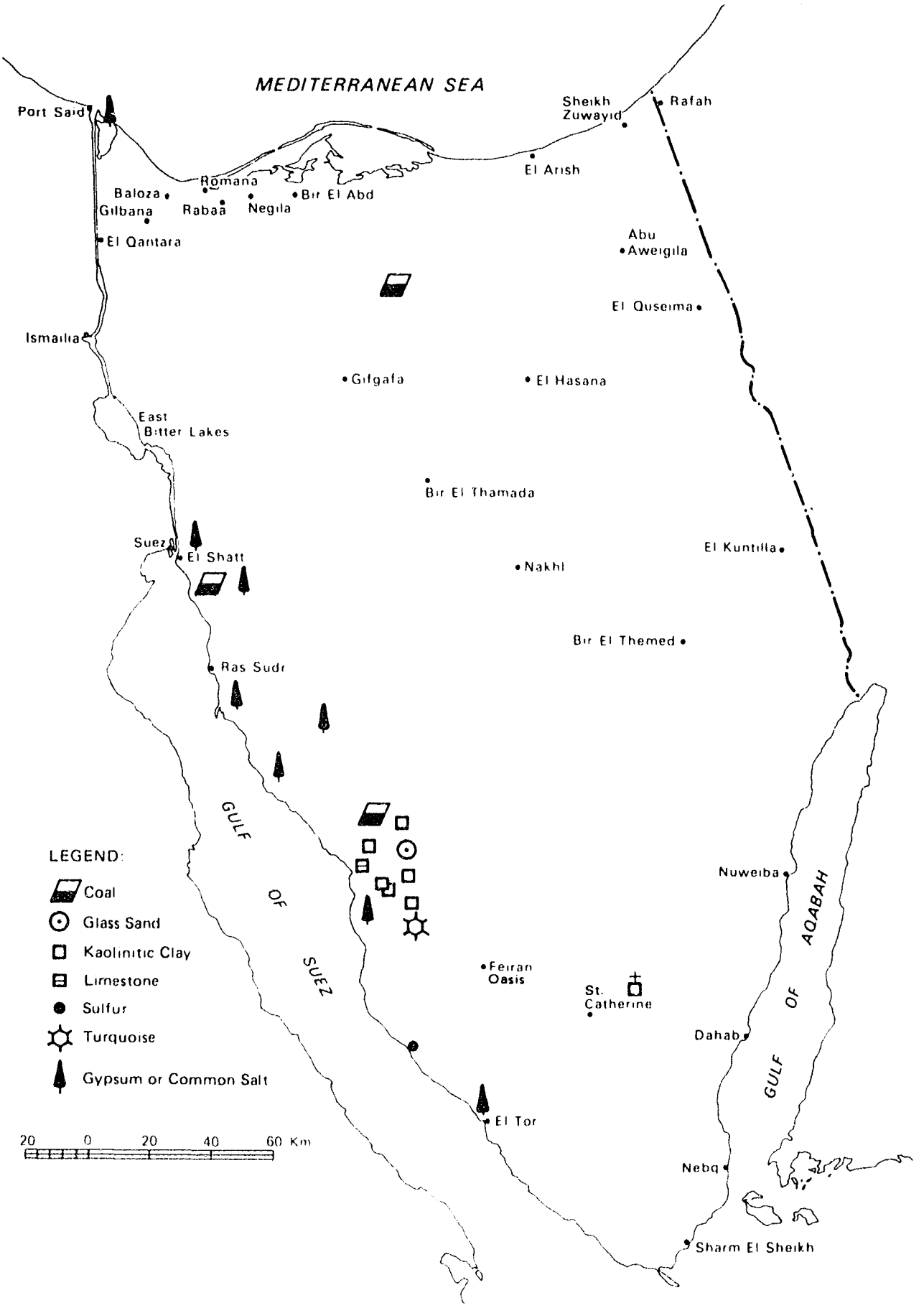
Source: Calculations by Consultant. Further detail is in Volume IV, see especially Chapter 3, Table 3-8, and Appendices A, B, and C.

LA-MI 1
Nonmetallic Mineral Occurrence Summary
1981

Location No.	Name of Locality	Ore Deposit	Comments
1	Port Said	Common salt	Under exploitation, major saline source
2	El Maghara	Coal	37-million-ton estimated reserve
3	El Shatt	Gypsum	Exploited until 1967
4	Wadi Rayana	Gypsum	--
5	Ayun Musa	Coal	Deep-seated seams, 40-million-ton estimated reserve
6	Ras Matarma	Gypsum	--
7	Gharandal	Gypsum	Exploited until 1967
8	Ras Malaab	Gypsum	240-million-ton estimated reserve, exploited until 1967
9	Beda and Thora	Coal	75-million-ton estimated reserve of carbonaceous shales
10	Farsh El Ghozlan	Kaolinitic clay	Exploited until 1967
11	El Khabouba	White sands	Exploited until 1967
12	Musabba Salama	Kaolinitic clay	Exploited until 1967
13	Abu Zenima	Limestone	--
14	Budra	Kaolinitic clay	Exploited until 1967
15	Abu Natash	Kaolinitic clay	Exploited until 1967
16	El Deheissa	Kaolinitic clay	--
17	Gini	Kaolinitic clay	--
18	Wadi Sidri	Gypsum	40-million-ton estimated reserve
19	Sarabit El Khadim	Turquoise	Under exploitation since ancient Egyptian times
20	Abu Durba	Sulfur	--
21	Abu Suweira	Gypsum	--

Note: See figure following this table.

Source: Mineral Map of Egypt With Descriptions (Cairo: Geological Survey and Mining Authority of Egypt, 1979).



NONMETALLIC MINERAL OCCURENCES IN SINAI

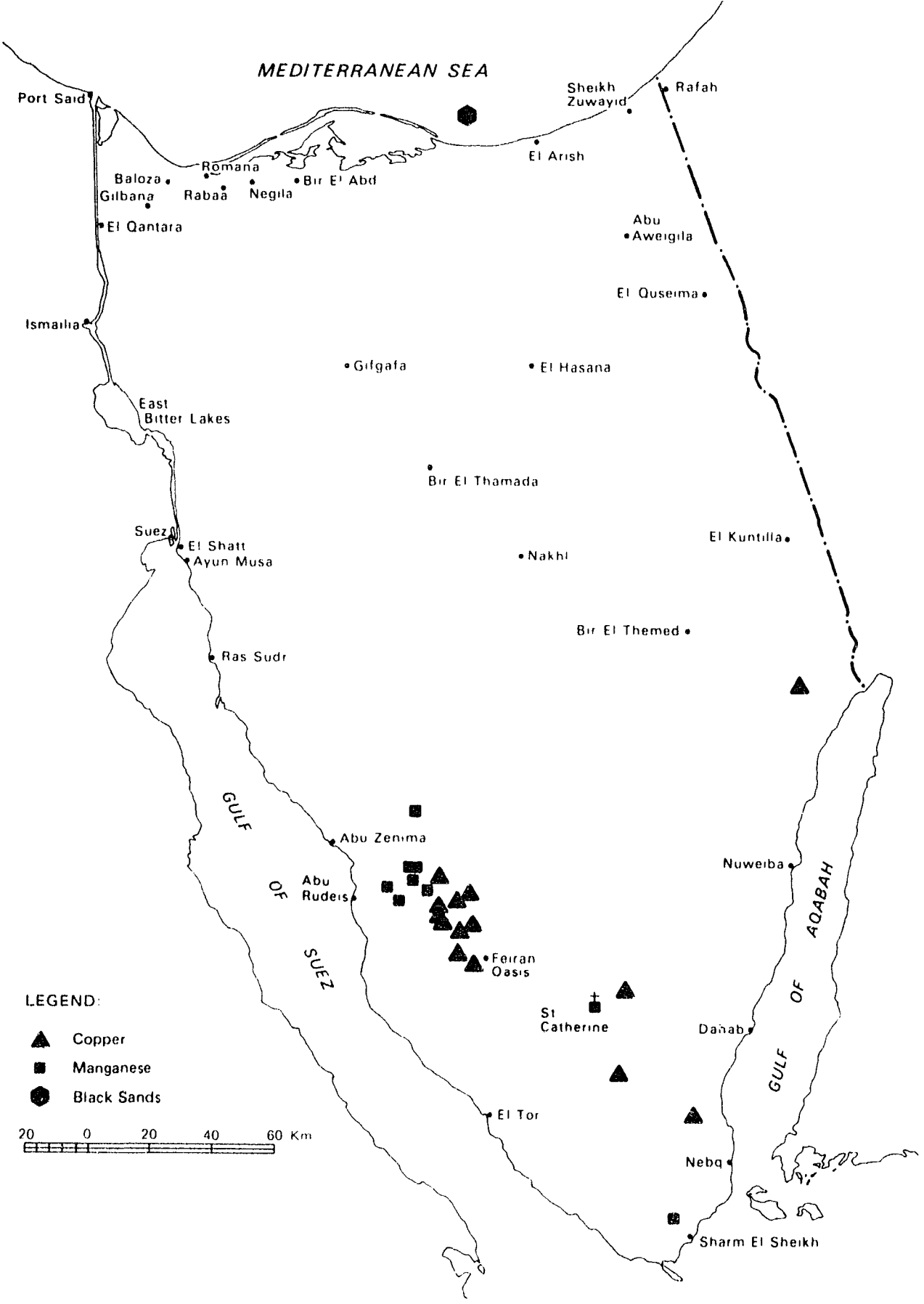
Dames & Moore

Metallic Mineral Occurrence Summary
1981

Location No.	Name of Locality	Ore Deposit	Comments
1	Wadi El Arish	Black sands	Preliminary field and laboratory studies undertaken
2	Umm Bugma	Manganese	Largest manganese reserves in Egypt, discovered 1898; production began in 1908; production from 1911 to 1967 totaled 5.5 million tons; 4-million-ton reserve
3	Wadi Nassib	Manganese	See comments for location no. 2
4	Wadi El Noaman	Manganese	See comments for location no. 2
5	Wadi El Shallala	Manganese	See comments for location no. 2
6	Gebel Abu Qafas	Manganese	See comments for location no. 2
7	Wadi El Husseni	Manganese	See comments for location no. 2
8	Gebel El Adidiya	Manganese	See comments for location no. 2
9	Sarabit El Khadim	Copper	Ancient workings
10	Abu Suweira	Copper	--
11	Abu Rudeis	Copper	--
12	Rashidia	Copper	--
13	Abu Zagatan	Copper	--
14	Tawilleh	Copper	--
15	Abu El Nimran	Copper	--
16	Tarfa	Copper	--
17	Tarr	Copper	--
18	Feiran Oasis	Copper	--
19	East of El Igma	Copper	Ancient mine
20	Regeita	Copper	Ancient mine, 0.21 to 8.85% copper
21	Rahaba	Copper	--
22	Samra	Copper	Ancient mine
23	Sharm El Sheikh	Manganese	Small reserves

Note: See Figure following table.

Source: Mineral Map of Egypt With Descriptions (Cairo: Geological Survey and Mining Authority of Egypt, 1979).



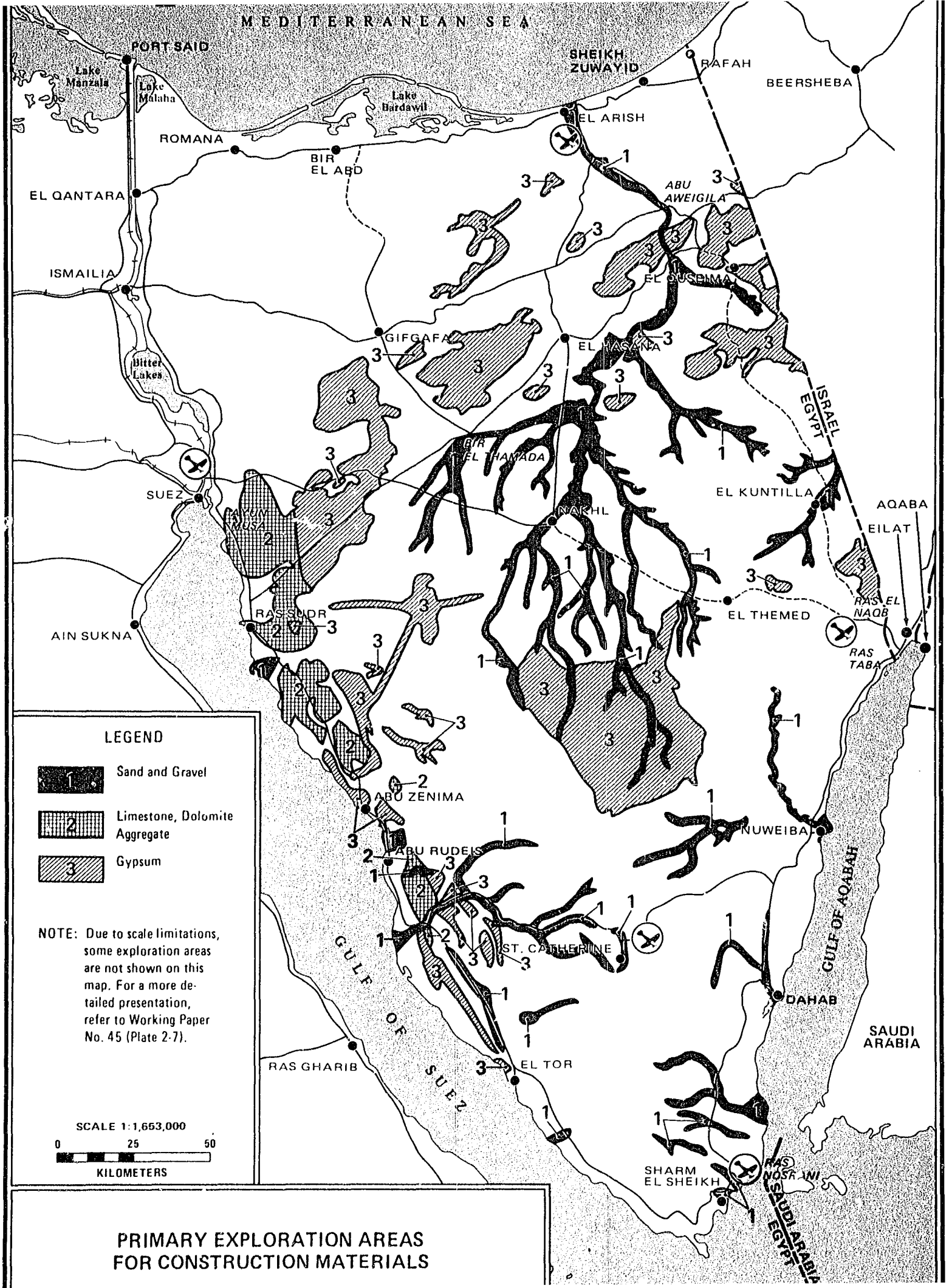
METALLIC MINERAL OCCURENCES IN SINAI

Dames & Moore

Correlation of Geology and Ore Deposits in Sinai and the Red Sea Area of Egypt 1978

Stratigraphy	Lithology	Ore Deposits
Cenozoic		
Pleistocene Pliocene	Raised beaches, terraces, gravel, limegrit, marl	Lead, zinc (Umm Gheig)
Miocene	Gypsum; limegrit, reef limestone; conglomerate, limegrit	Lead, zinc (Umm Gheig)
UNCONFORMITY		
	Clay, sandstone	Nepheline syenite (carbonatite)
Eocene	Limestone and chert, shale	
Mesozoic		
Danian	Chalk, Esna shale	
Maestrichtian	Phosphate formation, marl, limestone, chert	Phosphate beds (Quseir, Safaga)
Campanian	Quseir variegated shale	Iron (Aswan)
Cenomanian	Nubian sandstone and shale	
MAJOR UNCONFORMITY		
Lithostratigraphy		
Proterozoic		
Younger granite (Gattarian)	Riebeckite granite, micropegmatitic granite, albite, muscovite granite	
		Tantalum-tin-tungsten vein and apogranite (Abu Dabbab)
Hammamat Group	Polymictic conglomerate, graywacke, volcanic sandstone, siltstone, marble	
UNCONFORMITY		
Dokhan volanics	Basalt, andesite, dacite, latite flows, related pyroclastics	Ironstone (Wadi Karim) Copper-zinc-lead-silver massive sulfide body (Umm Samiuki) Talc (Atshan)
Older granite (Shaitian granite)	Gray biotite, hornblende granite, granodiorite	
Metagabbro diorite complex	Gabbro, ep. diorite, diabase	
Barramiya serpentinite	Serpentinite, dolomitic marble	
Wadi Mubarak geosynclinal metasediments	Sericite chlorite schist, phyllite, graywacke	
Shadit geosynclinal metavolcanics	Greenstone, pyroclastics	Chromite
		Ilmenitite (Abu Ghaqa) Nickel-copper-sulfide body (Gabbro Akarem)
Migif Hafafit paragenesis and migmatite	Schist, gneiss, amphibolite, leptynite, quartzite	Anthophyllite, vermiculite
		(Hafafit)
	Granite, orthogenesis	

Source: A. M. S. Al Shanti, W. Frisch, W. Pohl, and A. Tawab, Precambrian Ore Deposits in the Nubian and the Arabian Shields and Their Correlation Across the Red Sea, No. 3 (Vienna: Schriften d. Erdwiss. Komm. d. Osterr. Akad. d. Wiss (Earth Sciences Committee of the Austrian Academy of Science), 1978).



PRIMARY EXPLORATION AREAS FOR CONSTRUCTION MATERIALS

Characteristics of Coal From the El Maghara Mine

	As Received	Dry	Dry, Ash Free
Proximate analysis (%)			
Moisture	4.9	--	--
Ash	6.5	6.8	--
Volatiles	50.7	53.3	57.2
Fixed carbon	37.9	39.9	42.8
Ultimate analysis (%)			
Moisture	4.90	--	--
Ash	6.50	6.84	--
Carbon	70.66	74.33	81.98
Hydrogen	5.67	5.96	6.58
Nitrogen	1.04	1.09	1.21
Combustible sulfur	2.97	3.12	0.65
Oxygen (by difference)	8.26	8.69	9.58
Kilocalories per kilogram[a]			
Gross	7,215	7,610	8,476
Net	6,890	7,292	8,082

[a]Equivalent values (Btu/lb): gross, 12,990, 13,700, 15,260; net, 12,400, 13,120, 14,550.

Source: Maghara Coal Project Report on Reserves and Relevant Geology (Cairo: Powell Duffryn Technical Services, Ltd., for the General Organization for Industrialization, May 1966).

Natural Gas Availability in the Eastern Gulf of Suez Area

1980 - 2000

Field	Production (million standard cubic feet/day)			
	1980	1985	1990	1995
El Belayim area Petrobel marine field	31	25	21	17
Abu Rudeis area Locations 195, 185, 173	9	20	7	0
Shoab Ali area Alma field	10	9	1	0
TOTAL	50	54	29	17

Note: These data were presented to the Supreme Council for Energy in February 1981.

REFERENCES: LAND

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List of Volumes:

I	Geology		
II	Hydrogeology	A:	Text and Chemical Data
		B:	Information Sheets
III	Soils	A:	El Arish
		B:	El Bardawil & El Bruk
		C:	El Gifgafa & El Giddi
		D:	Nakhl & Sudr
		E:	El Qaa, Feiran & East of Suez Canal
IV	Ecology		
V	Plant Production		
VI	Animal Production		

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Richards, L.A. et al. 1954. Diagnosis and Improvement of Saline and Alkali Soils. Agriculture Handbook 60, U.S. Salinity Laboratory, U.S. Department of Agriculture, Riverside, California.

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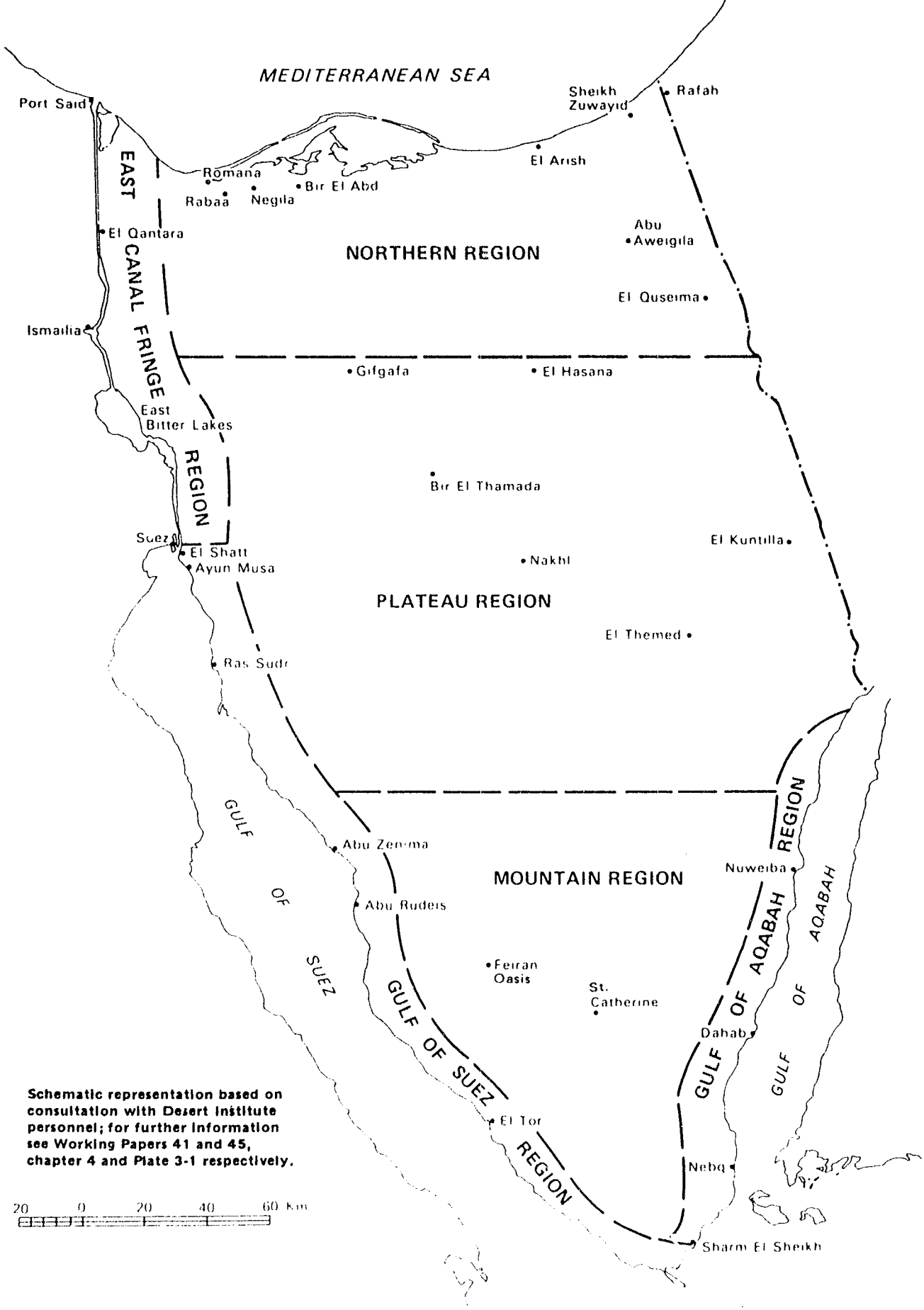
B. ENVIRONMENT (EN)

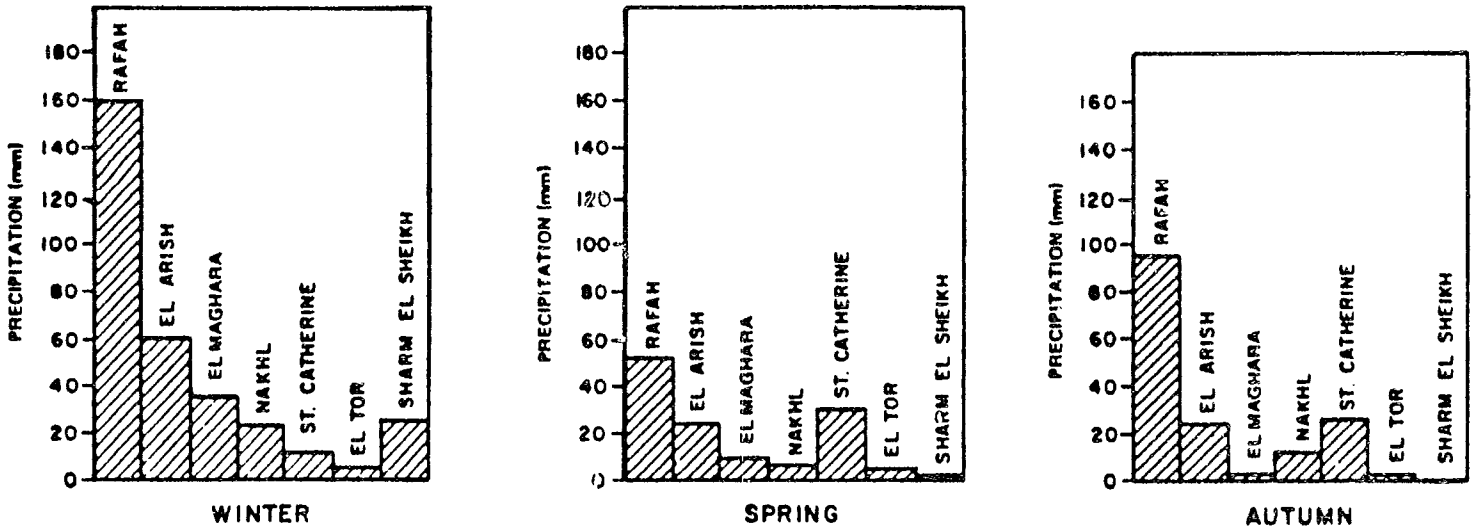
CLIMATE



Schematic representation based on consultation with Desert Institute personnel; for further information see Working Papers 41 and 45, chapter 4 and Plate 3-1 respectively.

CLIMATIC REGIONS OF SINAI

Dames & Moore



Source: Climatological Normals, The Arab Republic of Egypt, 1975 (Cairo: Meteorological Authority, 1975).

SEASONAL PROFILES OF PRECIPITATION IN SINAI

Dames & Moore

Summary of Rainfall and Evaporation Data for Stations in and Adjacent to Sinai

No.	Station	Mean Annual Rainfall (mm)	Standard Deviation of Mean Rainfall (mm)	Minimum Seasonal Rainfall (mm)	Maximum Seasonal Rainfall (mm)	Average Number of Days/Year With Rainfall			Maximum Daily Rainfall (mm)	Average Daily Evaporation (mm)[a]
						≥0.1 mm	≥1 mm	≥10 mm		
1	Port Said	79.0	--	44.0	165.0	23.3	15.3	1.5	58.0	5.3
2	Ismailia	37.7	--	--	--	11.2	8.3	0.4	50.8	7.6
3	Fayid	25.5	--	--	--	--	5.4	0.5	32.4	--
4a	Suez (old)	24.7	--	Trace	82.0	6.9	5.3	--	31.0	9.2
4b	Suez (new)	19.6	--	--	--	9.4	3.2	0.2	49.6	11.5
5	Abu Rudeis	21.5	--	--	--	6.2	3.1	0.3	32.9	10.0
6	El Tor	10.4	11.0	0.0	52.0	2.9	1.7	0.4	37.4	9.5
7	Sharm El Sheikh	23.8	--	--	--	--	3.0	--	20.4	--
8	St. Catherine	62.0	--	--	--	--	10.1	--	76.2	--
9	Ras El Naqb	27.7	23.2	0.0	97.0	--	5.2	--	15.0	--
10	El Kuntilla	23.3	21.1	2.0	76.0	--	4.9	--	32.0	--
11	El Themed	29.0	40.0	0.0	313.0	--	3.2	--	142.0	--
12	Nakhl	22.1	16.4	0.0	68.0	10.6	4.5	1.0	22.7	11.4
13	El Hasana	27.9	17.2	10.0	77.0	--	4.5	--	32.0	--
14	El Maghara	43.7	--	--	--	15.0	12.1	0.0	9.0	11.4
15	El Arish	99.7	37.6	Trace	214.0	22.0	17.8	3.7	59.0	4.6
16	Abu Aweigila	57.8	--	--	--	--	6.6	--	49.0	--
17	El Quseima	63.4	29.1	25.0	123.0	20.2	10.2	2.9	24.2	9.0
18	Rafah	304.1	--	--	--	--	34.7	--	37.0	--
19	Gaza	336.5	--	237.0	497.0	43.0	35.4	8.4	84.2	4.9
20	Beersheva	195.0	--	42.0	339.0	35.1	27.3	5.9	66.0	7.9
21	Shivta	86.0	--	26.0	153.0	--	--	--	--	--
22	Avdat	83.0	--	25.0	161.0	--	--	--	--	--
23	Eilat	50.0	--	6.0	98.2	--	--	--	--	--

[a]Measured with a Piche evaporometer.

Source: Derived from data in Tables 2-4 and 2-5 of Working Paper 33 in the SDS-I project files. Specific references are provided for each of the numerous data entries.

Estimated Rainfall Parameters for Basin Areas - 1981

No.	Basin Area[a]	A Area (km^2)	P Total Mean Annual Rainfall (mm)[b]	N_s Average No. of Days/Yr With Rainfall (≥10 mm)	P_s Estimated Average Rainfall Per Storm (≥10 mm)	Estimated Mean Annual Rainfall for Storms (≥10 mm)	(<10 mm)
	El Arish Upper Basin						
1a	El Bruk	3,345	27.7	1.08	13.5	14.6	13.1
1b	El Ruaq	6,481	28.0	1.02	18.3	18.7	9.3
1c	El Aqabah	2,839	26.4	0.90	19.3	17.4	9.0
1d	Geraia	3,641	28.0	1.25	13.2	16.5	11.5
1e	Israeli portion	45	40.0	1.78	13.2	23.5	16.5
	El Arish Lower Basin						
2a	Portion within Sinai	2,749	64.0	2.49	18.2	45.3	18.7
2b	Portion within Israel	1,253	64.0	2.33	19.3	45.0	19.0
3	Northeast coast	963	154.0	4.60	23.0	105.8	48.2
4	North coast	5,148	63.0	2.05	18.0	36.9	26.1
5	Hegayib	1,680	35.8	1.25	15.5	19.4	16.4
6	El Hasana-El Hamma	3,549	45.0	1.56	17.9	27.9	17.1
7	El Gerafi	2,446	26.7	1.00	17.3	17.3	9.4
8	Wasit	4,204	36.5	1.34	19.3	25.9	10.6
9	Dahab	2,684	53.5	2.04	17.8	36.3	17.2
10	Kid	1,355	49.0	1.87	17.8	33.3	15.7
11	Umm Adawi	964	39.0	1.45	18.5	26.8	12.2
12	El Qaa	3,904	31.6	1.14	20.2	23.0	8.6
13	Abu Durba	266	13.0	0.32	25.0	8.0	5.0
14	Feiran	1,717	47.0	1.59	23.4	37.2	9.8
15	Sidri	1,163	36.0	1.19	23.5	28.0	8.0
16	Baba	841	33.6	1.11	23.5	26.1	7.5
17	Tayiba	860	26.5	0.62	29.1	18.0	8.5
18	Gharandal	829	26.5	0.67	27.8	18.6	7.9
19	Wardan	1,569	24.0	0.60	27.8	16.7	7.3
20	Sudr	895	22.1	0.40	33.8	13.5	8.6
21	Lahata	603	22.1	0.40	33.8	13.5	8.6
22	El Raha	847	24.0	0.43	33.8	14.5	9.5
23	El Hagg	621	25.5	0.46	32.1	14.8	10.7
24	El Giddi	703	27.5	0.50	31.2	15.6	11.9
25	Umm Khisheib	4,641	41.0	0.96	25.0	24.0	17.0
	SINAI[b]	61,507	39.4	1.33	20.1	26.7	12.7

[a]Refer to Plate 5-2 in Working Paper 45 of the Sinai Development Study - Phase I for basin-area locations and boundaries.
[b]Excluding subbasins 1e and 2b.

Source: Total Mean Annual Rainfall Estimated from the isohyetal contour map (Plate 3-3) in Working Paper 45 of the Sinai Development Study - Phase I.

Annual Rainfall at El Arish From 1908 to 1966

(mm)

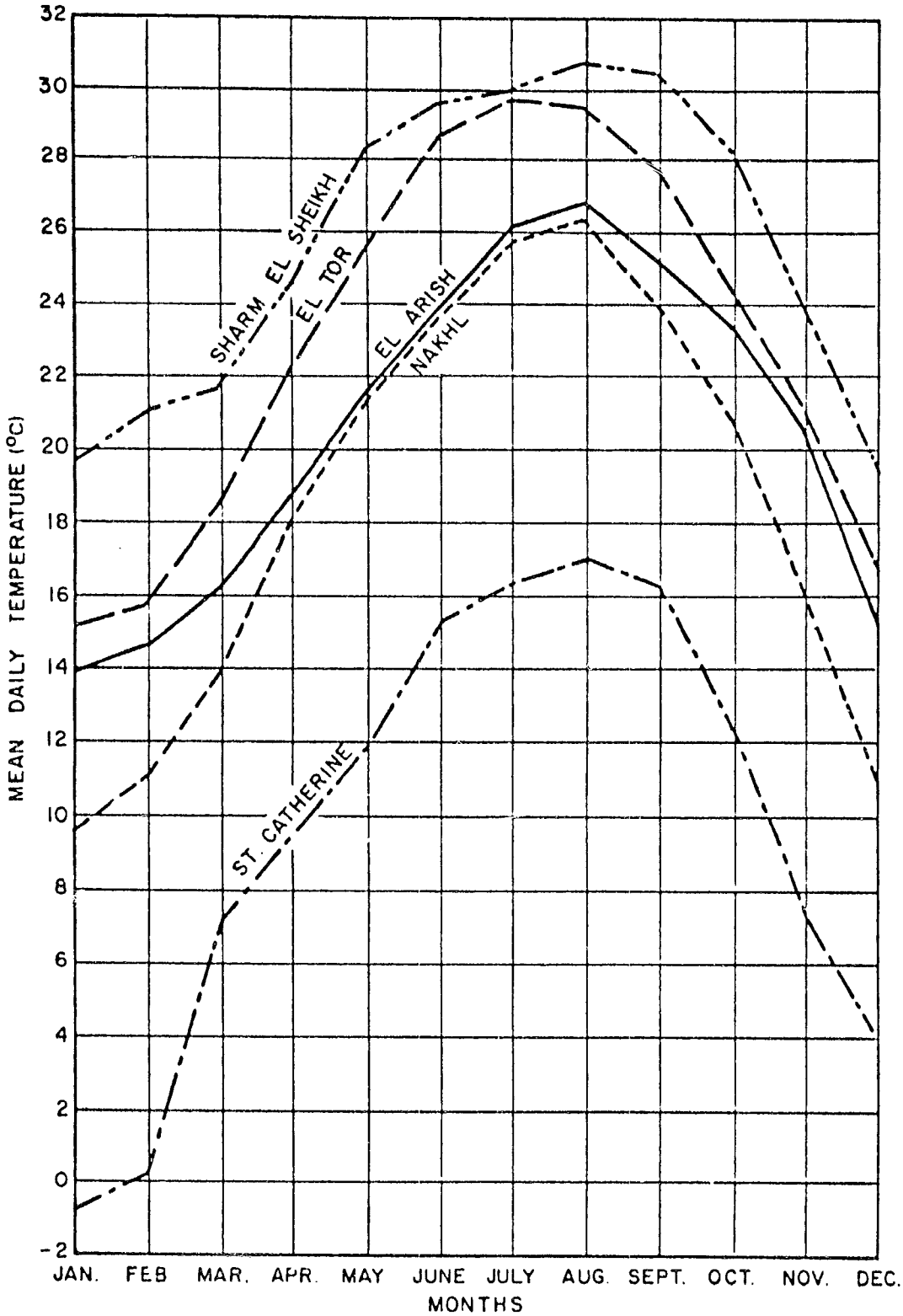
Year	Annual Rainfall (mm)	Year	Annual Rainfall (mm)
1908	126	1939	104
1909	65	1940	94
1910	122	1941	108
1911	136	1942	98
1912	92	1943	121
1913	101	1944	210
--	--	1945	--
1919	65	1946	--
1920	166	1947	37
1921	121	1948	87
1922	86	1949	80
1923	80	1950	127
1924	95	1951	45
1925	114	1952	64
1926	101	1953	126
1927	95	1954	113
1928	64	1955	130
1929	80	1956	--
1930	110	--	--
1931	69	1959	108
1932	58	1960	46
1933	82	1961	150
1934	78	1962	55
1935	37	1963	155
1936	61	1964	128
1937	123	1965	193
1938	126	1966	63

Source: Climatological data files (Cairo: Ministry of Irrigation, Nile Control General Directorate, 1981).

Annual Rainfall at El Tor From 1920 to 1966
(mm)

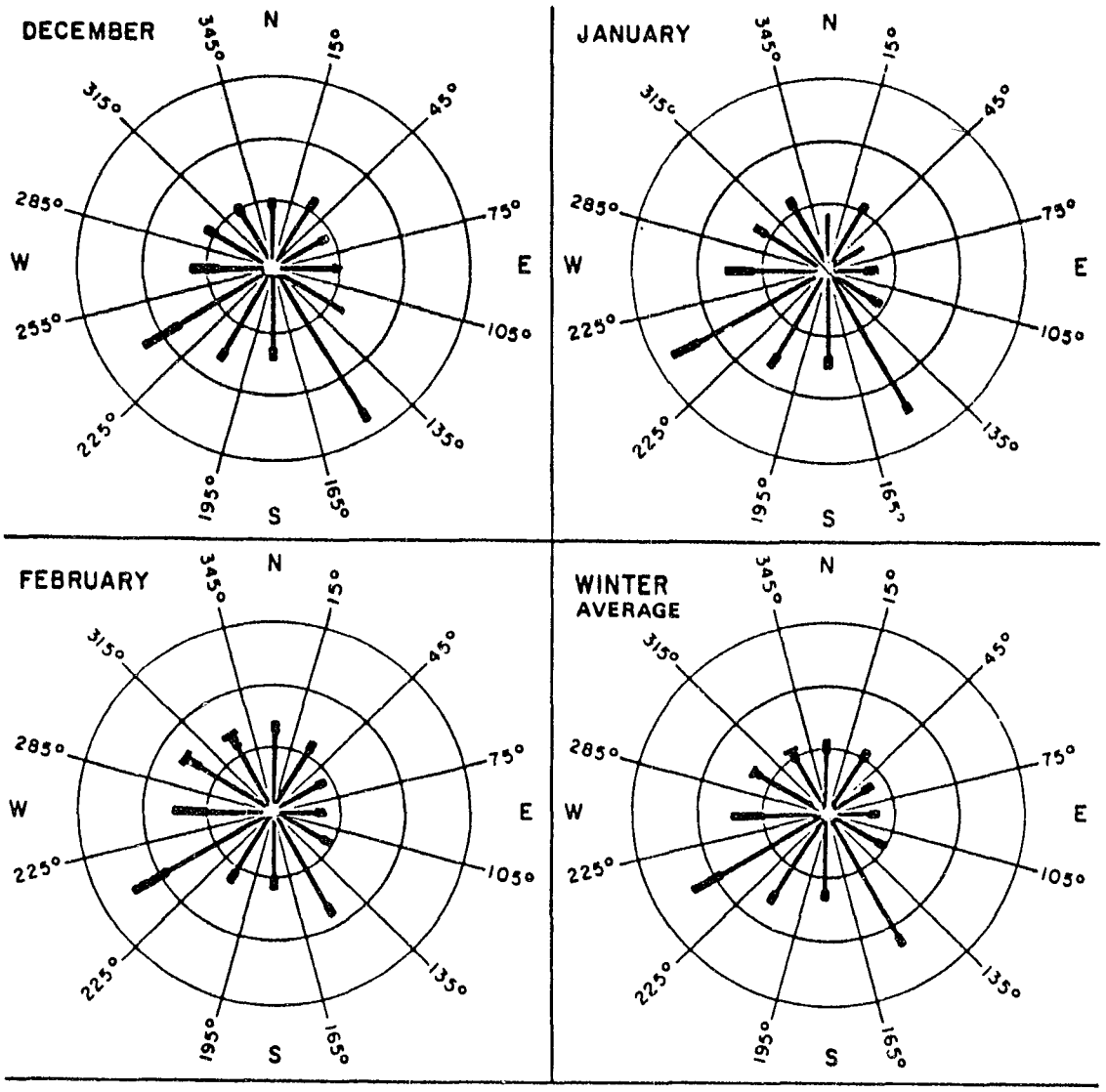
Year	Annual Rainfall (mm)	Year	Annual Rainfall (mm)
1920	27	1944	--
1921	8	1945	--
1922	5	1946	0
1923	13	1947	2
1924	17	1948	0
1925	38	1949	Trace
1926	14	1950	4
1927	9	1951	1
1928	8	1952	--
1929	9	1953	6
1930	24	1954	29
1931	4	1955	34
1932	3	1956	--
1933	11	1957	--
1934	12	1958	4
1935	2	1959	8
1936	3	1960	Trace
1937	11	1961	15
1938	30	1962	Trace
1939	15	1963	21
1940	10	1964	5
1941	43	1965	10
1942	11	1966	6
1943	4		

Source: Climatological data files (Cairo: Ministry of Irrigation, Nile Control General Directorate, 1981).



Source: Derived from meteorological station data.

MEAN TEMPERATURE PROFILES AT
FIVE STATIONS IN SINAI



LEGEND:

PERCENT FREQUENCY OF DIFFERENT SURFACE WIND SPEED RANGES

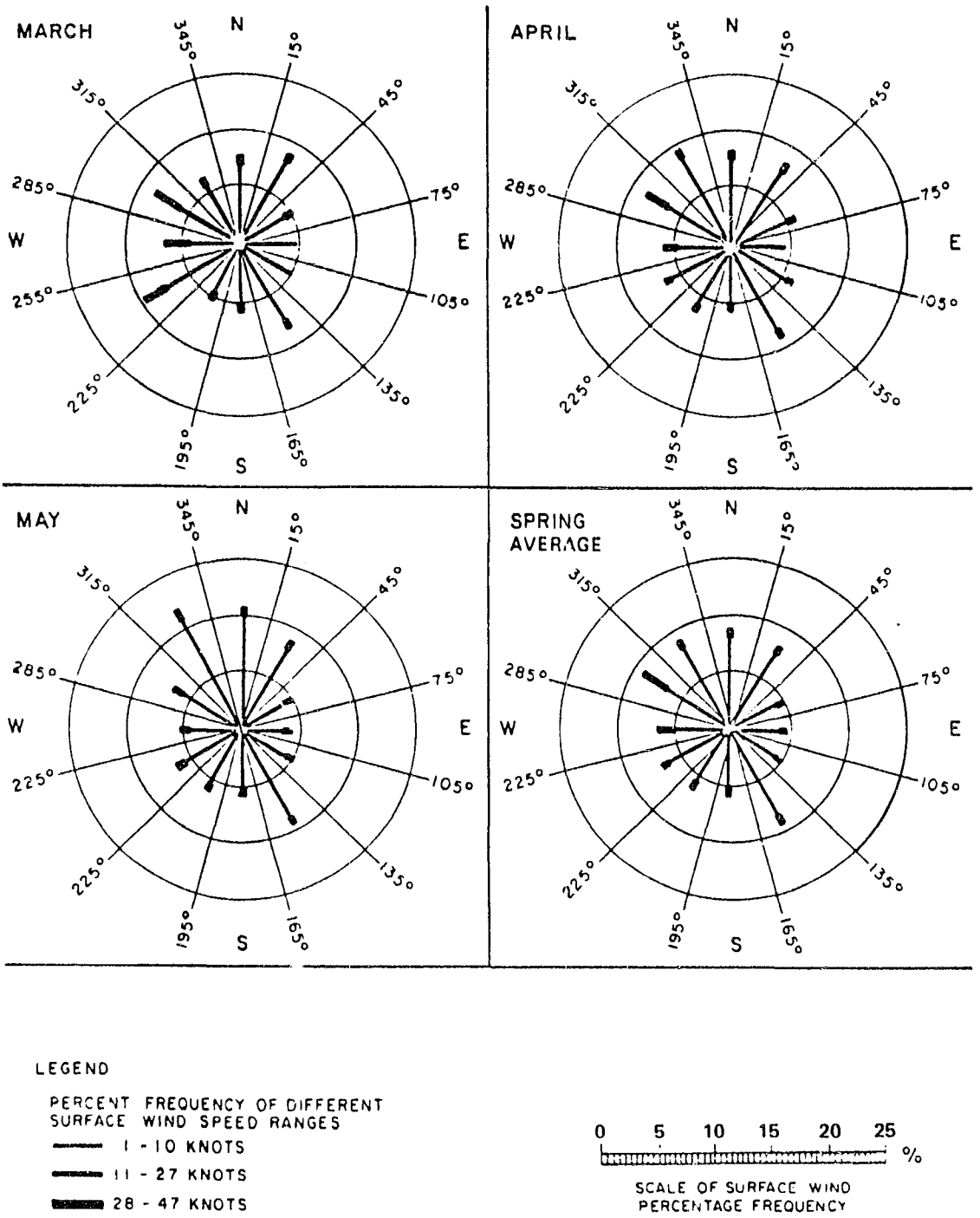
- 1 - 10 KNOTS
- 11 - 27 KNOTS
- 28 - 47 KNOTS

0 5 10 15 20 25 %

SCALE OF SURFACE WIND PERCENTAGE FREQUENCY

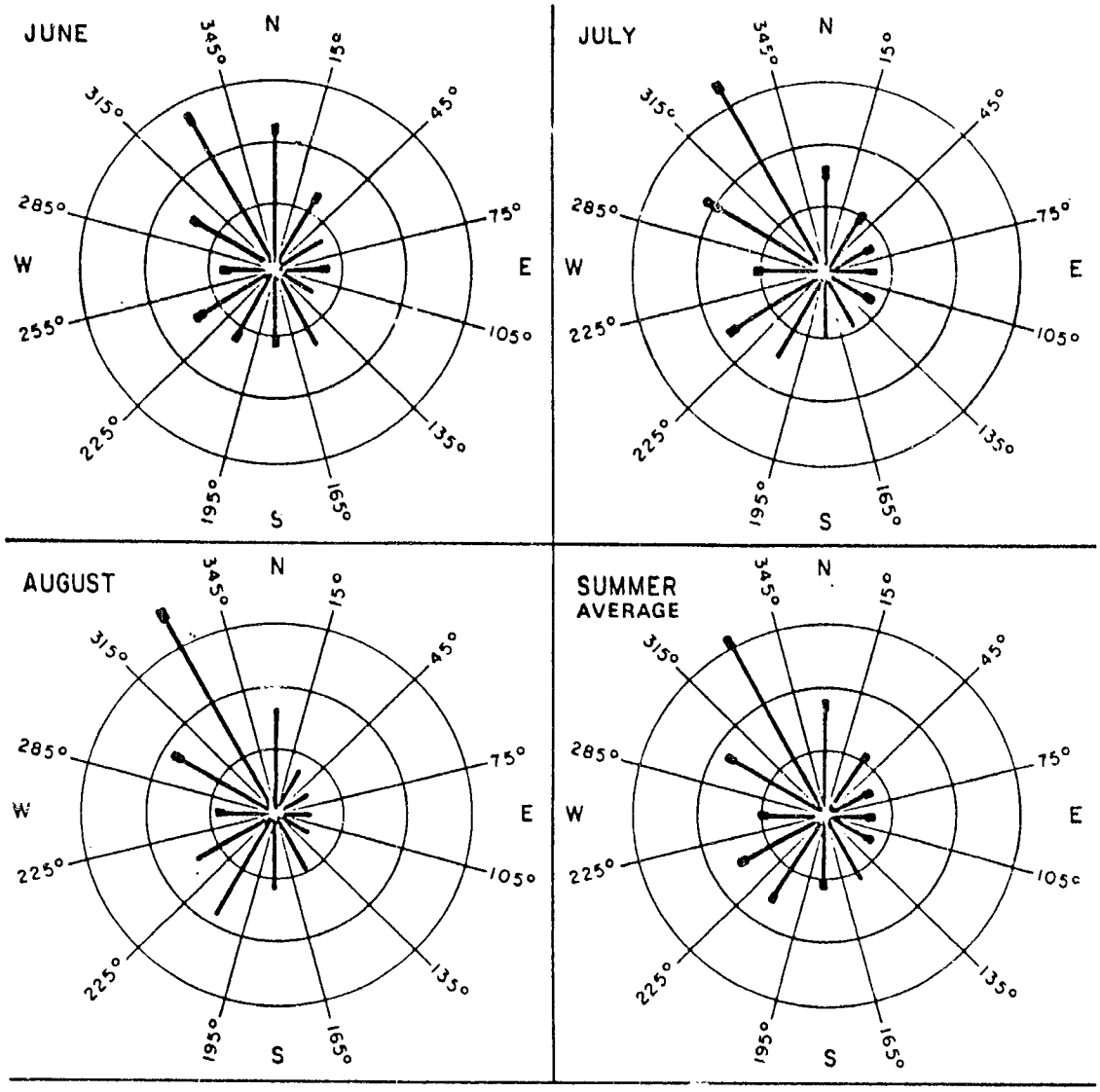
Source: Derived from meteorological station data collected from 1959-1975.

SURFACE WIND ROSES FOR WINTER, EL ARISH
(1959-1966)



Source: Derived from meteorological station data collected from 1959-1975.

SURFACE WIND ROSES FOR SPRING, EL ARISH
(1959-1966)



LEGEND

PERCENT FREQUENCY OF DIFFERENT SURFACE WIND SPEED RANGES

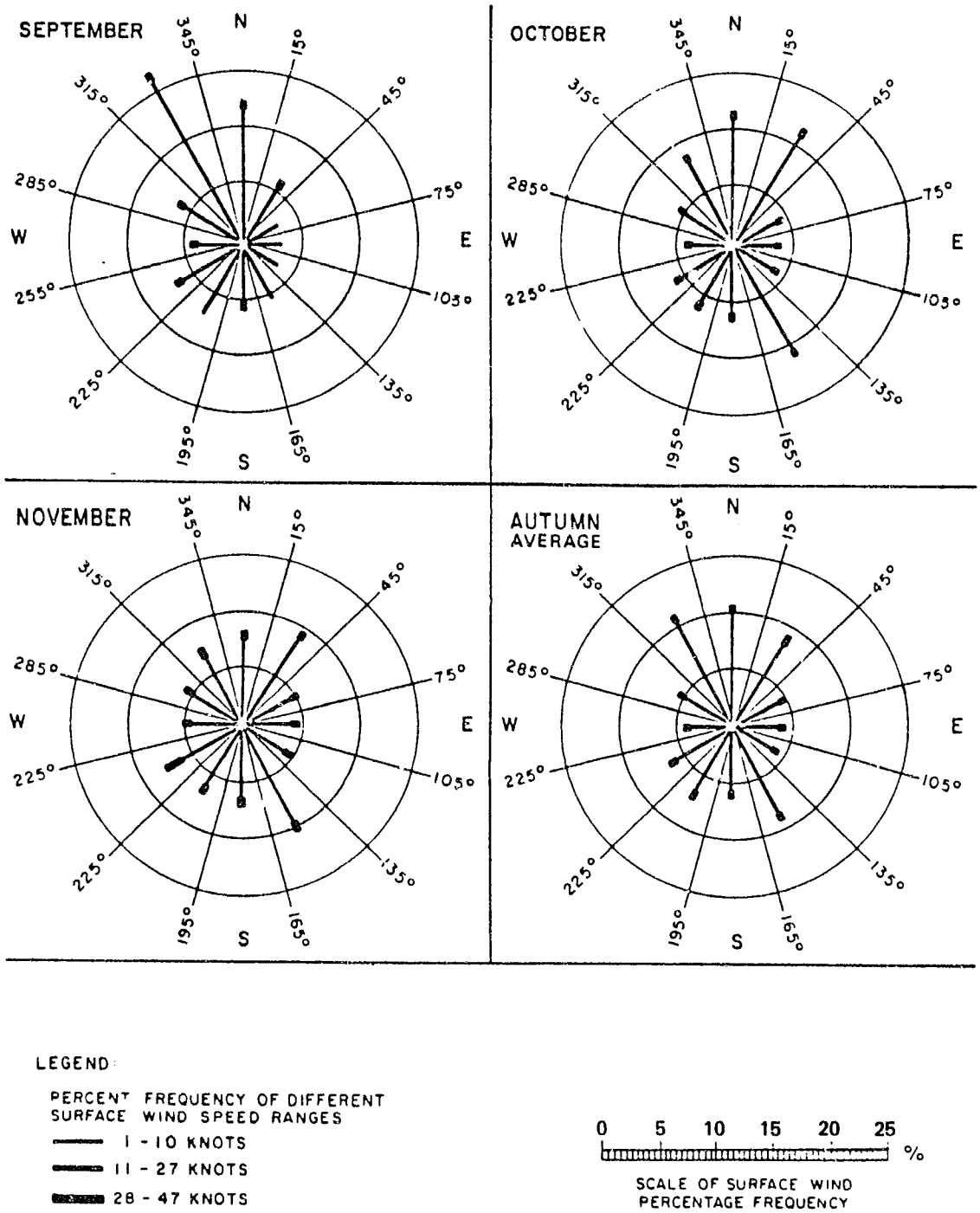
- 1 - 10 KNOTS
- 11 - 27 KNOTS
- 28 - 47 KNOTS

0 5 10 15 20 25 %

SCALE OF SURFACE WIND PERCENTAGE FREQUENCY

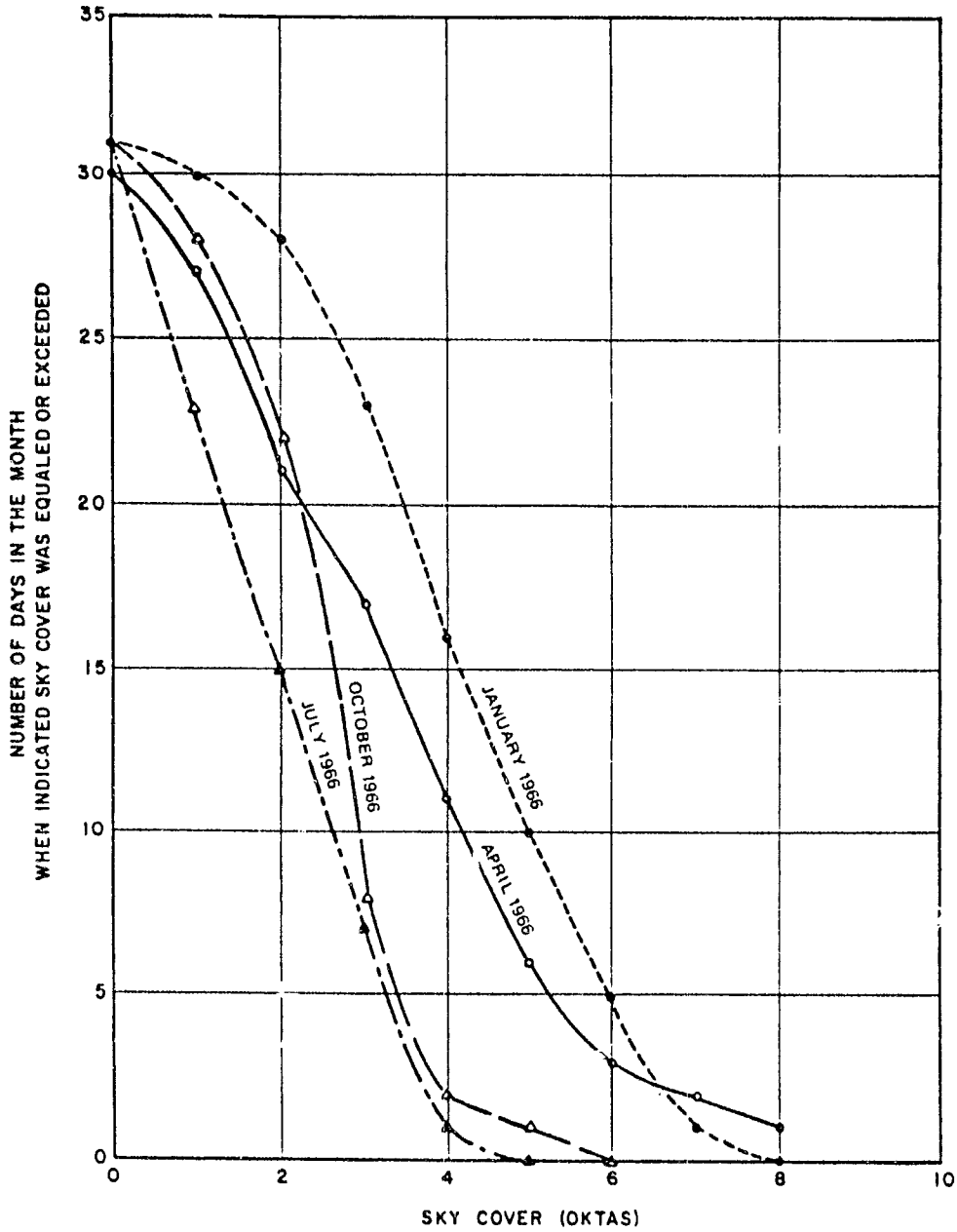
Source: Derived from meteorological station data collected from 1959-1975.

SURFACE WIND ROSES FOR SUMMER, EL ARISH
(1959-1966)



Source: Derived from meteorological station data collected from 1959-1975.

SURFACE WIND ROSES FOR AUTUMN, EL ARISH
(1959-1966)



Source: Derived from meteorological station data collected from 1959-1975.

NUMBER OF DAYS PER MONTH EQUALING OR EXCEEDING INDICATED SKY COVER AT EL ARISH

Dames & Moore

Computation of Reference Evapotranspiration by the Modified Penman Method--El Arish[a]

Parameter		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean temperature (°C)		13.6	13.9	16.0	18.7	21.6	24.7	26.2	27.0	25.6	23.2	19.7	15.5
Mean relative humidity (%)		70.0	69.0	67.0	67.0	68.0	72.0	74.0	75.0	71.0	73.0	71.0	66.0
Mean wind speed, 2-m height (km/day)		213.0	253.0	258.0	218.0	209.0	204.0	196.0	182.0	187.0	173.0	178.0	209.0
Cloudiness (oktas)		3.1	3.6	3.2	3.1	2.2	1.2	1.4	1.6	2.2	2.5	2.7	2.9
Vapor pressure parameters (mbar)	e_a	15.66	15.99	18.2	21.6	25.80	31.13	34.02	35.7	32.84	28.44	22.98	17.6
	e_d	10.96	11.03	12.19	14.46	17.54	22.41	25.17	26.78	23.32	20.76	16.32	11.62
	e_a-e_d (1)	4.7	4.96	6.01	7.12	8.26	8.72	8.85	8.92	9.52	7.68	6.66	5.98
Wind function f (U) (2)		0.845	0.953	0.967	0.859	0.834	0.821	0.799	0.761	0.775	0.737	0.751	0.834
Weighting factors	1-W (3)	0.396	0.392	0.36	0.333	0.296	0.263	0.248	0.24	0.254	0.278	0.323	0.368
	W (4)	0.604	0.608	0.64	0.67	0.706	0.737	0.752	0.76	0.746	0.722	0.686	0.632
Solar radiation parameters	R_a (mm/day)	8.5	10.4	12.95	15.1	16.5	17.0	16.8	15.6	13.75	11.4	9.25	8.05
	n/N	0.64	0.59	0.63	0.64	0.73	0.83	0.81	0.79	0.73	0.7	0.68	0.66
	R_{as} (mm/day)	3.63	4.25	5.49	6.46	7.6[illegible]	8.48	8.25	7.55	6.34	5.13	4.09	3.5
	f (T)	13.42	13.48	13.8	14.34	14.92	15.57	15.94	16.1	15.8	15.24	14.56	13.73
	f (e_d)	0.194	0.194	0.186	0.173	0.156	0.132	0.119	0.112	0.128	0.14	0.162	0.19
	f (n/N)	0.676	0.631	0.667	0.676	0.757	0.847	0.829	0.813	0.757	0.73	0.712	0.694
	R_{nl} (mm/day)	1.76	1.65	1.712	1.68	1.76	1.74	1.57	1.46	1.53	1.56	1.68	1.81
	R_n (mm/day) (5)	1.87	2.6	3.78	4.78	5.85	6.74	6.68	6.09	4.81	3.57	2.41	1.69
Estimated maximum relative humidity (%)		90.0	90.0	90.0	75.0	75.0	80.0	80.0	85.0	85.0	90.0	90.0	90.0
Adjustment factor[b] (6)		0.93	0.94	1.0	1.02	1.03	1.06	1.06	1.09	1.05	1.01	0.97	0.94
ET_o (mm/day)[c]		2.51	3.23	4.51	5.34	6.35	7.26	7.18	6.82	5.74	4.19	3.17	2.72

[a]El Arish--latitude, 31°07' N.; elevation, 15 meters.

[b]Assumed U_{day}/U_{night} = 1.5 (as per reference example for Cairo).

[c]ET_o = ((1) x (2) x (3) + (4) x (5)) x (6). Annual average ET_o = 4.92 mm/day.

Source: Method based on J. Doorenbach, and W. O. Pruitt, Guidelines for Predicting Crop Water Requirements, Irrigation and Drainage Paper 24 (Rome: U.N. Food and Agricultural Organization , 1977).

Computation of Reference Evapotranspiration by the Modified Penman Method--Nakhl[a]

Parameter		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean temperature (°C)		8.5	10.9	13.5	17.8	21.1	24.7	25.9	25.9	13.5	20.3	15.7	10.5
Mean relative humidity (%)		62.0	56.0	51.0	44.0	44.0	41.0	46.0	50.0	59.0	61.0	61.0	59.0
Mean wind speed, 2-m height (km/day)		182.0	115.0	142.0	235.0	240.0	262.0	227.0	213.0	231.0	160.0	147.0	182.0
Cloudiness (oktas)		2.5	2.8	2.3	2.2	1.5	0.5	0.3	0.7	1.2	1.8	2.4	2.5
Vapor pressure parameters (mbar)	e_a	11.1	13.0	15.55	20.36	25.05	31.13	33.41	33.41	15.55	23.85	17.84	12.7
	e_d	6.88	7.29	7.93	8.96	11.02	12.76	15.37	16.71	9.17	14.55	10.88	7.49
	$e_a - e_d$ (1)	4.22	5.73	7.62	11.4	14.03	18.37	18.04	16.71	6.38	9.3	6.96	5.21
Wind function f (U) (2)		0.761	0.581	0.653	0.907	0.918	0.977	0.883	0.845	0.894	0.702	0.667	0.761
Weighting factors	1-W (3)	0.45	0.415	0.385	0.33	0.29	0.25	0.25	0.25	0.385	0.30	0.355	0.424
	W (4)	0.55	0.585	0.615	0.67	0.71	0.75	0.75	0.75	0.615	0.78	0.645	0.576
Solar radiation parameters	R_a (mm/day)	8.8	10.7	13.1	15.2	16.5	17.0	16.8	15.7	13.9	11.6	9.5	8.3
	n/N	0.7	0.67	0.72	0.73	0.8	0.9	0.92	0.88	0.83	0.77	0.71	0.7
	R_{ns} (mm/day)	3.96	4.69	5.99	7.01	8.04	8.93	8.95	8.12	6.93	5.52	4.31	3.74
	f (T)	12.48	12.88	13.4	14.16	14.82	15.58	15.88	15.88	13.4	14.66	13.75	12.8
	f (e_d)	0.225	0.221	0.216	0.208	0.194	0.183	0.167	0.16	0.207	0.172	0.195	0.22
	f (n/N)	0.73	0.703	0.748	0.757	0.82	0.91	0.928	0.892	0.847	0.793	0.739	0.73
	R_{nl} (mm/day)	2.05	2.0	2.165	2.23	2.36	2.59	2.46	2.27	2.35	2.0	1.98	2.06
	R_n (mm/day) (5)	1.91	2.69	3.825	4.78	5.68	6.34	6.49	5.85	4.58	3.52	2.33	1.68
Estimated maximum relative humidity (%)		75.0	75.0	75.0	60.0	60.0	60.0	60.0	75.0	75.0	75.0	75.0	75.0
Adjustment factor[b] (6)		0.93	0.98	1.01	0.98	1.0	1.02	1.02	1.05	1.02	0.99	0.96	0.93
ET_o (mm/day)[c]		2.32	2.9	4.31	6.48	7.77	9.43	9.03	8.31	5.11	4.38	3.02	2.46

[a]Nakhl--latitude, 29°55' N.; elevation, 406 meters.

[b]Assumed U_{day}/U_{night} = 1.5 (as per reference example for Cairo).

[c]ET_o = ((1) x (2) x (3) + (4) x (5)) x (6). Annual average ET_o = 5.46 mm/day.

Source: Method based on J. Doorenbach and W. O. Pruitt, Guidelines for Predicting Crop Water Requirements, Irrigation and Drainage Paper 24 (Rome: U.N. Food and Agricultural Organization, 1977)

Computation of Reference Evapotranspiration by the Modified Penman Method--Abu Rudeis[a]

Parameter		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean temperature (°C)		16.0	16.8	19.2	22.0	25.1	27.6	28.6	29.6	27.9	25.9	22.1	17.6
Mean relative humidity (%)		57.0	55.0	53.0	53.0	55.0	55.0	59.0	59.0	62.0	61.0	58.0	58.0
Mean wind speed, 2-m height (km/day)		236.0	333.0	373.0	347.0	556.0	582.0	591.0	551.0	507.0	418.0	196.0	320.0
Cloudiness (oktas)		2.1	2.2	1.8	1.7	1.3	0.3	0.2	0.1	0.3	1.3	1.5	2.1
Vapor pressure parameters (mbar)	e_a	18.2	19.16	22.28	26.4	31.89	36.96	39.18	41.48	37.59	33.41	26.57	20.12
	e_d	10.37	10.54	11.81	13.99	17.54	20.33	23.12	24.47	23.31	20.38	15.41	11.67
	e_a-e_d (1)	7.83	8.62	10.47	12.41	14.35	16.63	16.06	17.01	14.28	13.03	11.16	8.45
Wind function f (U) (2)		0.907	1.169	1.277	1.207	1.771	1.841	1.866	1.758	1.639	1.399	0.799	1.134
Weighting factors	1-W (3)	0.36	0.35	0.33	0.29	0.26	0.235	0.228	0.222	0.232	0.25	0.29	0.345
	W (4)	0.64	0.65	0.67	0.71	0.74	0.765	0.772	0.778	0.768	0.75	0.71	0.655
Solar radiation parameters	R_a (mm/day)	9.05	10.9	13.25	15.25	16.5	16.9	16.75	15.7	14.0	11.8	9.7	8.55
	n/N	0.74	0.73	0.77	0.78	0.82	0.92	0.93	0.94	0.92	0.82	0.80	0.74
	R_{ns} (mm/day)	4.21	5.03	6.31	7.32	8.17	9.0	8.98	8.48	7.46	5.84	4.73	3.98
	f (T)	13.8	13.96	14.44	15.0	15.67	16.22	16.42	16.62	16.28	15.87	15.02	14.12
	f (e_d)	0.198	0.197	0.189	0.175	0.156	0.142	0.128	0.122	0.128	0.141	0.167	0.19
	f (n/N)	0.766	0.757	0.793	0.802	0.838	0.928	0.937	0.946	0.928	0.838	0.820	0.766
	R_{nl} (mm/day)	2.09	2.08	2.16	2.11	2.05	2.14	1.97	1.92	1.93	1.88	2.06	2.05
	R_n (mm/day) (5)	2.12	2.95	4.15	5.21	6.12	6.86	7.01	6.56	5.53	3.96	2.67	1.93
Estimated maximum relative humidity (%)		80.0	80.0	80.0	70.0	70.0	70.0	70.0	80.0	80.0	80.0	80.0	80.0
Adjustment factor[b] (6)		0.93	0.93	0.97	0.99	0.96	0.99	0.98	1.01	0.99	0.96	0.96	0.89
ET_o (mm/day)[c]		3.64	5.06	6.98	7.96	10.69	12.32	12.0	11.86	9.58	7.08	4.3	4.07

[a] Abu Rudeis--latitude, 28°53' N.; elevation, 18.9 meters.

[b] Assumed U_{day}/U_{night} = 1.5 (as per reference example for Cairo).

[c] ET_o = ((1) x (2) x (3) + (4) x (5)) x (6). Annual average ET_o = 7.96 mm/day.

Source: Method based on J. Doorenbach and W. O. Pruitt, Guidelines for Predicting Crop Water Requirements, Irrigation and Drainage Paper 24 (Rome: U.N. Food and Agricultural Organization, 1977).

Computation of Reference Evapotranspiration by the Modified Penman Method--El Tor[a]

Parameter		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean temperature (°C)		15.7	16.2	17.8	22.7	25.1	27.7	28.8	29.3	27.4	24.5	21.1	17.4
Mean relative humidity (%)		57.0	55.0	53.0	56.0	58.0	59.0	60.0	61.0	63.0	58.0	58.0	56.0
Mean wind speed, 2-m height (km/day)		351.0	302.0	347.0	373.0	409.0	489.0	440.0	436.0	444.0	280.0	240.0	262.0
Cloudiness (oktas)		1.5	1.5	1.2	1.2	0.9	0.1	0.2	0.2	0.1	0.7	1.2	1.8
Vapor pressure parameters (mbar)	e_a	17.84	18.44	20.36	27.59	31.89	37.17	39.64	40.79	36.54	30.75	25.05	19.88
	e_d	10.17	10.14	10.79	15.45	18.5	21.93	23.78	24.88	23.02	17.83	14.53	11.13
	e_a-e_d (1)	7.67	8.3	9.57	12.14	13.39	15.24	15.86	15.91	13.52	12.92	10.52	8.75
Wind function f (U) (2)		1.218	1.085	1.207	1.277	1.374	1.59	1.458	1.447	1.469	1.026	0.918	0.977
Weighting factors	1-W (3)	0.364	0.358	0.342	0.283	0.259	0.233	0.226	0.224	0.236	0.265	0.303	0.346
	W (4)	0.636	0.642	0.658	0.717	0.741	0.767	0.774	0.776	0.764	0.735	0.697	0.654
Solar radiation parameters	R_a (mm/day)	9.24	11.05	13.36	15.29	16.5	16.83	16.71	15.7	14.07	11.95	9.85	8.74
	n/N	0.8	0.8	0.83	0.83	0.86	0.94	0.93	0.93	0.94	0.88	0.83	0.77
	R_{ns} (mm/day)	4.5	5.39	6.66	7.63	8.41	9.09	8.96	8.42	7.6	6.18	4.91	4.16
	f (T)	13.75	13.84	14.16	15.14	15.67	16.24	16.45	16.56	16.18	15.53	14.82	14.08
	f (e_d)	0.2	0.2	0.195	0.167	0.151	0.134	0.125	0.121	0.129	0.154	0.172	0.193
	f (n/N)	0.82	0.82	0.847	0.847	0.874	0.946	0.937	0.937	0.946	0.892	0.847	0.793
	R_{nl} (mm/day)	2.25	2.27	2.34	2.14	2.07	2.06	1.928	1.877	1.975	2.133	2.159	2.155
	R_n (mm/day) (5)	2.25	3.12	4.32	5.49	6.34	7.03	7.03	6.54	5.63	4.05	2.75	2.01
Estimated maximum relative humidity (%)		80.0	80.0	80.0	70.0	70.0	70.0	70.0	80.0	80.0	80.0	80.0	80.0
Adjustment factor[b] (6)		0.89	0.95	1.0	0.99	1.0	1.0	1.01	1.03	1.0	0.99	0.95	0.92
ET_o (mm/day)[c]		4.3	4.97	6.79	8.24	9.46	11.04	10.77	10.54	8.99	6.42	4.60	3.93

[a]El Tor--latitude, 28°14' N.; elevation, 2.7 meters.

[b]Assumed U_{day}/U_{night} = 1.5 (as per reference example for Cairo).

[c]ET_o = ((1) x (2) x (3) + (4) x (5)) x (6). Annual average ET_o = 7.5 mm/day.

Source: Method based on J. Doorenbach and W. O. Pruitt, Guidelines for Predicting Crop Water Requirements, Irrigation and Drainage Paper 24 (Rome: U.N. Food and Agricultural Organization, 1977).

Computation of Reference Evapotranspiration by the Modified Penman Method--Saint Catherine[a]

Parameter		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean temperature (°C)		3.9	4.3	6.9	9.35	11.8	15.65	16.3	16.9	16.2	12.0	7.25	3.85
Mean relative humidity (%)		28.0	30.0	20.0	17.0	23.0	18.0	23.0	22.0	17.0	30.0	40.0	36.0
Mean wind speed, 2-m height (km/day)[b]		267.0	209.0	245.0	304.0	325.0	376.0	334.0	325.0	338.0	220.0	194.0	222.0
Cloudiness (oktas)[c]		2.6	3.2	2.75	2.65	1.85	0.85	0.85	1.15	1.7	2.15	2.55	2.7
Vapor pressure parameters (mbar)	e_a	8.05	8.22	9.93	11.78	13.82	17.78	18.56	19.28	18.44	14.0	10.17	8.02
	e_d	2.25	2.48	1.99	2.0	3.18	3.2	4.27	4.24	3.13	4.2	4.07	2.89
	$e_a - e_d$ (1)	5.8	5.8	7.94	9.78	10.64	14.58	14.29	15.04	15.31	9.8	6.1	5.14
Wind function f (U) (2)		0.991	0.834	0.932	1.091	1.168	1.285	1.172	1.148	1.183	0.864	0.794	0.869
Weighting factors	1-W (3)	0.462	0.456	0.418	0.381	0.35	0.302	0.295	0.289	0.296	0.348	0.412	0.463
	W (4)	0.538	0.544	0.582	0.619	0.65	0.698	0.705	0.711	0.704	0.652	0.588	0.537
Solar radiation parameters	R_a (mm/day)	9.18	11.0	13.32	15.28	16.5	16.85	16.72	15.7	14.05	11.9	9.8	8.68
	n/N	0.67	0.63	0.675	0.685	0.765	0.865	0.865	0.835	0.78	0.735	0.695	0.565
	R_{ns} (mm/day)	5.03	4.66	5.87	6.79	7.83	8.62	8.56	7.86	6.74	5.51	4.39	3.47
	f (T)	11.66	11.76	12.16	12.6	13.06	13.75	13.86	13.98	13.64	13.1	12.25	11.68
	f (e_d)	0.274	0.271	0.278	0.278	0.262	0.241	0.249	0.249	0.262	0.258	0.251	0.265
	f (n/N)	0.783	0.667	0.708	0.716	0.788	0.878	0.878	0.852	0.802	0.762	0.726	0.608
	R_{nl} (mm/day)	2.25	2.12	2.4	2.51	2.7	3.15	3.03	2.96	2.91	2.5	2.23	1.88
	R_n (mm/day) (5)	1.78	2.54	3.47	4.28	5.13	5.47	5.53	4.9	3.83	3.01	2.16	1.59
Estimated maximum relative humidity (%)		75.0	75.0	75.0	60.0	60.0	60.0	60.0	75.0	75.0	75.0	75.0	75.0
Adjustment factor[d] (6)		0.9	0.94	0.98	0.95	0.98	0.99	0.99	1.02	0.99	0.97	0.94	0.90
ET_o (mm/day)[e]		3.25	3.37	5.01	6.38	7.46	9.38	8.75	8.64	7.98	4.76	3.07	2.63

[a]Saint Catherine--latitude, 28°32' N.; elevation, 2,620 meters.

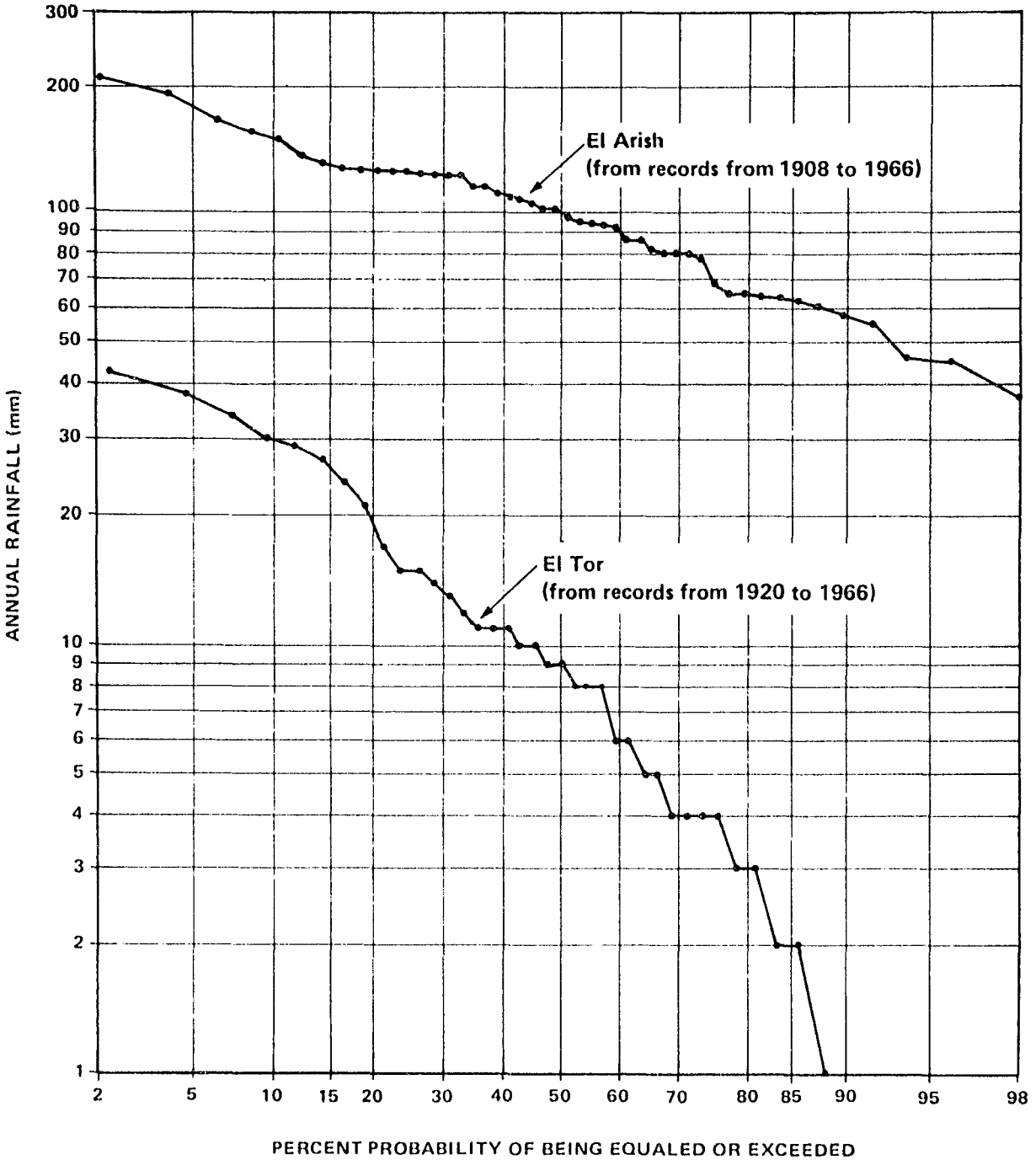
[b]Wind speed taken as average of Nakhl and El Tor values.

[c]Cloudiness taken as average of Nakhl and El Arish values.

[d]Assumed U_{day}/U_{night} = 1.5 (as per reference example for Cairo).

[e]ET_o = ((1) x (2) x (3) + (4) x (5)) x (6). Annual average ET_o = 5.89 mm/day.

Source: Method based on J. Doorenbach and W. O. Pruitt, Guidelines for Predicting Crop Water Requirements, Irrigation and Drainage Paper 24 (Rome: U.N. Food and Agricultural Organization, 1977).



ANNUAL RAINFALL PROBABILITY CURVES
FOR EL ARISH AND EL TOR

Dames & Moore

Locality and Habitat Types of Plants Observed in Sinai
1981

Plant Species	Locality	Type of Habitat
Acacia radiana	Wadi El Fath	Wadi bed
	Wadi Gharandal	Terraces
	Wadi Sidri	Rocky habitat
	Wadi El Bruk	Terraces
Acacia saligna	Wadi El Arish	Sand dunes
	Wadi El Fath	Rocky habitat
Achillea fragrantissima	Wadi Gharandal	Rocky habitat
Achillea santolina	Wadi El Arish	Wadi bed
Aerva javanica v. bovei	El Tor	High terraces
Aerva javanica v. forsskalii	Wadi Feiran	Elevated plain
Agave sp.	Wadi El Arish	Sand dunes
Ajuga tridactylites	Wadi El Sheikh	Rocky habitat
Alhagi maurorum	Wadi Gharandal	Wadi bed
Alkanna orientalis	Wadi El Sheikh	Wadi bed
Ambrosia maritima	Nakhl	Wadi bed
Anabasis articulata	Gebel El Maghara	Sand dunes
	Wadi El Bruk	Wadi bed
	Wadi El Bruk	Terraces
	Wadi El Fath	Elevated plain
	Wadi El Arish	Cliffs
Anabasis setifera	Wadi Gharandal	Gullies
Anastatica hierochuntica	Wadi El Bruk	Elevated plain
Anthemis cotula	Wadi Araba	Terraces
Artemisia herba - alba	Aghaidara	Terraces
	Wadi Gharandal	Elevated plain
Artemisia judaica	Wadi El Fath	Rocky habitat
	Wadi El Bruk	Elevated plain
	Nakhl	Wadi bed

Plant Species	Locality	Type of Habitat
Artemisia monosperma	Wadi El Arish	Cliffs
	Lake Bardawil	Sand dunes
	Wadi El Bruk	Terraces
	Gebel El Maghara	Gullies
Arthrocnemon glaucum	Lake Bardawil	Salt marsh
Asparagus aphyllus	Wadi El Arish	Elevated plain
Asparagus stipularis v. brachyclodos	Wadi El Arish	Sandy plain
Asphodelus viscidulus	Nakhl	Wadi bed
	Wadi El Bruk	Wadi bed
Asteriscus graveolens	Wadi Gharandal	Rocky habitat
Astragalus sp.	Wadi Thaghada	Wadi bed
Astragalus sieberi	Bir Nasib	Rocky habitat
	Wadi Gharandal	Elevated plain
Astragalus spinosus	Wadi Sidri	Rocky habitat
Atractyles carduus	Wadi El Hegayib	Rocky habitat
Atriplex halimus	Wadi El Arish	Terraces
	Nakhl	High terraces
	Wadi Gharandal	Coastal dunes
	Ghader	Elevated plain
Atriplex leucoclada	Nakhl	Wadi bed
Avena fatua	Mitla Pass	Sandy plain
Bassia eriophora	Wadi Wirqa	Terraces
Blepharis edulis	Wadi El Bruk	Elevated plain
Calotropis procera	Wadi Feiran	Wadi bed
Capparis cartilaginea	Wadi Gharandal	Rocky habitat
Capparis spinosa	Wadi Sidri	Rocky habitat
Caralluma sinaica	Meleiz	Rocky habitat
Carduncellus eriocephalus	Gebel El Zarafa	Wadi bed

Plant Species	Locality	Type of Habitat
Centaurea aegyptiaca	Wadi El Arish	Cliffs
Centaurea pallescens	Wadi El Arish Wadi El Bruk	Elevated plain Terraces
Citrullus colocynthes	Bir Nasib	Rocky habitat
Chenopodium murale	Wadi El Fath Wadi Wirqa	Wadi bed Limestone cliffs
Chenopodium vulvaria	Ayun Musa	Coastal depression
Cleome arabica	Wadi El Raha	Upstream
Colutea haleppica	Wadi El Fath	Wadi bed
Convolvulus lanatus	Wadi Sidri	Wadi bed
Cressa cretica	El Tor	Wadi bed
Cucmis prophetarum	Wadi El Fath Bir Nasib Wadi Gharandal	Wadi bed Rocky habitat Rocky habitat
Cynodon dactylon	Wadi El Arish	Cliffs
Cyperus laevigatus	El Tor	Wadi bed
Diplotaxis acris	Wadi El Arish Wadi El Arish Wadi El Bruk	Terraces Wadi bed High terraces
Diplotaxis harra	Wadi El Bruk Wadi Gharandal	High terraces Rocky habitat
Echinops spinosissimus	Wadi El Sheikh	Wadi bed
Ephedra alata	Wadi El Natila El Tor Meleiz	Elevated plain High terraces Wadi bed
Erodium bryoniaefolium	Nakhl	Wadi bed
Erodium hirtum	Wadi El Bruk	Elevated plain
Eryngium creticum	Meleiz	Rocky habitat

Plant Species	Locality	Type of Habitat
Euphorbia arabica	Gebel El Maghara	Gullies
	Wadi El Fath	Wadi bed
	Wadi El Fath	Rocky habitat
	Wadi El Fath	Wadi bed
Euphorbia kaherensis	Gebel El Zarafa	Wadi bed
	Wadi El Bruk	High terraces
	Gebel El Maghara	Gullies
	Nakhl	Wadi bed
	Wadi El Bruk	Elevated plain
Fagonia arabica	Wadi El Bruk	Wadi bed
	Nakhl	Wadi bed
	Wadi Gharandal	Elevated plain
	Wadi Wirqa	Terraces
Fagonia kahirina	Nakhl	Wadi bed
	Wadi Gharandal	Rocky habitat
Fagonia mollis	Wadi Gharandal	Rocky habitat
Farsetia aegyptiaca	Wadi Giddi	Gullies
	Aghaidara	Deltaic
	Ghader	Wadi bed
	Wadi Gharandal	Elevated plain
	Wadi Araba	Wadi bed
Farsetia longisiliqua	Wadi El Natila	Cliffs
Ferula marmarica	Hemma	Gravel
Ferula sinaica	El Tih Plateau	Rocky habitat
Filago spathiolata	Wadi El Arish	Cliffs
Francoeuria crispa	Wadi Gharandal	Elevated plain
Gymnocarpus decanderum	Gebel El Maghara	Rocky habitat
Halocnemum strobilaceum	Sabkhet El Bardawil	Salt marsh
Halogeton alopecuroides	Wadi El Natila	Terraces
Haloxylon articulatum	Meleiz	Elevated plain

Plant Species	Locality	Type of Habitat
Haloxylon salicornicum	Aghaidara	Elevated plain
	Wadi Sidri	Sandy tract
	Wadi El Arish	Elevated plain
Halopeplis perfoliata	Wadi El Natila	Terraces
	Nakhl	Wadi bed
Helianthemum visicarium	Wadi El Arish	Cliffs
	Nakhl	Wadi bed
Heliotropium arabainese	Wadi El Arish	Elevated plain
Heliotropium luteum	Wadi El Arish	Wadi bed
	Wadi El Arish	Terraces
Herniaria hemistemon	Nakhl	Wadi bed
Hyoscyamus desertorum	Meleiz	Elevated plain
Hyoscyamus muticus	Wadi El Arish	Elevated plain
Ifloga spicata	Wadi El Arish	Cliffs
Jasonia montana	Wadi Sudr	Upstream
Juncus acutus	Wadi Sudr	Saline depression
Juncus subulatus	Sabkhet El Bardawil	Saline depression
	Wadi Gharandal	Saline depression
Lasipogon muscoides	Wadi Gharandal	Elevated plain
Limonium pruinosum	Wadi Gharandal	Saline terrace
Lotus lanuginosus	Wadi El Saheimi	Wadi bed
Lycium europeum	Wadi El Arish	Wadi bed
	Wadi El Fath	Wadi bed
	Mitla Pass	Elevated plain
Malabaila suaveolens	Wadi El Hegayib	Rocky habitat
Malva sp.	Wadi El Fath	Wadi bed
Malva sylvestris	Meleiz	Rocky habitat
Mathiola elliptica	El Tor	Wadi bed

Plant Species	Locality	Type of Habitat
Mentha microphylla	Wadi Gharandal	Terraces
Mesemberianthemum forsskalei	Wadi El Bruk	Sandy tract
Möltkea callosa	Wadi El Arish	Sand dunes
	Sabkhet El Bardawil	Sand dunes
Moricandia nitens	Wadi El Arish	Wadi bed
	Wadi El Sheikh	Wadi bed
Moricandia sinaica	Wadi Gharandal	Rocky habitat
Naea mucronata	Wadi Giddi	High terraces
Nicotian glaucum	Wadi El Arish	Sand dunes
Nitraria retusa	Wadi El Arish	Terraces
	Wadi El Arish	Elevated plain
	Sabkhet El Bardawil	Cliffs
	Wadi El Natila	Elevated plain
	Nakhl	Terraces
	Gebel El Zarafa	Elevated plain
	Wadi Gharandal	Elevated plain
	Wadi Wirqa	Saline depression
Ochradenus baccatus	Wadi Natila	Wadi bed
	Wadi Natila	Cliffs
Orbanche cernua v. nepalensis	Gebel El Maghara	Sand dunes
Orgzopsis milicea	Wadi El Garf	Sandy tract
Pancratium arabicum	Wadi El Arish	Wadi bed
Pancratium sickenbergeri	Wadi El Arish	Wadi bed
Pancratium sp.	Wadi El Arish	Wadi bed
Panicum coloratum	Wadi El Garf	Sandy tract
Panicum turgidum	Wadi El Arish	Sand dunes
	El Tor	Sandy plain
Peganum harmala	Wadi El Arish	Wadi bed
	Wadi El Arish	Elevated plain
	Wadi El Arish	Sand dunes
	Wadi El Fath	Wadi bed
	Wadi El Arish	Cliffs
	Ayun Musa	Coastal depression

Plant Species	Locality	Type of Habitat
Pergularia daemia	Wadi Gharandal	Rocky habitat
Pergularia tomentosa	Wadi Sudr	Rocky habitat
Phagnalon nitidium	Wadi El Hegayib	Rocky habitat
Phlomis aurea	Wadi El Sheikh	Rocky habitat
Phragmites communis	Wadi Gharandal	Saline depression
Pituranthus tortuosus	Wadi El Arish	Elevated plain
	Wadi El Bruk	Elevated plain
	Wadi El Hegayib	Rocky habitat
Plantago albicans	Wadi El Arish	Cliffs
	Aghaidara	Deltaic
Plantago cylindrica	Wadi El Arish	Sand dune
Polypogon monospeliensis	El Tor	Upstream
Pteranthus dichotomus	Wadi El Arish	Terraces
Reaumuria hirtella	Nakhl	Wadi bed
Retama raetam	Wadi El Arish	Elevated plain
	Sabkhet El Bardawil	Sand dunes
	Wadi El Fath	Wadi bed
	Hemma	Wadi bed
	Hemma	Elevated plain
	Wadi Wirqa	Cliffs
Ricinus communis v. araishy	Wadi El Arish	Sand dunes
Rosmarinus officinarum	Wadi El Sheikh	Runoff
Rumex cyprius v. sinatum	Ayun Musa	Coastal depression
Salicornia fruticosa	Mitla Pass	Gullies
Salsola tetrandra	Wadi El Natila	Wadi bed
Salvia deserti	Wadi Sidri	Sandy tract
	Wadi Gharandal	Rocky habitat
Savignia parviflora	Wadi El Bruk	Elevated plain
Senecio aegyptius	Wadi El Arish	Sand dunes

Plant Species	Locality	Type of Habitat
Silene succulenta	Wadi El Arish	Elevated plain
Stachys aegyptiaca	Wadi Gharandal	Elevated plain
	Mitla Pass	Elevated plain
	Mitla Pass	Gullies
Suaeda monica	Wadi Gharandal	Coastal strip
Suaeda pruinosa	Wadi El Natila	Terraces
Tamarix aphylla	Wadi El Arish	Cliffs
Tamarix mannifera	Wadi El Arish	Cliffs
Teuricum polium	Wadi El Sheikh	Runoff
Thymalaea hirsuta	Hemma	Elevated plain
	Wadi El Arish	Wadi bed
	Wadi El Fath	Wadi bed
	Sabkhet El Bardawil	Sand dunes
Thymus decussatus	Mitla Pass	Wadi bed
Teigonella stellata	Wadi El Arish	Wadi bed
	Wadi El Arish	Cliffs
Typha ausbralis	Wadi Thaghada	Elevated plain
Verbascum fruiticulosum	Mitla Pass	Wadi bed
Zilla biparmata	Wadi Gharandal	Rocky habitat
Zilla spinosa	Wadi El Arish	Elevated plain
Zygophyllum album	Sabkhet El Bardawil	Coastal ridges
	Wadi El Bruk	High terraces
	Wadi El Bruk	Elevated plain
	Wadi Araba	Coastal fan
Zygophyllum coccineum	Meleiz	High terraces
	Wadi Thaghada	Wadi bed
	Wadi Araba	Wadi bed
Zygophyllum decumbens	Wadi El Fath	Rocky habitat
	Wadi El Natila	Cliffs
	Wadi Gharandal	Elevated plain
Zygophyllum simplex	Wadi Gharandal	Terraces

SOURCE: The Desert Institute, 1981.

Endemic Vascular Plant Species
1981

Scientific Name	Distribution in Sinai		
	MC	NS	SS
Caralluma sinaica (Decne) A. Berger[a]		X	X
Bufonia multiceps Decne			X
Dianthus sinaicus Boiss.[a]		X	X
Silene leucophylla Boiss.			X
Silene odontopetala Fenzl var. conjesta Boiss.			X
Silene schimperiana Boiss.			X
Phagnalon sinaicum Bornm. & Kneuck.			X
Scorzonera drarii Tackh.[a]			X
Scorzonera mollis M. Bieb. var. glabrata Bornm.			X
Ipomoea sinaica Tackh. & Boulos[a,b]			X
Arabidopsis kneukeri (Bornm.) O. E. Schulz			X
Rorippa integrifolia Boulos		X	
Torularia aculeolata (Desf.) O. E. Schulz[b,c]			X
Tuniperus phoenicea L.[b,c]		X	
Pterocephalus arabicus Boiss.		X	
Pterocephalus sanctus Decne			X
Euphorbia bivonae Steud. var. sinaica Hadidi		X	
Centaurium malacianum Maire			X
Lophochloa pumila (Desf.) Bor. var. glabreseens Tackh.	X		
Stipagrostis drarii (Tackh.) De Winter[a,b]		X	
Hypericum sinaicum Hochst.			X
Hypecoum dimidiatum Del.			X
Ballota kaiseri Tackh.			X
Nepeta septemcrenata Ehrenb.			X
Otostegia fruticosa (Forssk.) Brig. var. kaiseri (Tackh.) Tackh.			X
Phlomis aurea Decne			X
Thymus decussatus Benth.[c]		X	X
Astragalus camelorum Barb.	X	X	
Astragalus spinosus (Forssk.) Muschler var. Kneuckeri (Freyn) Tackh. Boulos		X	
Vicia sinaica Boulos	X		
Leopoldia logistyla Tackh. Boulos[a]	X		
Leopoldia salah-eidii Tackh. Boulos	X	X	
Polygala sinaica Botsch.		X	
Primula boveana Decne		X	
Delphinium bovei Decne	X	X	
Rosa arabica Crep.		X	
Anarrhinum pubescens Fresen		X	
Kickxia scariosepala Tackh. Boulos		X	
Verbascum kaiseri Tackh.[a]		X	
Veronica musa Tackh. Hadidi[a]		X	
Bupleurum falcatum L. var. linearifolium (Boiss.) Tackh.		X	
Fagonia boulosii Hadidi var. crameri Hadidi		X	

Note: MC = Mediterranean coastal region of Sinai, located north of Route 6.

NS = Northern Sinai, located south of Route 6 and north of El Igma escarpment, which roughly traverses Sinaí between Abu Zenima and Eilat.

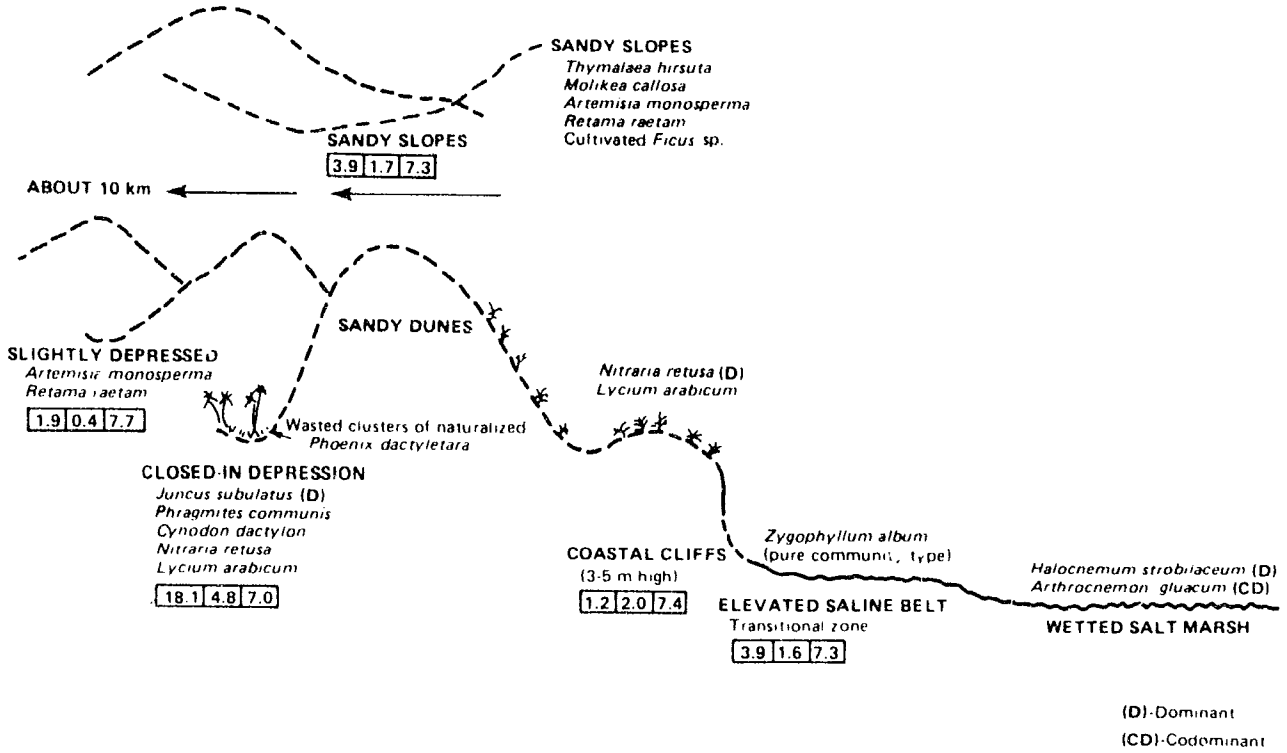
SS = Southern Sinai, south of El Igma escarpment.

[a]Species is endangered.

[b]Not endemic to Sinai.

[c]Species is threatened.

SOURCE: L. Boulos, personal communication, April 2, 1981.



LEGEND

1 2 3

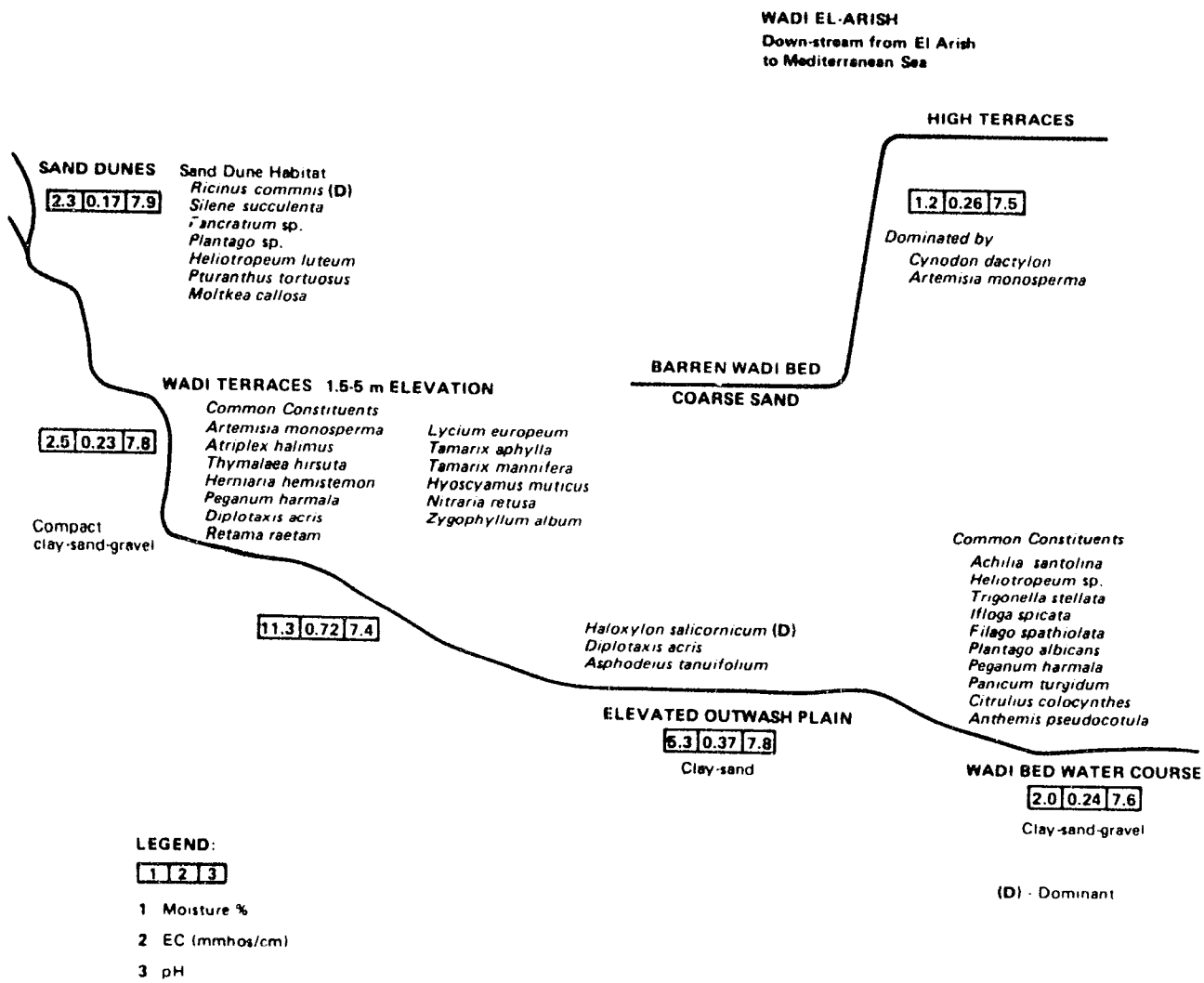
1 Moisture %

2 EC (mmhos/cm)

3 pH

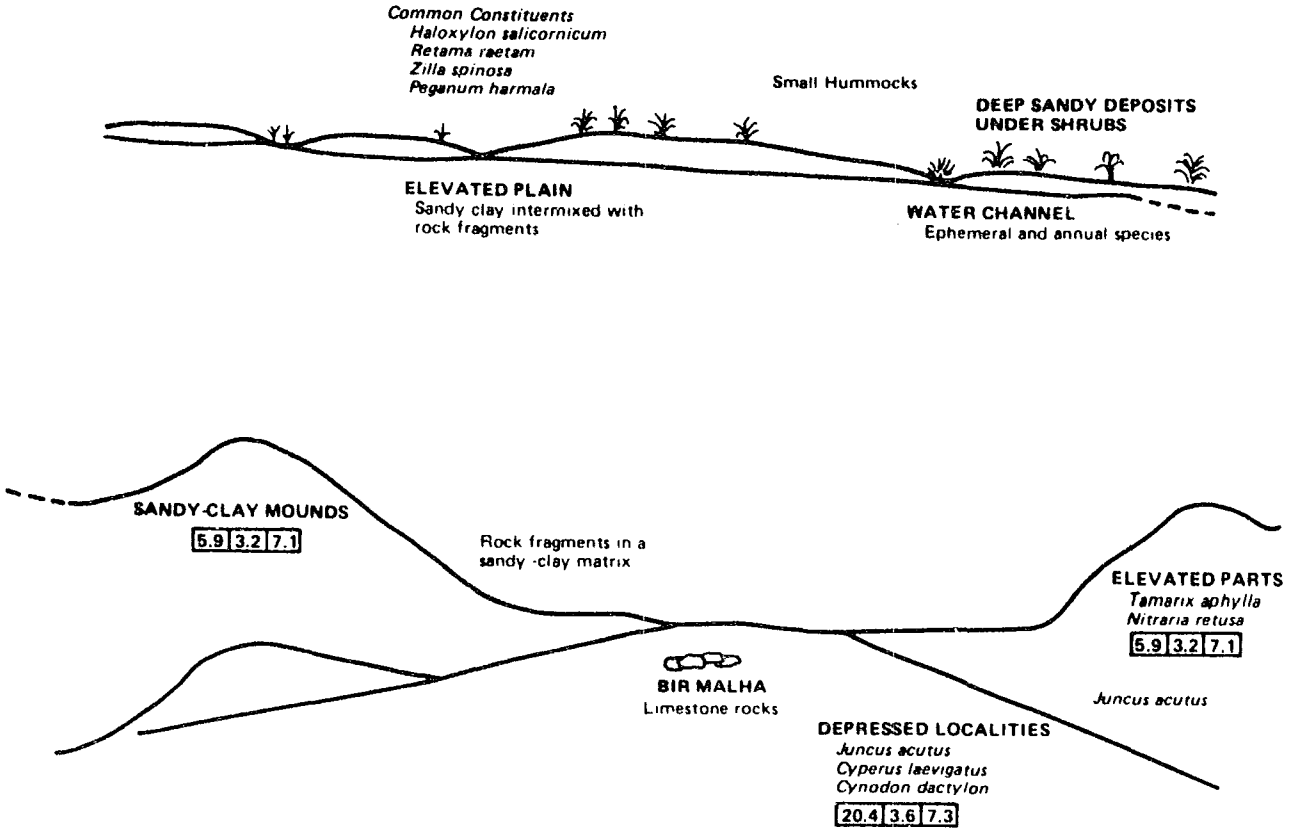
SCHEMATIC REPRESENTATION OF VEGETATIVE SPECIES FOR VARIOUS HABITATS IN THE LAKE BARDAWIL AREA

Dames & Moore



SCHEMATIC REPRESENTATION OF VEGETATIVE SPECIES FOR VARIOUS HABITATS OF WADI EL ARISH

Dames & Moore



LEGEND:

1 2 3

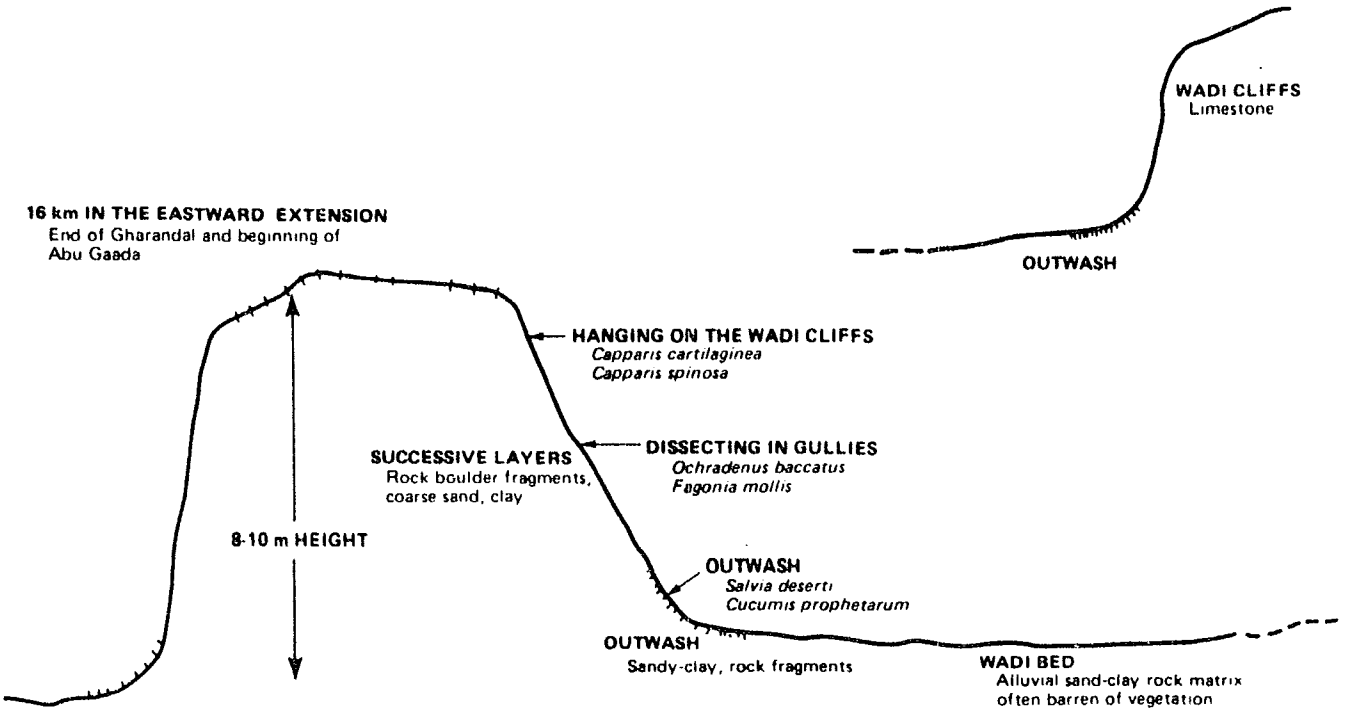
1 Moisture %

2 EC (mmhos/cm)

3 pH

SCHEMATIC REPRESENTATION OF VEGETATIVE SPECIES FOR VARIOUS HABITATS IN WADI GHARANDAL NEAR THE WELL AT BIR MALHA

Dames & Moore



LEGEND:

1	2	3

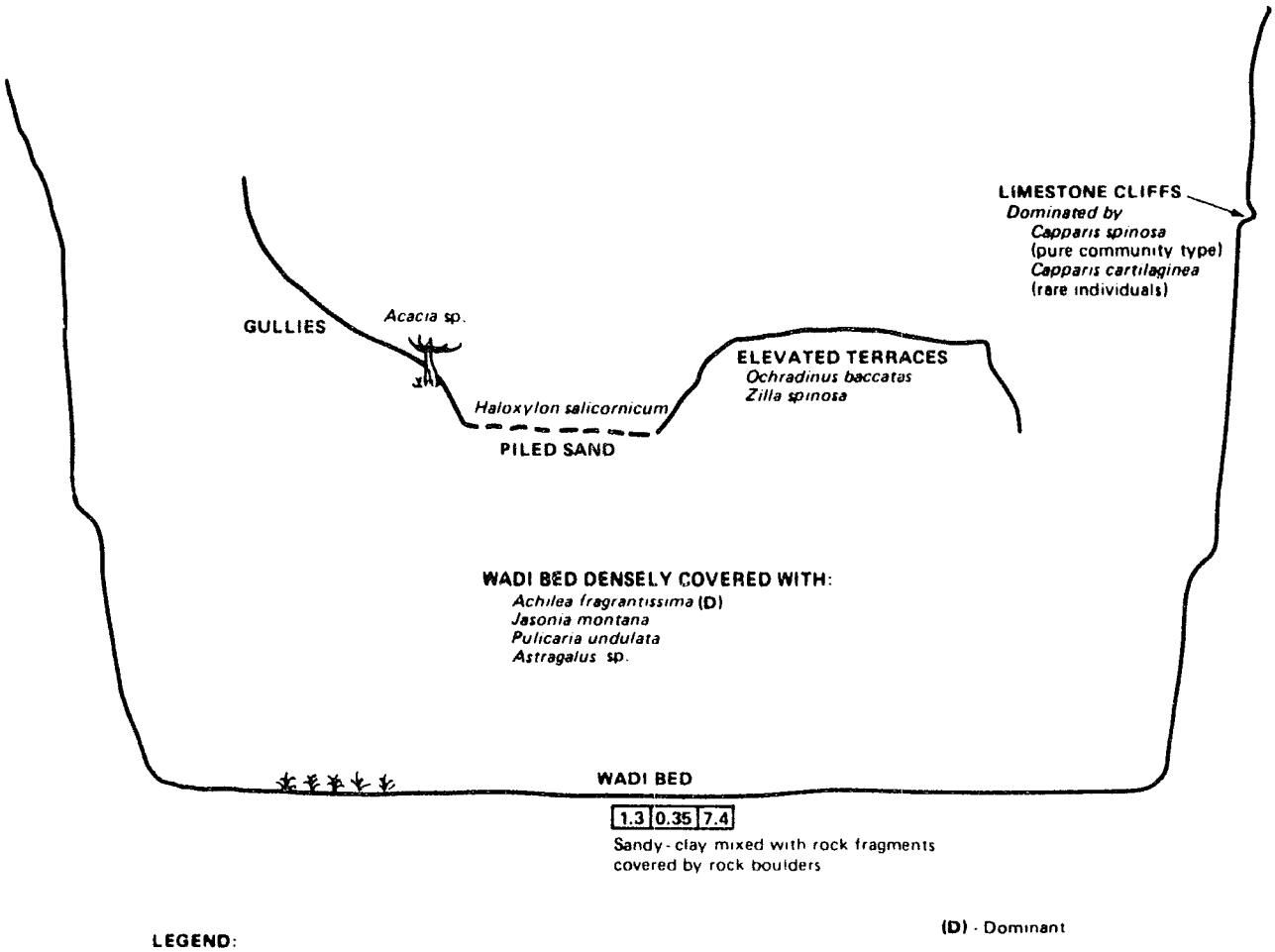
1 Moisture %

2 EC (mmhos/cm)

3 pH

SCHEMATIC REPRESENTATION OF VEGETATIVE SPCIES FOR VARIOUS HABITATS IN WADI GHARANDAL NEAR ABU GAADA

Dames & Moore



(D) - Dominant

LEGEND:

1 2 3

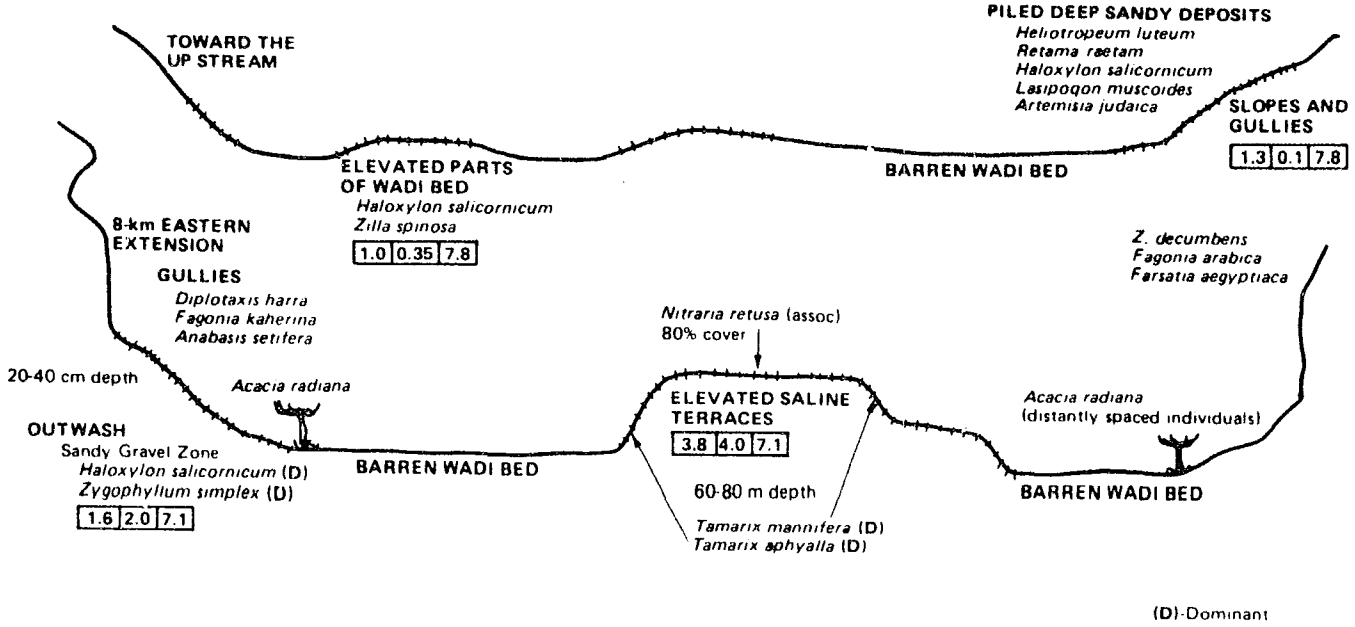
1 Moisture %

2 EC (mmhos/cm)

3 pH

SCHEMATIC REPRESENTATION OF VEGETATIVE SPECIES FOR VARIOUS HABITATS IN WADI GHARANDAL BETWEEN ABU GAADA AND WADI UMM LISSEIFA

Dames & Moore



LEGEND:

1 2 3

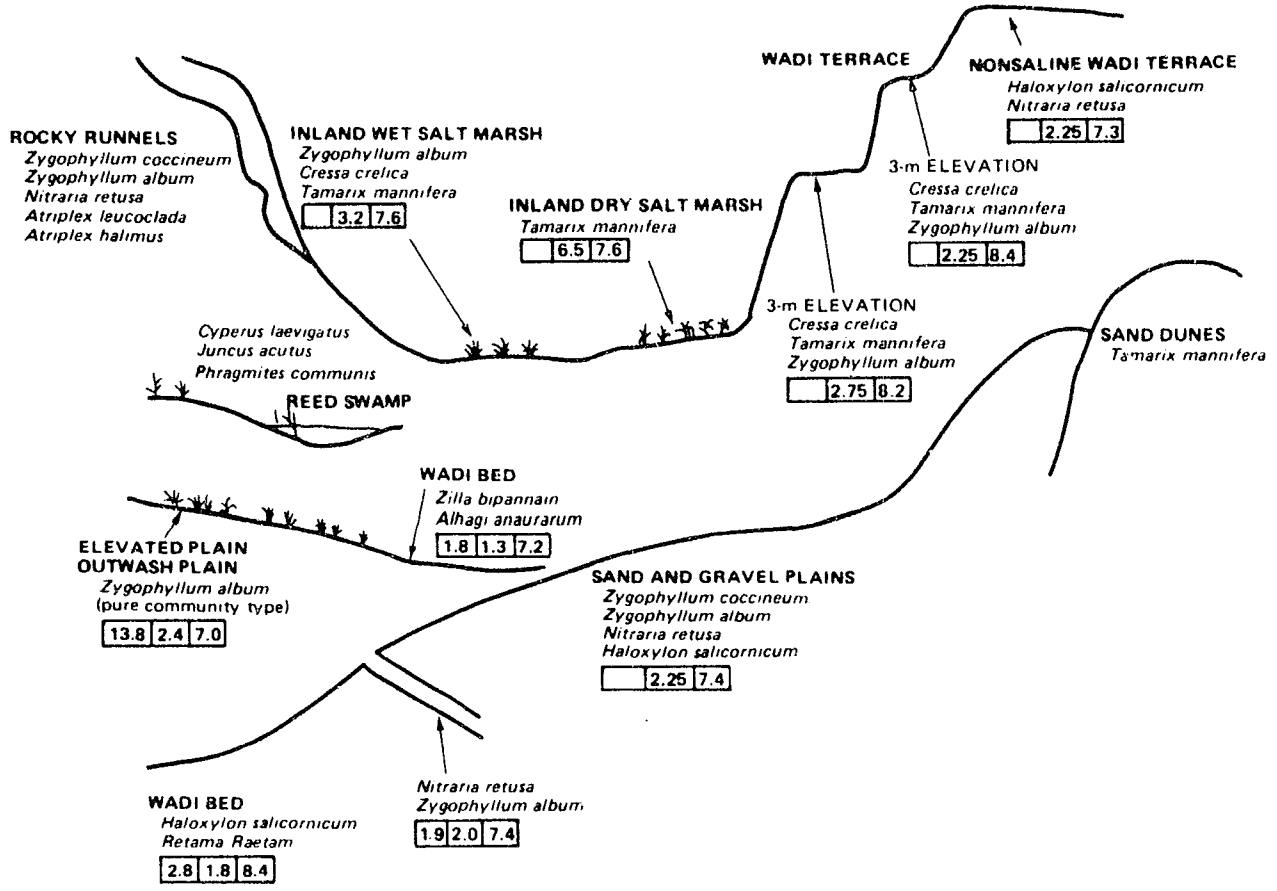
1 Moisture %

2 EC (mmhos/cm)

3 pH

SCHEMATIC REPRESENTATION OF VEGETATIVE SPECIES FOR VARIOUS HABITATS IN THE WADI GHARANDAL EASTERN EXTENSION

Dames & Moore



LEGEND:

1 2 3

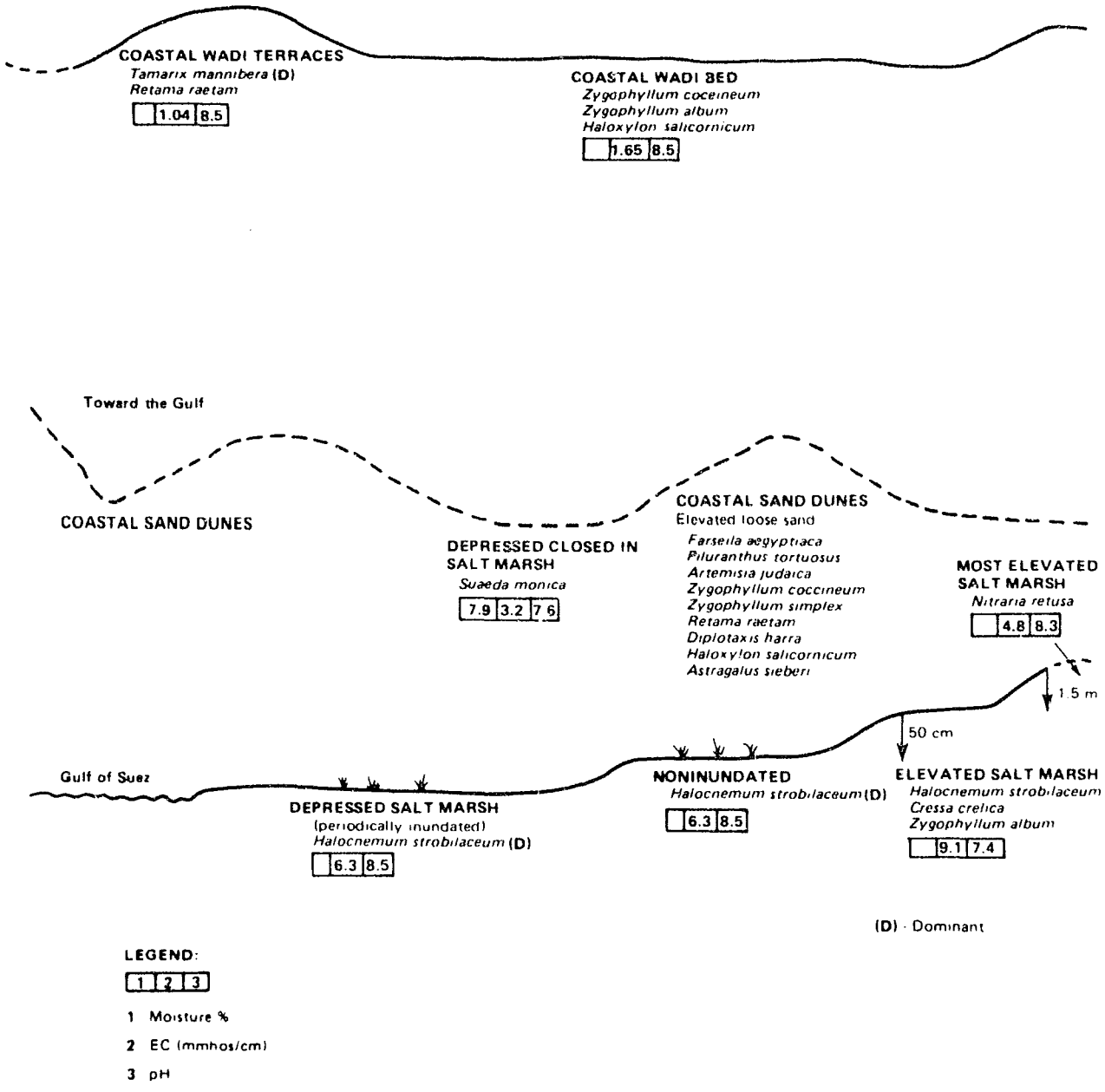
1 Moisture %

2 EC (mmhos/cm)

3 pH

SCHEMATIC REPRESENTATION OF VEGETATIVE SPECIES FOR VARIOUS HABITATS IN THE WADI GHARANDAL PLATEAU REGION

Dames & Moore



SCHEMATIC REPRESENTATION OF VEGETATIVE SPECIES FOR VARIOUS HABITATS IN THE WADI GHARANDAL COASTAL ZONE

Dames & Moore

FAUNA

Important Wild Mammals
1980

Order	Genus and Species	Common Name	Location in Sinai
Insectivora		Hedgehogs and shrews	
	Hemiechinus auritus aegyptiana	Long-eared hedgehog	Northeast
	Paraechinus dorsalis dorsalis	Desert hedgehog	Southwest
	Crocidura suaveolens portali	Lesser white-toothed shrew	South-central, near St. Catherine's Monastery
Lagomorpha		Hares	
	Lepus capensis sinaiticus	Hare	Northeast, west, and south (Gebel Musa)
Rodentia		Rodents	
	Gerbillus pyramidum flowerl	Greater gerbil	Northeast and along the east side of the Gulf of Suez opposite Suez
	Gerbillus andersoni boshotei	Anderson's gerbil	Northeast
	Gerbillus gerbillus asyutensis	Lesser gerbil	Northeast
	Dipodillus dasyurus dasyurus	Rough-tailed dipodil or Wadi Hof gerbil	North, northeast, west-central, east central, and southern mountains
	Dipodillus henleyi mariae	Henleys gerbil or pigmy dipodil	Southwest along Gulf of Suez coast
	Sekeetamys calurus calurus	Bushy-tailed dipodil	West-central/southern mountains near St. Catherin
	Meriones crassus crassus	Silky jird	North, central, and northeast, Gulf of Suez coast, mountains near St. Catherine
	Meriones sacramenti	Negev jird	Extreme northeast
	Psammomys obesus terraesanctae	Fat sand rat	North
	Rattus rattus	House rat	North
	Mus musculus praetextus	House mouse	North, west, and southeast
	Acomys russatus russatus	Golden spiny mouse	Southwest
	Acomys cahirinus dimidiatus	Egyptian spiny mouse	Southwest along Gulf of Suez
	Eliomys queranus melanurus	Garden dormouse	East and west-central/mountains near St. Catherin
	Jaculus orientalis orientalis	Greater Egyptian jerboa	Southwest
	Jaculus jaculus schlueteri	Lesser jerboa	West and southwest
	Hystrix cristata	Crested porcupine	North central
Carnivora			
Family: canidae			
	Canus aureus lupaster	Jackal	Northeast
	Vulpes vulpes aegyptiaca	Nile fox	West-central, across Gulf of Suez from Suez
	Vulpes ruppelli ruppelli	Ruppel's sand fox	Southwest
	Fennecus zerda	Fennec fox	North
Family: hyaenidae			
	Hyaena hyaena dubbah	Striped hyaena	Extreme north and south
Family: felielae			
	Felis sylvestris tristrami	Wild cat	Northeast and southwest
	Caracal caracal schmitzi	Caracal	Extreme north and south
	Acinoryx jubatus	Cheetah	North central
Hyracoidea			
Family: procavidae			
	Procavia capensis syriaca	Hyrax	South and southeast
Artiodactyla			
Family: bovidae			
	Gazella dorcus saudiya	Dorcus gazelle	Northeast
	Capra ibex nubiana	Ibex	West and southwest

Source: D. J. Osborne and I. Helmy, "The Contemporary Land Mammals of Egypt (Including Sinai)," Fieldians Zoology New Series, No. 5 (Cairo: Field Museum of Natural History, 1980).

Estimated Numbers of Livestock
1950 - 1981

Type	1950[a]	1967[b]	1978[c]	1981[d]
Goats (*Capra* spp.)	9,000	15,600	66,200	120,600
Sheep (*Ovis* spp.)	7,500	9,500	25,400	38,000
Camels (*Camelus dromedarius*)	5,000	8,500	9,050	20,050
Donkeys (*Equus asinus*)	3,250	1,300	unreported	6,300
Horses (*Equus caballus*)	100	250	250	300
Cattle (*Bos* spp.)	800	1,250	160	100
TOTAL	25,650	36,400	101,060	185,350

[a]Ministry of Agriculture.

[b]General Desert Development Organization.

[c]The Israeli Occupied Territories Authorities.

[d]Desert Institute field survey, 1981.

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C. WATER RESOURCES (WA)

Estimated Water Use in Sinai during Late 1981, by Source
(37 Areas or Settlements)

Area or Community	Local Groundwater: Total Groundwater Currently Withdrawn (m^3/day)	Local Groundwater: Aquifer and Location	Local Groundwater: Wells or Springs	Local Groundwater: Uses: Public Supply (m^3/day)	Local Groundwater: Uses: Irrigation (m^3/day)	Local Groundwater: Uses: Exported to Other Areas (m^3/day)	Local Groundwater: Uses: Exported to Other Areas: Destination	Nile Water for Irrigation: Amount (m^3/day)	Nile Water for Irrigation: Origin	Piped Water for Domestic Supply: Amount (m^3/day)	Piped Water for Domestic Supply: Origin	By Truck for Domestic Supply: Amount (m^3/day)	By Truck for Domestic Supply: Origin	Total (m^3/day)
El Arish	25,000	Quaternary aquifer	Wells	8,100	14,300	2,600	Gifgafa and Wadi Umm Khisheib, also El Quseima	0	--	0	--	0	--	25,000
Rafah-Sheikh Zuwayid	15,000	Quaternary aquifers	Wells	Mostly from Israel National Carrier	15,000[a]	0	--	0	--	10,000[b]	Israel[c] National Carrier	0	--	25,000
Abu Aweigila	120	Wadi alluvium	Wells	20[a]	100[a]	0	--	0	--	600	El Arish[c] groundwater	0	--	720
El Quseima	310	Eocene or Cretaceous limestone	Well and springs	10[a]	300[a]	0	--	0	--	600	El Arish[c] groundwater	0	--	910
Bir El Abd	250	Sand dune aquifer	Wells	250[a]	0	0	--	0	--	0	--	16	Nile water at El Qantara	266
Bagila	30	Sand dune aquifer	Well	30[a]	0	0	--	0	--	0	--	28	Nile water at El Qantara	58
Rabaa	200	Sand dune aquifer	Wells and trench	20[a]	180	0	--	0	--	0	--	16	Nile water at El Qantara	216
Romana	30	Sand dune aquifer	Wells	30[a]	0	0	--	0	--	0	--	16	Nile water at El Qantara	46
Balaza	0	--	--	0	0	0	--	0	--	0	--	25	Nile water at El Qantara	25
Gilbana	100	Sand dunes or Pleistocene aquifer	Wells	100[a]	0	0	--	0	--	0	--	30(?)	Nile water at El Qantara	130
El Qantara East	0	--	--	0	0	0	--	0	--	500	Nile water, from across Suez Canal	0	--	500

[a]Estimated.

[b]Approximately 7,000 m^3/day of this quantity is believed to have been used for irrigation.

[c]Discontinued during summer of 1982.

Estimated Water Use Late 1981 (Continued)

Area or Community	Local Groundwater: Total Groundwater Currently Withdrawn (m^3/day)	Aquifer and Location	Wells or Springs	Uses: Public Supply (m^3/day)	Irrigation (m^3/day)	Exported to Other Areas (m^3/day)	Destination	Nile Water for Irrigation: Amount (m^3/day)	Origin	Piped Water for Domestic Supply: Amount (m^3/day)	Origin	By Truck for Domestic Supply: Amount (m^3/day)	Origin	Total (m^3/day)
New Mit Abul Kom, Heroes' Village and Youth Farms, East Bitter Lakes area	0	--	--	0	0	0	--	55,000	Nile water via Suez Irrigation Canal and siphons south of Ismailia	0	--	0	--	55,000
Gifgafa	10	Lower Cretaceous aquifer (?)	Military well	10[a]	0	0	--	0	--	100	El Arish[c] groundwater	0	--	110
"Early warning station" at Wadi Umm Khisheib	0	--	--	0	0	0	--	0	--	1,200[d]	El Arish groundwater	0	--	1,200
El Hema (Bachdad)	0	--	--	0	0	0	--	0	--	100	El Arish groundwater	0	--	100
El Hasana	130	Wadi alluvium, Paleocene formation, and basalt dykes	Wells	130[a]	0	0	--	0	--	0	--	24	El Hema pumping station (El Arish groundwater)	154
Bir El Thamada	12	Wadi alluvium	Wells	12[a]	0	0	--	0	--	0	--	10(?)	El Hema pumping station (El Arish groundwater)	22
Nakhl	100	Wadi alluvium and Lower Cretaceous	Wells	100[a]	0	0	--	0	--	0	--	0	--	100
El Shatt	0	--	--	0	0	0	--	0	--	0	--	2	Nile water from El Qantara	2

[d] Some of this flow was reportedly used for agriculture at the Wadi Umm Khisheib station.

Estimated Water Use Late 1981 (Continued)

Area or Community	Local Groundwater: Total Groundwater Currently Withdrawn (m^3/day)	Aquifer and Location	Wells or Springs	Uses: Public Supply (m^3/day)	Irrigation (m^3/day)	Exported to Other Areas (m^3/day)	Destination	Nile Water for Irrigation: Amount (m^3/day)	Origin	Piped Water for Domestic Supply: Amount (m^3/day)	Origin	By Truck for Domestic Supply: Amount (m^3/day)	Origin	Total (m^3/day)
El Kuntilla	60	Wadi alluvium	Wells	60[a]	0	0	--	0	--	0	--	0	--	60
El Themed	75	Wadi alluvium and Middle Cretaceous aquifer	Wells	75[a]	0	0	--	0	--	0	--	0	--	75
Ayun Musa	500-1,000[e]	Miocene and Lower Cretaceous aquifers	Flowing wells and springs	0	0	0	--	0	--	0	--	1	Nile water from El Qantara	1
Ras Misalla	150	Basal ~~Miocene and~~ Cretaceous	2 wells	0	0	150[a]	Ras Sudr	0	--	0	--	0	--	150
Ras Sudr and Abu Suweira	500	Quaternary	Wells	0	500[a]	0	--	0	--	150[a]	2 wells at Ras Misalla	40	Nile water from El Qantara	690
Wadi Gharandal	102	Quaternary	Wells	2	100[a]	0	--	0	--	0	--	0	--	102
Abu Zenima	50	--	--	50[a]	0	0	--	0	--	0	--	4	Nile water from El Qantara	54
Abu Rudeis	900	Quaternary	Wells (~8 km away in Wadi Sidri)	100[a]	0	0	--	0	--	0	--	8	Nile water from El Qantara	908
Feiran and Belayim oil-fields	0	Quaternary --	Nearby wells --	800[f] 0	0	0	--	0	--	1,300[f]	Wells in Wadi Feiran located 10-12 km from sea	0	--	1,300

[e]Estimated free flow from springs and flowing wells at Ayun Musa. The water is apparently not put to use; total dissolved solids (TDS) reported to range from 2,500 to 13,000 mg/l.

[f]Estimated use for oilfields.

Estimated Water Use Late 1981 (Continued)

Area or Community	Local Groundwater: Total Groundwater Currently Withdrawn (m^3/day)	Aquifer and Location	Wells or Springs	Uses: Public Supply (m^3/day)	Irrigation (m^3/day)	Exported to Other Areas (m^3/day)	Destination	Nile Water for Irrigation: Amount (m^3/day)	Origin	Piped Water for Domestic Supply: Amount (m^3/day)	Origin	By Truck for Domestic Supply: Amount (m^3/day)	Origin	Total (m^3/day)
Wadi Feiran (10-12 km from Gulf of Suez)	1,300	Miocene sandstone and possibly Quaternary	3 wells	0	0	1,300[f]	Feiran and Belayim oil-fields	0	--	0	--	0	--	1,300
Feiran Oasis	1,400	Wadi alluvium	Wells	50	1,350[a]	0	--	0	--	0	--	0	--	1,400
Wadi El Sheikh (between Feiran Oasis and Watia Pass)	210	Wadi alluvium	Wells	10	200[a]	0	--	0	--	0	--	0	--	210
Gebel Katherina area	100	Quaternary and crystal-line units	Wells and springs	60	40	0	--	0	--	0	--	0	--	100
El Tor area	2,800	Quaternary	Wells	700	100	2,000	Sharm El Sheikh	0	--	0	--	4	Nile water	2,804
Sharm El Sheikh	10	Miocene sandstone	Wells	10	0	0	--	0	--	2,000	El Tor wells	0	--	2,010
Nebq	50	Quaternary	Wells	50	0	0	--	0	--	0	--	0	--	50
Dahab	50	Quaternary	Wells	50	0	0	--	0	--	100[a]	Springs in crystalline rock located a few kilo-meters west	0	--	150
Nuweiba/ Nasit	50	Quaternary	Wells	50	0	0	--	0	--	100[a]	Springs in crystalline rock located a few kilo-meters west	0	--	150
TOTAL	49,099[g]	--	--	10,879	32,170	6,050	--	55,000	--	16,750	--	224	--	121,073

[g]Excludes unused free discharge at Ayun Musa.

SOURCE: Calculations by the Consultant.

Summary of Estimated Late 1981 Water Use in Sinai

		Estimated Average Use (m^3/day)
Water withdrawn from wells or springs in Sinai and used locally, subtotal		43,049
- Used for public supply	10,879	
- Used for irrigation	32,170	
Water withdrawn from wells or springs and conveyed to other parts of Sinai, subtotal		6,250
- El Arish groundwater	2,600	
- El Tor groundwater	2,000	
- Ras Misalla groundwater	150	
- Wadi Feiran groundwater	1,300	
- Crystalline-rock groundwater in Southeast Subregion	200	
Water imported from outside Sinai, subtotal		65,690
- Nile water		
by pipeline	55,500	
by truck	190	
by tanker	a/	
- From Israel		
from Eilat to Ras El Naqb	N/A	
from National Water Carrier at Rafah	10,000	
TOTAL		114,989

a/ Abu Rudeis and the Feiran and Belayim oilfields receive freshwater from Suez by tanker.

SOURCE: Derived from the detailed estimates of use shown on Table WA-US 1.

Sinai Water Resources Availability and Estimated Cost by Subregion

Subregion and Aquifer Type	Groundwater: Estimated Quantity Available[a] (m^3/day)	Groundwater: Approximate TDS[b] (mg/l)	Groundwater: Cost Range (LE/m^3)	Desalinized Water: Feedwater	Desalinized Water: Quantity per Desalinization Unit (m^3/day)	Desalinized Water: Cost (LE/m^3)	Nile Water: Cost of Piped Water (LE/m^3)	Local Surface Water: Type	Local Surface Water: Quantity (m^3/day)	Local Surface Water: Cost (LE/m^3)
Northwest										
Miocene sandstone	10,000	1,000-8,000	0.02-0.30	Groundwater	1,000	0.40	0.03-.24	Nil	Nil	--
Northeast and Uplands										
Quaternary coastal aquifers (Romana to Rafah)	70,000	400-7,000	0.01-0.12	Groundwater	400	0.45	0.08-.36	Storage reservoirs	3,000-30,000 (released 1 year out of 3 or 4)	0.40-1.20[c]
Wadi alluvium (Wadi El Arish and tributaries, and Wadi El Gerafi)	30,000	1,500-6,000	0.02-0.21	Seawater	1,200	1.70	0.23-.56			--
Eocene limestone (near El Quseima)	3,000	500-3,000	0.01-0.14	--	--	--	0.47-.56	Spreader dyke storage and conservation	20,000[d] (on 1,500 feddans)	0.02-0.03
Middle Cretaceous aquifer	225,000	1,000-6,000	0.01-0.65	--	--	--	--		--	--
Lower Cretaceous and Nubian aquifer	350,000	1,000-7,000	0.01-2.00	--	--	--	--	--	--	--
Southwest										
Wadi alluvium (Wadi Sudr to Wadi Feiran)	20,000	200-7,000	0.02-0.70	Groundwater	1,000 5,000	0.40 0.33	0.12-.45	Spreader dyke storage and conservation	4,000[d] (on 300 feddans)	0.01-0.03
El Qaa Quaternary aquifer	110,000	600-5,000	0.01-0.10	Seawater	1,200	1.70	0.48-.52			
Miocene sandstone	2,000	2,500-8,000	0.01-0.20	--	--	--	--	--	--	--
Crystalline rock	15,000	200-2,500	0.03-0.45	--	--	--	--	--	--	--
Southeast										
Wadi alluvium (Wadi Watir to Wadi Umm Adawi)	8,000	300-4,000	0.02-0.60	Groundwater	1,000	0.40	--	Spreader dyke storage and conservation	4,000[d] (on 300 feddans)	0.01-0.03
Miocene sandstone (Sharm El Sheikh)	600	2,000-7,000	0.07-0.40	Seawater	1,200	1.70	--		--	--
Crystalline rock	15,000	200-2,500	0.03-0.45	--	--	--	--	--	--	--

[a] Includes any amount presently pumped from wells in addition to the amount presently used.

[b] TDS = total dissolved solids.

[c] Delivered to El Arish.

[d] Estimated long-term annual average.

SOURCE: Calculations by the Consultant in memoranda in Project files. Also see Appendix Table A-13 of Volume V.

Estimated Total Available Groundwater for Selected Areas*

Area	Aquifer	Case I: Original Estimate of Available Groundwater[a] (m^3/day)	Case II: Updated Estimate of Available Groundwater[b] (m^3/day)	Estimated Average Cost of Groundwater Under Case II (LE/m^3)	Estimated TDS of Water[c] (mg/l)
6. East side of Gebel El Maghara	Middle Cretaceous	5,000	10,000	0.10	2,000-5,000
7. Gebel El Halal	Middle Cretaceous	5,000	15,000	0.10	1,500-4,000
8. Gebels Yelleq and Fallig	Middle Cretaceous	9,000	20,000	0.10	1,500-4,000
11. Gebels Burga and Taliat El Bedan	Middle Cretaceous	2,000	12,000	0.10	2,000-4,000
12. Central Sinai	Middle Cretaceous	10,000	55,000	0.23	1,500-4,000
17. Wadi El Gerafi	Wadi alluvium	7,000	15,000	0.06	1,500-3,000
21 Wadi Sudr Delta	Wadi alluvium	1,200	4,000	0.05	2,500-5,000
22. Wadi Wardan Delta	Wadi alluvium	1,200	6,000	0.05	2,000-7,000
23. South central Sinai	Middle Cretaceous	12,000	43,000	0.17	1,500-4,000
24. Gebel Somar to Gebel Igma	Middle Cretaceous	12,000	37,000	0.09	1,000-3,000
25. El Themed to Ras El Gineina	Middle Cretaceous	12,000	32,000	0.13	2,000-6,000
33. El Qaa Plain	Quaternary fluvial deposits	30,000	110,000	0.04	600-5,000
40. Gebel El Maghara	Lower Cretaceous sandstone	6,000	46,000	0.13	1,200-6,000
41. Risan Aneiza	Lower Cretaceous sandstone	2,400	30,000	0.15	2,000-7,000
44. Central Sinai	Lower Cretaceous sandstone	10,000	180,000	0.41	1,500-2,500
45. South central Sinai	Lower Cretaceous sandstone	10,000	35,000	0.23	1,500-2,500
46. South Sinai	Nubian aquifer (Lower Cretaceous and older)	7,000	57,000	0.18	1,500-3,500

*Figures 2.5-2.7 in Volume V give locations. The only other major areas considered to have substantial groundwater potentials are the Quaternary aquifers near El Arish and Rafah (see Table 2-9 of Volume V), which are already actively exploited and in the opinion of some observers probably over-exploited.

[a]Based on the "water balance" approach (see Appendix Table A-4 in Volume V).
[b]Based on an optimum drawdown caused by a network of wells over a 30-year period.
[c]TDS = total dissolved solids.

SOURCE: Derived from the reanalysis of groundwater availability undertaken early in 1983, which is described and documented in Section 2.2.4.3 of Volume V.

Definition of Water Quality Groups

Descriptive Term	Quality Group	TDS Assumed Range (mg/l)[a]
"Very good"	1	0-500
"Good" "Fresh"	2	500-1,500
"Fairly good" "Fair" "Slightly brackish" "Slightly good"	3	1,500-2,500
"Brackish" "Slightly saline"	4	2,500-4,000
"Poor" "Not good" "Very brackish" "Fairly salty"	5	4,000-7,000
"Salty" "Foul" "High salinity" "Bad"	6	>7,000

[a]TDS = total dissolved solids.

Sources:

1) M. Pavlov, and M. Ayuty, Groundwaters of the Sinai Peninsula, Report to the General Director of the General Desert Development Authority (Cairo: February 1961).

2) South Sinai, Sheet 6 of Map of Egypt, T/43/327, 1:500,000 scale, Second Edition (Cairo: Survey of Egypt, 1943).

3) North Sinai, Sheet 3 of Map of Egypt, 45/57, 1:500,000 scale, Third Edition (Cairo: Survey of Egypt, 1945).

4) Map 1, International Boundary and the Lines of the Zones, Sinai--North Sheet and Sinai--South Sheet, No. 5041073-79, 1:250,000 scale (U.S. Army Map Service, 1979).

Definition of Water Yield Groups
(quantity)

Descriptive Term	Yield Group	Assumed Yields (m^3/day)
"Very large quantity" "Large quantity" "Abundant" "Plentiful supply" "Unlimited supply"	1	>200
"Fairly large quantity" "Good quantity" "Good supply"	2	20-200
"Fair quantity" "Fair supply" "Medium supply" "Indifferent supply"	3	2-20
"Limited quantity" "Small quantity" "Very small quantity" "Poor supply"	4	<2

Sources:

1) M. Pavlov, and M. Ayuty, Groundwaters of the Sinai Peninsula, Report to the General Director of the General Desert Development Authority (Cairo: February 1961).

2) South Sinai, Sheet 6 of Map of Egypt, T/43/327, 1:500,000 scale, Second Edition (Cairo: Survey of Egypt, 1943).

3) North Sinai, Sheet 3 of Map of Egypt, 45/57, 1:500,000 scale, Third Edition (Cairo: Survey of Egypt, 1945).

Summary of Water Quality and Yield Data for Water Points in Sinai, by Geologic Unit

Geologic Unit	Mean Quality Index (Q)	s_Q [a]	No. of Points With Quality Data	Mean Yield Index (Y)	s_Y [a]	No. of Points With Yield Data
Dune sands	4.1	1.5	51	1.8	1.2	16
Quaternary sand and gravel sediments	3.3	1.6	245	1.2	0.7	142
Pliocene	5.7	0.6	3	2.5	2.1	2
Miocene sedimentary rock	5.0	1.2	51	1.5	0.8	12
Miocene dyke rock	5.0	1.0	3	2.0	0	3
Eocene	4.9	1.6	28	1.9	1.1	10
Paleocene	4.0	0	1	--	--	0
Upper Cretaceous	3.7	1.6	30	2.6	1.2	21
Middle Cretaceous	3.0	1.7	37	2.8	1.1	20
Lower Cretaceous	4.1	1.5	39	1.7	0.9	10
Jurassic	5.4	0.8	12	2.5	0.7	7
Cambrian to Cenomanian (undifferentiated) and Cambrian to Triassic (undifferentiated)	3.3	1.3	19	2.8	1.3	4
Precambrian crystalline rocks	2.4	1.0	55	2.5	1.2	14
TOTAL	3.6	--	574	1.7	--	261

[a] "s" refers to the estimate of the standard deviation.

SOURCE: Derived from data presented in Tables 3-13a through 3-13m in Working Paper No. 33 in the SDS-I project files. The basic data on each of the 716 water points, including source reference, are given on the hydrogeologic information cards in Working Paper No. 34. Values are averaged over all groundwater provinces.

Summary of Water Quality and Yield Data for Water Points in Sinai, by Groundwater Province

Geomorphic Groundwater Province[a]	Mean Quality Index (Q)	No. of Points With Quality Data	Mean Yield Index (Y)	No. of Points With Yield Data
Mediterranean Foreshore	3.4	156	1.2	126
Mobile Platform	4.0	67	2.4	27
Northern Stable Platform	3.8	23	2.5	11
Southern Stable Platform	2.8	66	2.7	40
Southern Platform	2.0	75	2.4	13
Suez Rift	4.7	143	1.5	36
Aqabah Rift	3.9	44	1.6	8
TOTAL	3.6	574	1.7	261

[a] See Figure 2.8 in Volume V for location of Groundwater Provinces.

SOURCE: Derived from data presented in Tables 3-13a through 3-13m in Working Paper No. 33 in the SDS-I project files. The basic data on each of the 716 water points, including source reference, are given on the hydrogeologic information cards in Working Paper No. 34. Values are averaged over all groundwater provinces.

Estimation of Pumpage From Wells in the El Arish Area, Fall 1981

Agricultural Use

Crop	No. of Feddans Irrigated	Estimated Irrigation Duration (days/yr)	Estimated Consumptive Use Rate (mm/yr)	Total Estimated Consumptive Use (m^3/yr)	Total Estimated Consumptive Use (m^3/day)
Citrus	30	320	1,830	0.23×10^6	630
Pomegranate, almonds, figs, guavas, cashurina	40	320	1,830	0.30×10^6	840
Vegetables, grapes, melons, etc.	450	130	1,020	1.90×10^6	5,240
Olives	700[a]	320	580	1.70×10^6	4,630
TOTAL	1,220	--	--	4.10×10^6	11,340

Assuming an overall irrigation and conveyance efficiency of approximately 80 percent, gross pumpage for agricultural purposes	~14,300
Public Supply, from town supply wells	8,100
Public Supply, from military wells[b]	2,600
TOTAL	25,000

[a] Approximately 70,000 olive trees.

[b] Water was pumped from the military wells as El Arish by pipeline to Abu Aweigila and Quseima, and to El Hema, Gifgafa, and Umm Khisheib, until early 1982.

SOURCE: Derived from data supplied by the agricultural officer at El Arish.

Hydrographic Basin Areas in Sinai

Basin	Area (km2)	Subregion[a]
1. Upper El Arish	16,306[b]	UP
a. El Bruk	3,345	UP
b. El Ruaq	6,481	UP
c. El Aqabah	2,839	UP
d. Geraia	3,641	UP
2. Lower El Arish	2,749[c]	NE and UP
3. Northeast coast	963	NE
4. North coast	5,148	NE and UP
5. Hegayib	1,680	UP
6. El Hasana-El Hema	3,549	UP and NE
7. El Gerafi	2,446	UP
8. Wasit	4,204	SE
9. Dahab	2,684	SE
10. Kid	1,355	SE
11. Umm Adawi	964	SE
12. El Qaa	3,904	SW
13. Abu Durba	266	SW
14. Feiran	1,717	SW
15. Sidri	1,163	SW
16. Baba	841	SW
17. Tayiba	860	SW
18. Gharandal	829	SW
19. Wardan	1,569	SW
20. Sudr	895	SW
21. Lahata	603	SW
22. El Raha	847	NW
23. El Hagg	621	NW
24. El Giddi	703	NW
25. Umm Khisheib	4,641	NW
TOTAL	Approximately 61,000[d]	

[a] The Study Team defined five subregions for planning purposes. The boundaries of these subregions were based primarily, but not exclusively, on the approximate boundaries of groups of hydrographic basins. See Figure 2.2 of Volume V for location of basins.

[b] Total basin area includes an additional 45 square kilometers outside Sinai.

[c] Total basin area, including portions outside Sinai, is approximately 4,000 square kilometers.

[d] Sinai basin areas add to 61,507 square kilometers but are rounded to 61,000 square kilometers in this report.

SOURCE: The Consultant divided Sinai into 25 hydrographic basin areas for the purposes of this Study. Square kilometers were estimated by planimeter after basins were drawn on a 1:750,000-scale map.

Reported Floodwater Quantities Flowing in the Lower Part of Wadi El Arish

Date	Magnitude of Flood (Torrent)	Annual Rainfall at El Arish (mm)	Reference
Oct. 1925	"Very strong"	114	1268
Dec. 1928	"Strong"	64	1268
Dec. 1930	"Strong"	110	1268
Oct. 1931	"Medium"	69	1268
Dec. 1933	"Strong"	82	1268
Oct. 1935	"Strong"	37	1268
Oct. 1937	"Very strong"	123	1268
Oct. 1938	"Medium"	126	1268
Oct. 1940	"Medium"	94	1268
Dec. 1942	"Strong"	98	1268
March 1943	"Weak"	121	1268
Jan. 1945	"Very strong"	--	1268
1945	7 days continuous flow at Mitmetni	--	(a)
1948	21×10^6 m^3(b)	87	1037, 1350
1950	18×10^6 m^3(b)	127	1037
1951	$\sim 3 \times 10^6$ m^3(b)	45	1037
1953	$\sim$800,000 m^3(c)	126	1350
1954-1964	Information missing	--	--
1965/1966	$>1 \times 10^6$ m^3(b)	193/63	1350
1967-1974	Information missing	--	--
1975	"Large flood" at El Arish	--	1265
1976-1979	Information missing	--	--
1980	"Large flood" at El Arish	--	1265

[a]Observed by Dr. A. Shata.

[b]At Rawafaa dam.

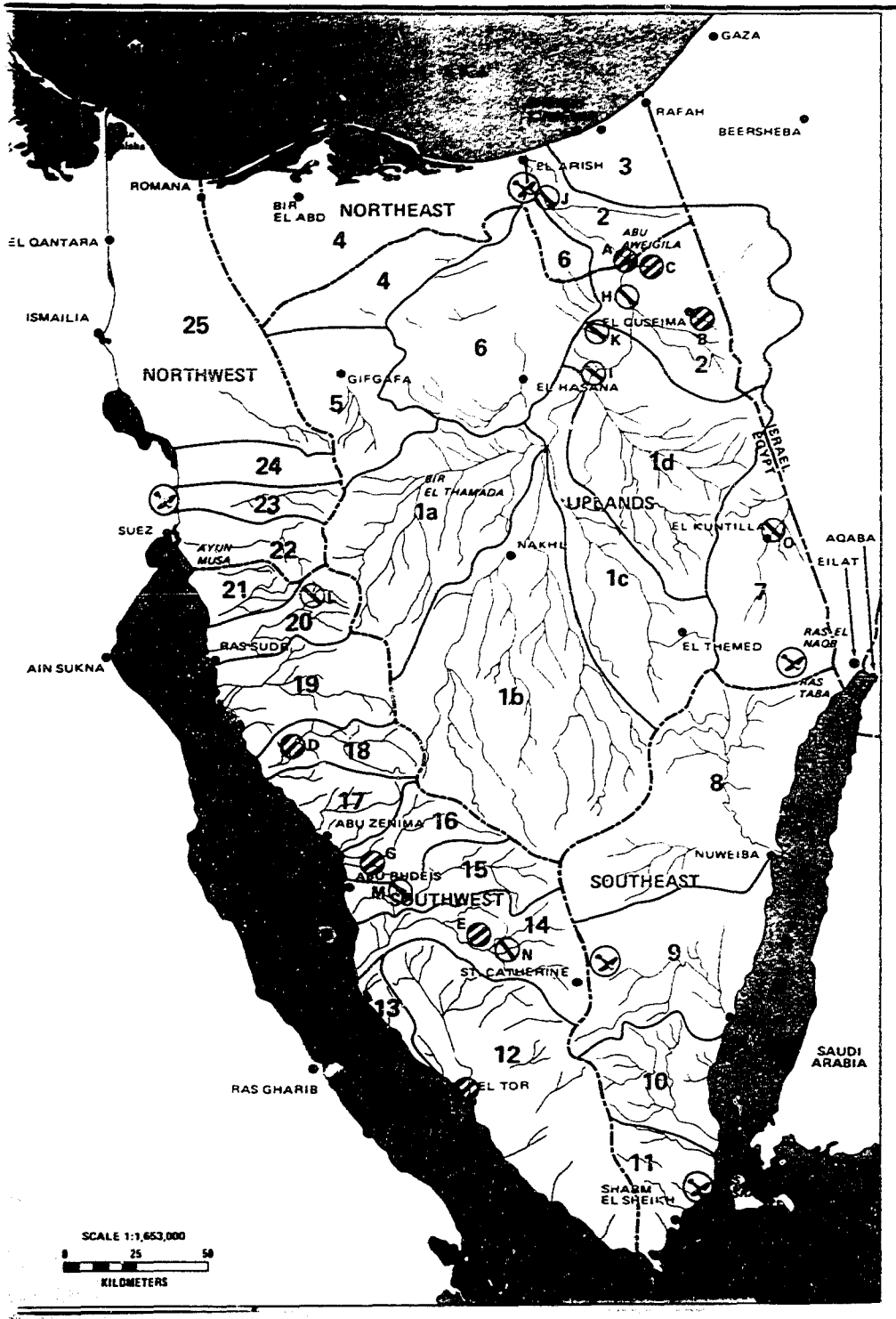
[c]The quantity reaching Wadi El Arish from Wadi Hareidin.

Inventory of Dams in Sinai[a]

Name	Description	Reference
A. Rawafaa Dam	Arched masonary dam located on Wadi El Arish, about 52 km south of El Arish; capacity about 3,000,000 m^3; reported to be silted up.	1268, 1350
B. El Gudeirat Dam	Masonry dam, located about 9 km west of the Israeli border; built by the Turks in World War I, but presently silted up.	1268
C. Perkins Dam	Masonry dam on Wadi El Gudeirat located on Wadi Sad, one of the short wadis draining the southeastern flank of Gebel Dalfa (east of Gebel El Halal).	1268
D. Wadi Gharandal Dams	Two small diversion dams in Wadi Gharandal, located 10-12 km from the Gulf of Suez; used for irrigation; the uppermost one ponds back 300-400 m^3 of slightly brackish water; presumably an earthen structure in both cases.	0230
E. Wadi Nefuz Dam	Wadi Nefuz flows from Gebel Banat to Wadi Feiran and is located north of the Oasis of Feiran; the dam is located in the upper part of this wadi, where it flows through a red granite canyon, exhibiting springs; the dam is filled with eroded soil.	1335
F. El Wadi Dam	A large dam built by the Bedouins at El Wadi, north of El Tor, for irrigation purposes; it was subsequently washed away.	1335
G. Wadi Shellal Dam	Formerly supplied piped water to Umm Bugma.	1333

[a] Locations of these dams are shown on Figure 2.2 in Volume V.

SOURCE: Information from various sources as noted in reference column, which refers to the detailed list of references in Appendix B of Volume V.



HYDROGRAPHIC BASINS, EXISTING DAMS AND POSSIBLE DAM SITES

LEGEND

25 — HYDROGRAPHIC BASIN IDENTIFICATION NUMBER, REFER TO KEY FOR BASIN NAMES

PORTION OF BASIN OUTSIDE SINAI PENINSULA

G — EXISTING DAM, REFER TO KEY FOR DAM NAME AND LOCATION

O — POSSIBLE DAM SITE, REFER TO KEY FOR SITE LOCATION

–KEY TO HYDROGRAPHIC BASINS–

IDENTIFICATION NUMBER	BASIN
1	Upper El Arish
1a	El Bruk
1b	El Ruaq
1c	El Aqabah
1d	Geraia
2	Lower El Arish
3	Northeast coast
4	North coast
5	Hegayib
6	El Hasana - El Hema
7	El Gerafi
8	Wasit
9	Dahab
10	Kid
11	Umm Adawi
12	El Qaa
13	Abu Durba
14	Feiran
15	Sidri
16	Baba
17	Tayiba
18	Gharandal
19	Wardan
20	Sudr
21	Lahata
22	El Raha
23	El Hagg
24	El Giddi
25	Umm Khisheib

–KEY TO EXISTING DAMS–

IDENTIFICATION LETTER	NAME AND LOCATION
A.	Rawafaa Dam, Wadi El Arish
B.	Gudeirat Dam, Wadi El Gudeirat
C.	Perkins Dam, Wadi Sad
D.	Two Small Dams on Wadi Gharandal
E.	Dam on Wadi Nefuz
F.	Dam at Wadi El Wadi, Wadi El Aawag (Destroyed)
G.	Dam on Wadi Shellal

–KEY TO POSSIBLE DAM SITES–

IDENTIFICATION LETTER	LOCATION
H.	El Daiqa Gorge, Wadi El Arish
I.	Mitmetni Gorge, Wadi El Arish
J.	El Lahfan Gorge, Wadi El Arish
K.	Wadi El Hadira
L.	Wadi Sudr
M	Wadi Sidri
N.	Wadi Feiran
O.	Wadi El Gerafi

–NOTES–

Additional Information Pertaining to Hydrographic Basins may be found in Tables 2-2, 2-4, 2-11, and 2-12.

HYDROGRAPHIC BASINS, EXISTING DAMS AND POSSIBLE DAM SITES

Distribution of Spreader Dyke Areas in Sinai

Location	No. of Areas Observed on Aerial Photomosaics to Contain Spreader Dykes
Gebel El Maghara	3
Wadi El Hegayib and Wadi Dalma (north of Gebel Umm Khisheib and on east side of Gebel Yelleq)	9
Southeast of Gebel Dalfa	1
Wadi El Gerafi	5
Wadi El Hagg, upper reaches	1
Wadi El Arish Basin	
Gebel Hamra-Gebel El Heitan area (headwaters area of Wadi El Bruk)	4
Wadi El Bruk	5
Wadi El Aqabah	6
Wadi Geraia	9
Wadi El Arish (upstream of confluence with Wadi El Bruk)	13
Wadi El Arish (between confluence of Wadi El Bruk and confluence of Wadi Geraia with Wadi El Arish)	2
Wadi El Arish (between confluence with Wadi Geraia and El Daiqa Gorge)	1
Wadi Abu Gada (upper reaches)	1
Wadi Sudr delta	1
Wadi Sidri (upper reaches)	1
TOTAL (number of areas identified)	62

SOURCE: Interpretation by Consultant of photomosaics compiled from 1955-to-1956 aerial photographs. Plate 6-5 of Working Paper No. 45 shows the locations of these 62 areas.

Possible Dam Locations in Sinai

Location[a]	Wadi	Possible Purpose	Possible Problems
H. El Daiqa Gorge	El Arish	Supply of water to El Arish town; flood protection for El Arish town.	Deprivation of downstream areas; requires long conveyance system; evaporation loss relatively high.
I. Mitmetni Gorge	El Arish	Supply of water to El Arish town; flood protection for El Arish town.	Deprivation of downstream areas; requires long conveyance system; evaporation loss relatively high.
J. El Lahfan Gorge	El Arish	Supply of water to El Arish town; flood protection for El Arish town.	Possible foundation problems; long dam required; seepage losses could be high.
K. Gebel El Halal	El Hadira	Supply of irrigation water to El Arish flood plain south of Gebel El Halal.	Expected yield is relatively low.
L. 5 km west of Ain Sudr	Wadi Sudr	Public supply at Ras Sudr; irrigation supply for Wadi Sudr delta; cultivation in bed of reservoir.	Rate of siltation expected to be high; evaporation loss relatively high; expected yield is not high.
M. Near Gebel Maghara (South Sinai)	Wadi Sidri	Public supply for Abu Rudeis; irrigation water for Wadi Sidri Plain.	Rate of siltation expected to be high; evaporation loss relatively high; expected yield is not high.
N. Upstream of the Oasis of Feiran	Wadi Feiran	Flood protection for oasis; irrigation supply to the oasis and to northern El Qaa Plain.	Rate of siltation expected to be high; evaporation loss relatively high.
O. Near Kuntilla	Wadi El Gerafi	Irrigation supply; groundwater recharge.	Rate of siltation and evaporation expected to be high; modest yield; would require negotiations with Israel.

[a] Locations of these dams are shown on Figure 2.2 in Volume V.

SOURCE: Derived from SDS-I analysis of topographic characteristics of Sinai as described in Section 3.2.5 of Working Paper No. 33.

Availability of Nile Water for the Five Reclamation Areas Proposed in Sinai as Part of the Water Master Plan of 1981

No.	Name	Gross Area (feddans)	Proposed Method of Irrigation	Source of Water	Total Annual Water Duty ($m^3 \times 10^6$)
1	Coastal area between El Tina Plain and El Arish	265,000	Surface	El Salaam Canal	1,855
2	Coastal area between contours 5 and 60	250,000	Sprinkler	Salhia Canal (from Ismailia Canal)	1,250
3	El Tina Plain	135,000	Surface	El Salaam Canal	945
4	East Bitter Lakes	30,000	Sprinkler	Suez Irrigation Canal	150
5	East of Suez Canal	55,000	Sprinkler	Suez Irrigation Canal or Maadi-Suez pipeline	275
	TOTAL	735,000			4,475

SOURCE: Information from Reference (0862), listed in Appendix B of Volume V. Refer to Figure 2.11 in Volume V (and to Plate 5-3 in Working Paper No. 45 in the SDS-I project files) for the location of these proposed reclamation areas.

Estimated Groundwater Recharge for Major Aquifers in Sinai

Unit	Location[a]	Size of Outcrop or Recharge Areas (km^2)	Estimated Average Recharge (m^3/yr x 10^6)	Estimated Average Recharge (m^3/day)
Cambrian to Triassic sequence (undifferentiated), primarily sandstones	Southern Sinai	920	13.0	36,000
Cambrian to Cenomanian sequence (undifferentiated), primarily sandstones	Southern Sinai	290	5.9	16,000
Lower Cretaceous sandstones	Southern Sinai	610	8.5	23,000
Lower Cretaceous sandstones and carbonates	Northern Sinai	240	5.4	15,000
Middle Cretaceous sandstones, shales, and carbonates	Southern Sinai	4,450	46.0	126,000
Middle Cretaceous carbonates	Northern Sinai	1,950	24.0	66,000
El Qaa Plain Quaternary aquifer	Southern Sinai	2,300	24.0	66,000
El Arish Quaternary aquifer	El Arish area	200	11.0	27,000
El Rafah Quaternary aquifers	Rafah area	180	14.0	38,000
TOTAL				413,000

[a]Refer to Figure 2.9 in Volume V (and Plate 5-11 in Working Paper No. 45 in the SDS-I Project files) for recharge/outcrop area locations.

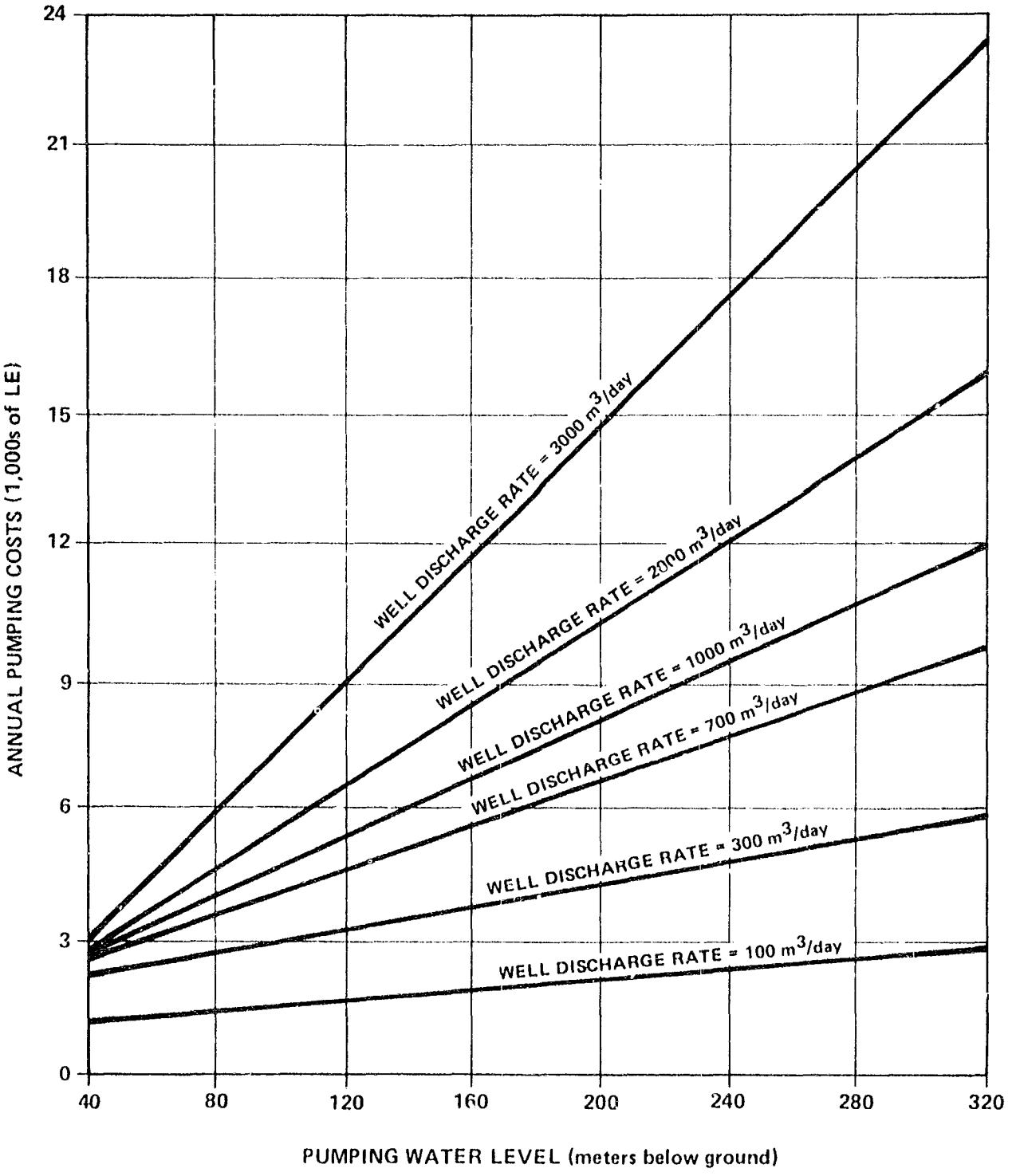
SOURCE: Estimated by planimetering the outcrop areas for consolidated rock aquifers on a 1:500,000-scale geology map (reference 0385)) and planimetering the recharge areas for major Quaternary aquifers on 1:100,000-scale topographic maps. Mean annual recharge was estimated from the results of the water balance analysis. See Table 2-12 of Volume V for further detail.

Assumptions Regarding Freshwater Requirements for Industrial and Mining Enterprises

Type of Enterprise	Assumed Water-Use Rate (m^3/day/employee)
Fertilizer plant	36.0*
Petrochemical plant	16.0*
Cement plant	7.0
Agricultural processing, sulfur extraction	2.0
Mineral processing	1.5
Industrial park industries, petroleum production	0.5
High-technology factories, quarrying	0.4
Manufacture of agricultural implements, fish processing	0.3
Light industries	0.2
Manufacture of clothes; storage of agricultural products; kaolin, turquoise, potash, and gypsum extraction	0.1
Handicrafts manufacture; mining of glass sand and salt	0.05

* Constitutes approximately half of the total water demand. The remainder is assumed to be provided by seawater or highly brackish water.

SOURCE: Working Papers Nos. 36 and 37 of the Sinai Development Study, Phase One, April 1982.

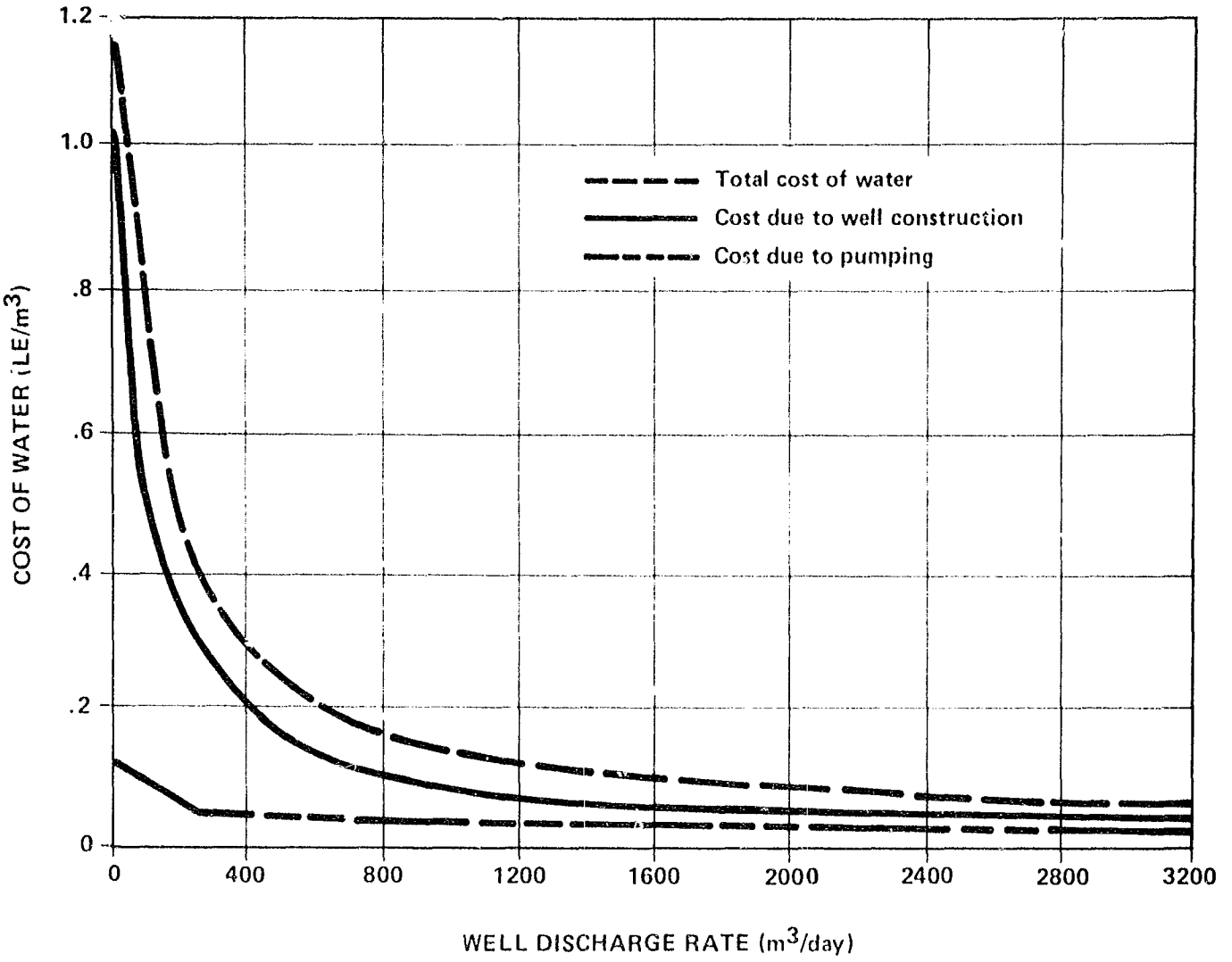


ASSUMPTIONS:

1. 10-year life for pumping unit.
2. Pumping only occurs 8 hours per day.

NOTE:
An example reading from this table would be as follows: To bring 2,000 m^3/day of water up from a depth of 240 meters, the annual pumping cost would be LE 12,000.

ANNUAL GROUNDWATER PUMPING COSTS



ASSUMPTIONS:

1. 300mm-diameter well in sedimentary rock.
2. Well depth is 500 meters.
3. Pumping water level is 130 meters below ground.

PROTOTYPICAL COST OF WATER FROM WELLS

Dames & Moore

Figure 4.6(a) Baloza - Romana - Negila Area

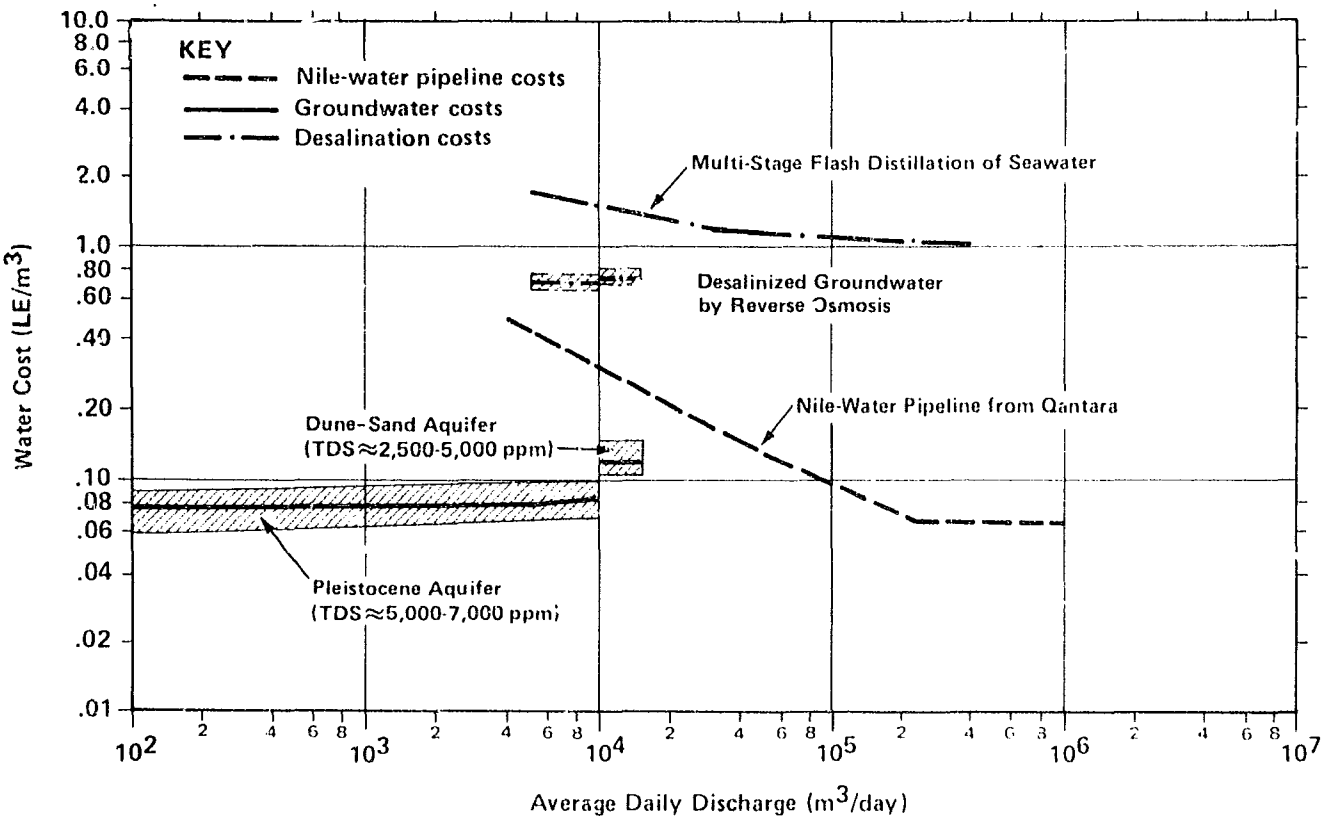
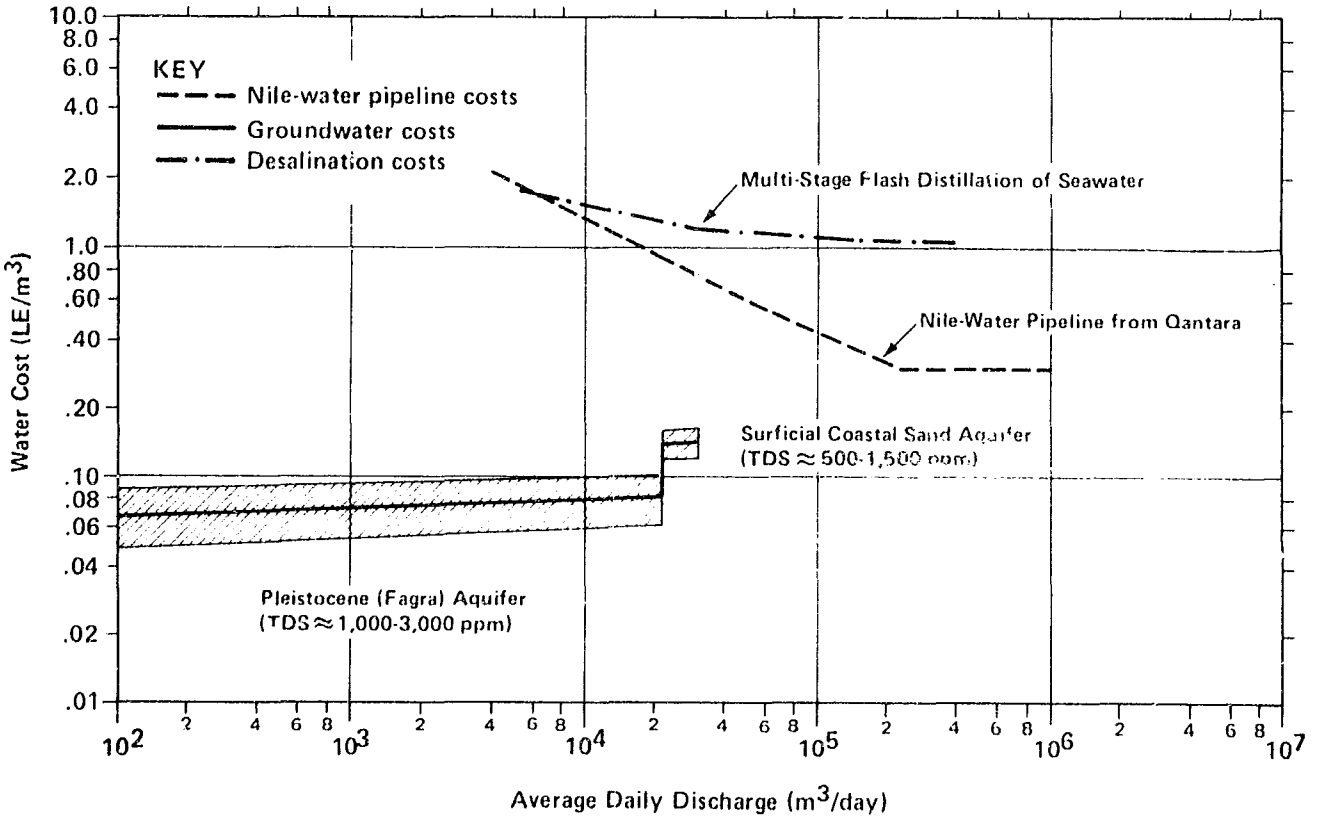


Figure 4.6(b) Sheikh Zuwayid - Rafah Area



GENERALIZED WATER-COST CURVES:
NORTH COAST AREAS

Dames & Moore

Figure 4.7(a) El Arish - Bir El Lahfan Area

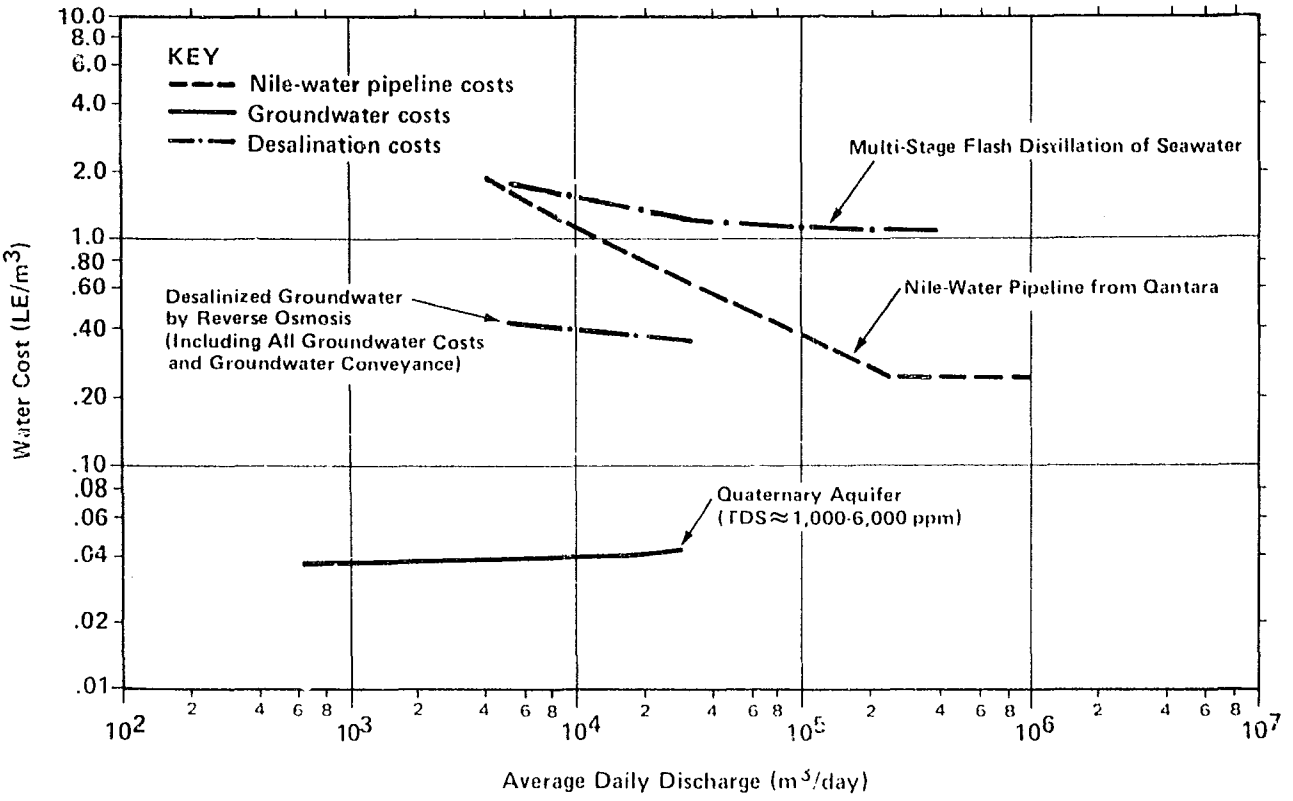
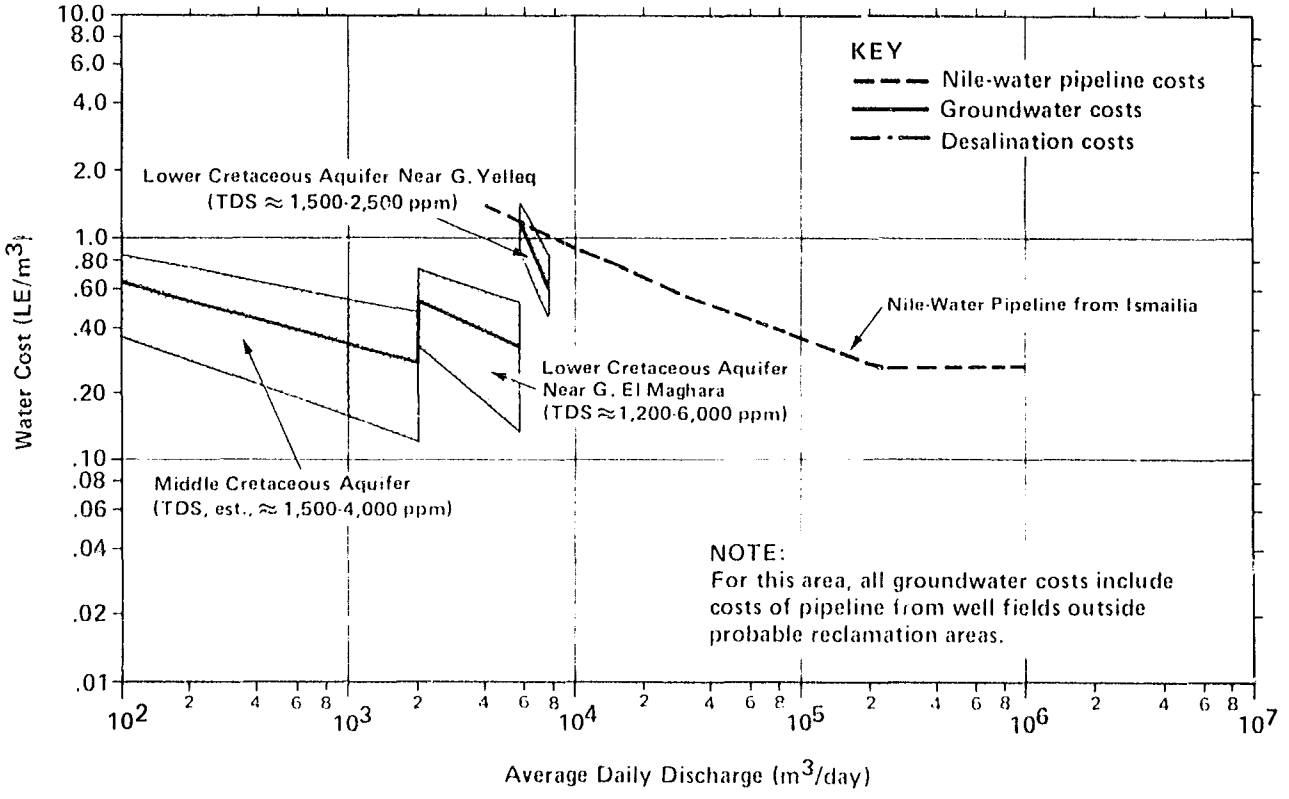


Figure 4.7(b) Gifgafa Area



GENERALIZED WATER-COST CURVES:
LOWER WADI EL ARISH AND GIFGAFA AREAS

Dames & Moore

Figure 4.8(a) Wadi El Bruk Area

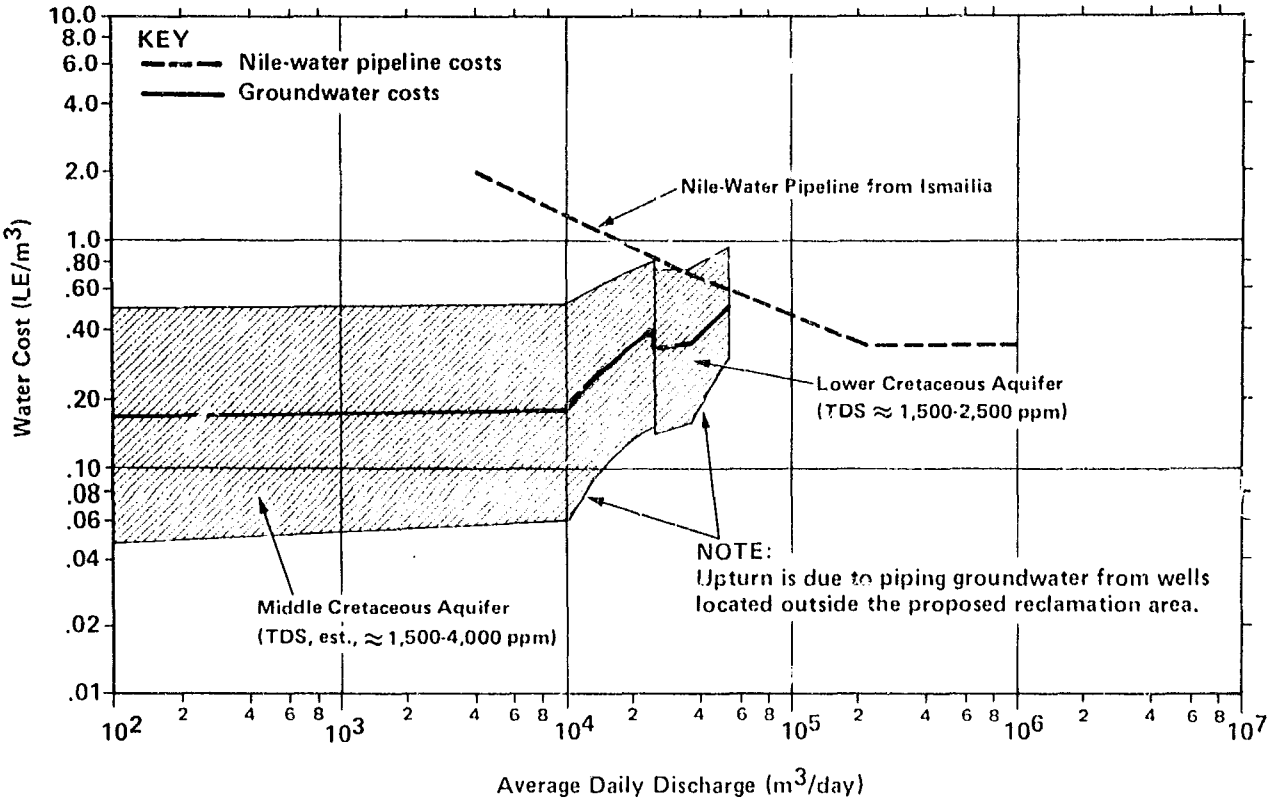
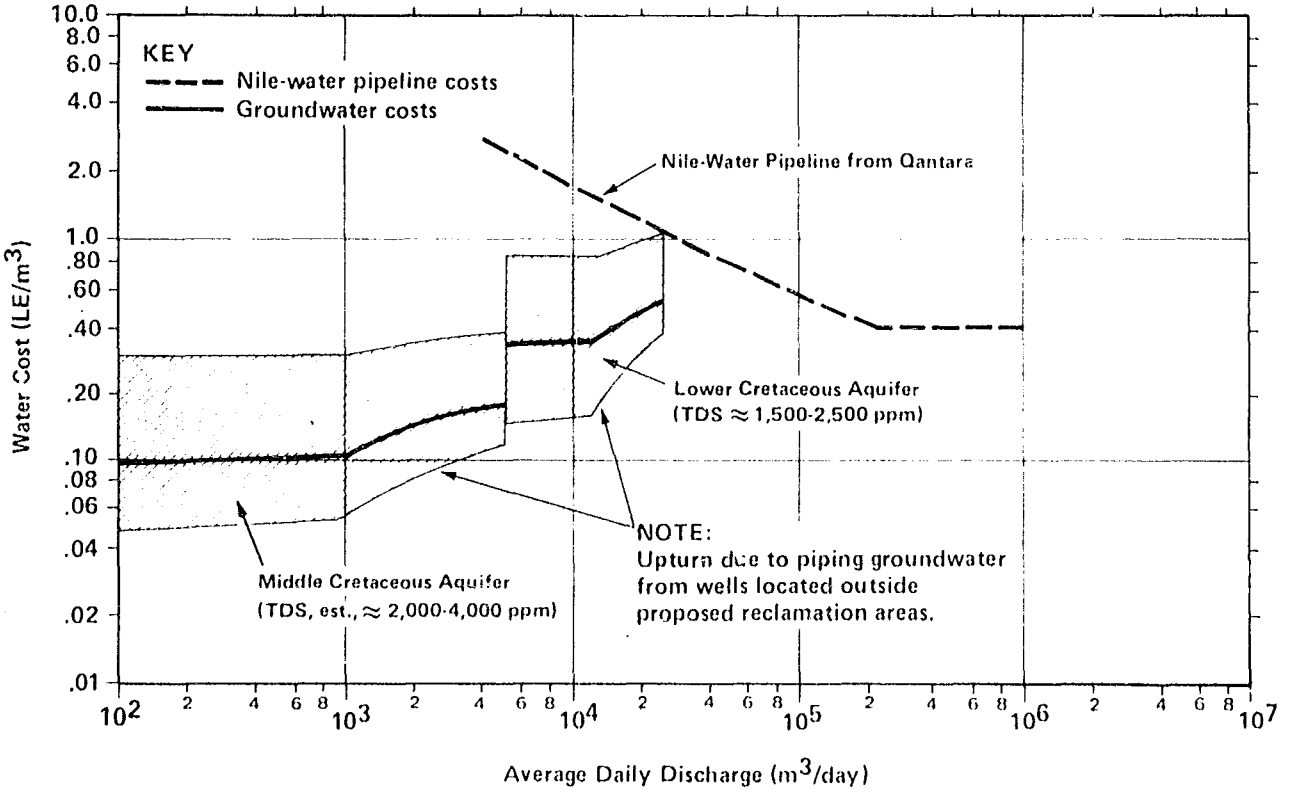


Figure 4.8(b) Middle Wadi El Arish - Wadi El Gayifa Area



GENERALIZED WATER-COST CURVES:
WADI EL BRUK AND MIDDLE WADI EL ARISH

Dames & Moore

Figure 4.9(a) Abu Rudeis - El Markha Plain - Wadi Sidri

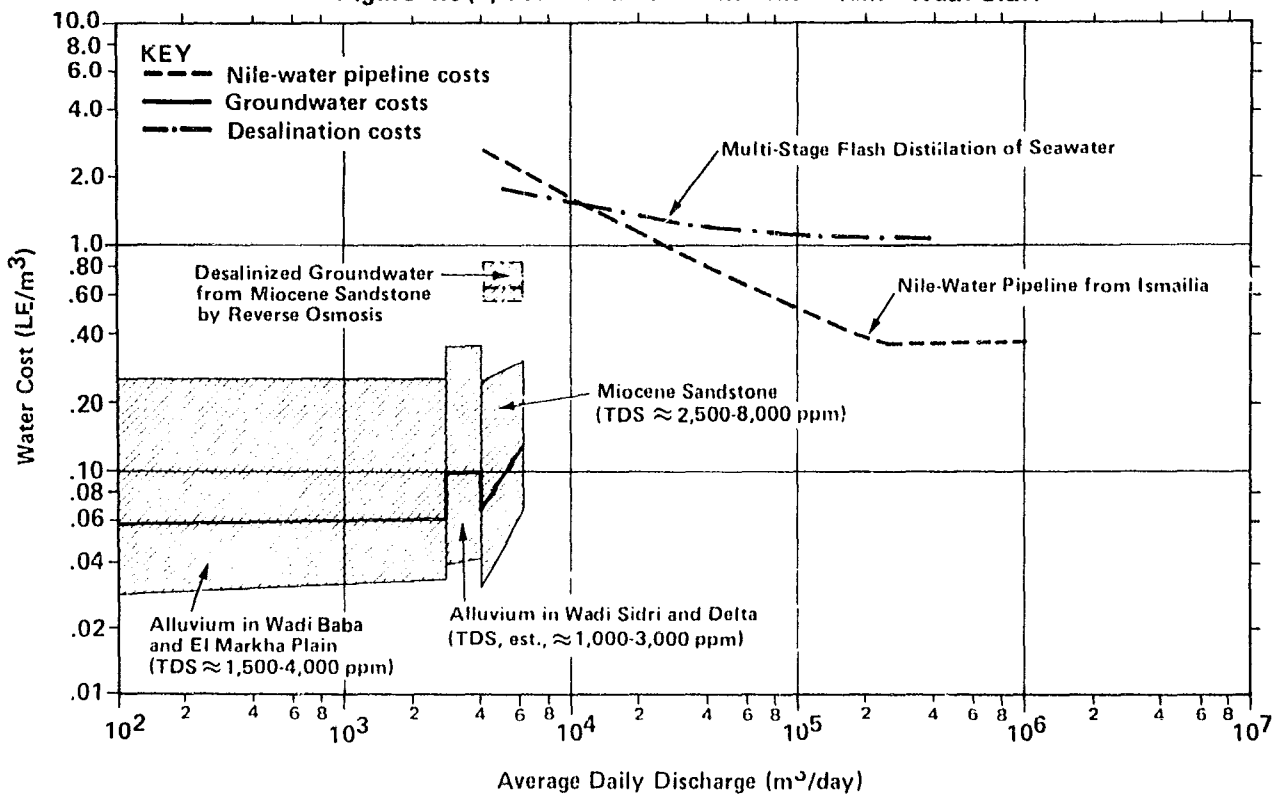
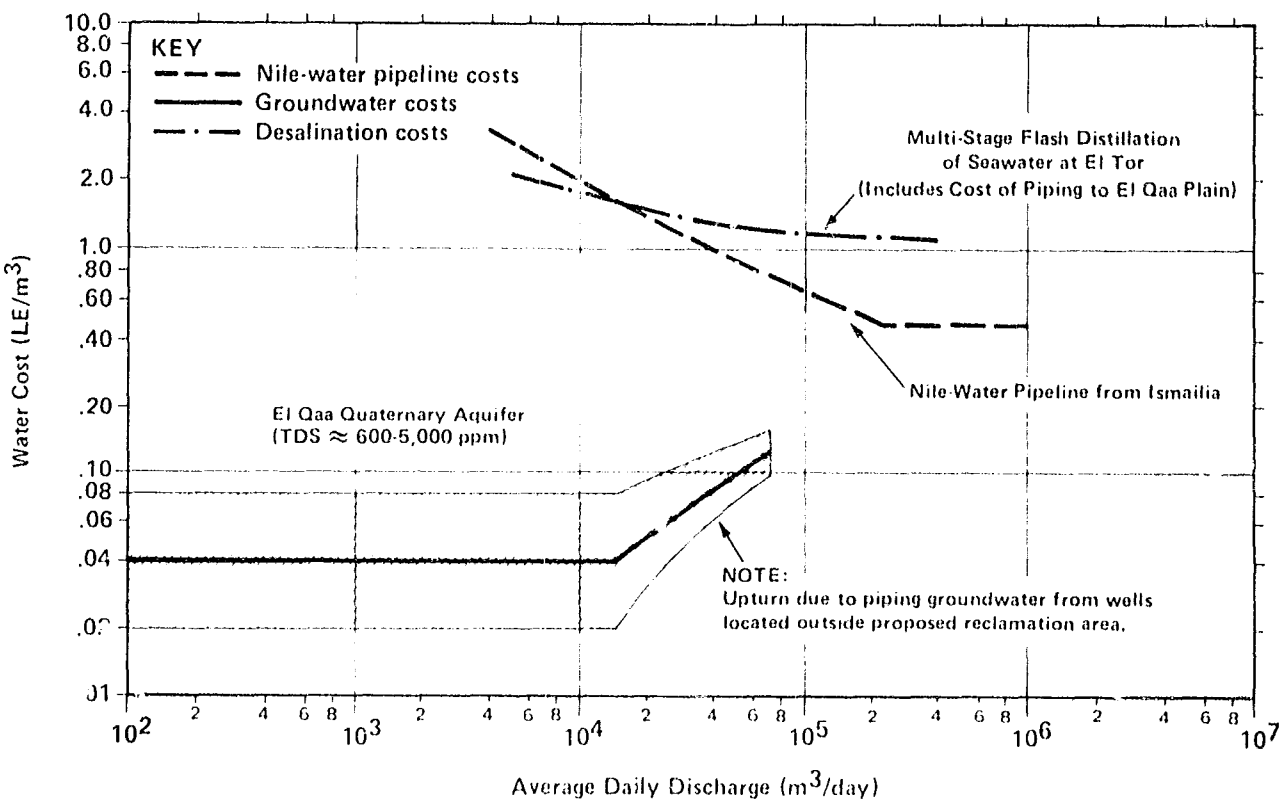


Figure 4.9(b) El Qaa Plain



GENERALIZED WATER-COST CURVES:
ABU RUDEIS AND EL QAA AREAS

Dames & Moore

An extensive list of references relating to the hydrology of Sinai appears as Appendix B of Volume V, Water Supplies and Costs.

POPULATION ESTIMATED BY SETTLEMENT, 1981

Settlement	Population
Abu Aweigila	2,000
Abu Rudeis	3,500
Abu Zenima	2,300
Ayun Musa	500
Baloza	2,100
Bir El Abd	13,000
Bir El Thamada	600
Dahab	1,500
El Arish	70,000
El Hasana	6,500
El Kuntilla	2,000
El Mazar	N/A
El Qantara	5,000
El Quseima	1,000
El Shatt	500
El Teila	N/A
El Themed	2,500
El Tor	2,200
Feiran Oasis	1,500
Gifgafa	4,000
Gilbana	5,000
New Mit Abul Kom	N/A
Nakhl	1,500
Negila	1,800
Nebq	2,000
Nuweiba	1,500
Qatia	N/A
Rabaa	1,200
Rafah	N/A
Ras Misalla	N/A
Ras Sudr	5,000
Ras Taba	N/A
Romana	1,800
Sharm El Sheikh	2,500
Sheikh Zuwayid	35,000
St. Catherine	2,000
TOTAL	180,000[a]

N/A For settlements where specific population estimates are not available, residents are included in estimates for the nearest settlement. Estimates for nomadic peoples are also included in estimates for nearest settlements.

[a] After further research and release of the 1982 CAPMAS census report, this total was revised to 172,000.

SOURCE: Estimate by Consultant based on field surveys and discusssion with local officials and community leaders, conducted during 1981.

POPULATION

Estimate by Subregion and Settlement, 1981

SUBREGION	SETTLEMENT	POPULATION
A. SUEZ CANAL (NW)		13,100
	Ayun Musa	500
	Baloza	2,100
	El Qantara	5,000
	El Shatt	500
	El Teila	N/A
	Gilbana	5,000
	New Mit Abul Kom	N/A
B. MEDITERRANEAN (NE)		124,800
	Abu Aweigila	2,000
	Bir El Abd	13,000
	El Arish	70,000
	El Mazar	N/A
	Negila	1,800
	Qatia	N/A
	Rabaa	1,200
	Rafah	N/A
	Romana	1,800
	Sheikh Zuwayid	35,000
C. UPLANDS (UP)		18,100
	Bir El Thamada	600
	El Hasana	6,500
	El Kuntilla	2,000
	El Quseima	1,000
	El Themed	2,500
	Gifgafa	4,000
	Nakhl	1,500
D. GULF OF SUEZ (SW)		16,500
	Abu Rudeis	3,500
	Abu Zenima	2,300
	El Tor	2,200
	Feiran Oasis	1,500
	Ras Misalla	N/A
	Ras Sudr	5,000
	St. Catherine	2,000

SUBREGION	SETTLEMENT	POPULATION
E. GULF OF AQABAH (SE)		7,500
	Dahab	1,500
	Nebq	2,000
	Nuweiba	1,500
	Ras Taba	N/A
	Sharm El Sheikh	2,500
	TOTAL	180,000[a/]

N/A For settlements where specific population estimates are not available, residents are included in estimates for the nearest settlement. Estimates for nomadic peoples are also included in estimates for nearest settlements.

[a/] After further research and release of the 1982 CAPMAS census report, this total was revised to 172,000.

SOURCE: Estimate by Consultant based on field surveys and discusssion with local officials and community leaders, conducted during 1981.

PO-DE-3

1982 Census

North & South Sinai Governorates

by Markaz and Town

Governorate	Markaz	Town[a/]	Total
North Sinai			136,663
	Bir El Abd		20,821
		Bir El Abd*	4,979
		Qatia	2,417
		Romana	2,457
		El Khorba	2,502
		Rabaa	2,916
		Negila	1,567
		Baloza	2,249
	El Arish		54,017
		El Arish*	44,136
		Abu Sakl	4,692
		Wadi El Arish	1,558
	El Hasana		15,728
		El Hasana*	389
		El Quseima	285
		Gifgafa	2,353
		Wadi El Amar	1,879
	Nakhl		3,510
		Nakhl*	1,217
		El Kuntilla	353
	Rafah		23,332
		Rafah*	7,640
		El Masoura	2,378
	Sheikh Zuwayid		19,255
		Sheikh Zuwayid*	4,036
		El Teila	1,580
		El Gavarir	1,115
		El Kharouba	1,592
		El Korneya	1,348
		El Shalak	1,667
		El Zoheir	2,250

TO-DE-3 (continued)

Governorate	Markaz	Town	Total
South Sinai			20,913
	Abu Zenima		2,541
		Abu Zenima*	334
	Abu Rudeis		4,004
		Abu Rudeis*	1,848
		Wadi Feiran	484
	Dahab		1,025
		Dahab*	86
		Asl	744
	El Tor		3,335
		El Tor*	1,908
	Nuweiba		1,147
		Nuweiba* and el Maziena	622
	Ras Sudr		4,659
		Ras Sudr*	972
	Sharm el Sheikh		933
		Sharm El Sheikh*	603
	St. Catherine's		3,269
		St. Catherine's Monestary*	238
TOTAL NORTH AND SOUTH SINAI GOVERNORATES			157,576[b]

*Markaz Capital

[a] Defined to include all settled places with population of 1,000 or more, markaz capitals, and a few other places of special importance.

[b] Does not include an estimated 14,400 persons living in Port Said, Ismailia and Suez Governorates.

Source: Derived from unofficial translation of "Results of the Census of the Inhabitants of the North Sinai Governorate, 1982," and "Results of the Census of the Inhabitants of the South Sinai Governorate, 1982," published by CAPMAS in February, 1983.

PO-DE 4
COMPARISON OF POPULATION SURVEYS
1981 (Consultant) and 1982 (CAPMAS)
by Markaz

Markaz	Consultant Survey 1981[a]	1982 CAPMAS Census
El Arish	70,000	54,017
Rafah	25,000	23,332
Nakhl	4,100	3,510
El Hasana	12,000	15,728
Sheikh Zuwayid	15,000	19,255
Bir El Abd	21,800	20,821
North Sinai Governorate	147,900	136,663
El Tor	2,200	3,335
Ras Sudr	5,000	4,659
Abu Zenima	2,300	2,531
Abu Rudeis	3,500	4,004
Sharm El Sheikh	4,500	933
Dahab	1,500	1,025
Nuweiba	1,500	1,142
St. Catherine	3,500	3,269
South Sinai Governorate	24,000	20,898
TOTAL	171,900	157,561[b]

[a] Equivalent areas; Canal Governorates excluded.

[b] Roughly 9 percent less than the Consultant's estimate based on incomplete field visits more than one year earlier.

Population by Sex and by Markaz
1982

	Male	Female	Total
North Sinai subtotal	69,182	67,481	136,663
Rafah	11,646	11,686	23,332
El Arish	28,326	25,691	54,017
Nakhl	1,407	2,103	3,510
El Hasana	7,707	8,021	15,728
Sheikh Zuwayid	9,513	9,742	19,255
Bir El Abd	10,583	10,238	20,821
South Sinai subtotal	12,379	8,530	20,909
Nuweiba	624	518	1,142
Dahab	557	468	1,025
Sharm El Sheikh	672	261	933
El Tor	2,135	1,200	3,335
Ras Sudr	2,478	2,181	4,659
St. Catherine	1,775	1,494	3,269
Abu Zenima	1,394	1,148	2,542
Abu Rudeis	2,744	1,260	4,004
TOTAL, NORTH AND SOUTH SINAI GOVERNORATES			157,571[a]

[a] Does not include an estimated 14,400 persons living in northwest Sinai in Port Said, Ismailia and Suez Governorates.

Source: Derived from unofficial translation of "Results of the Census of Inhabitants of the North Sinai Governorate, 1982" and "Results of the Census of the Inhabitants of the South Sinai Governorate, 1982," published by CAPMAS in February, 1983; North Sinai Volume, Table 1, pp. 5-8 and South Sinai Volume Table 1, pp. 5-9.

Population, Area, and Population Density

by Subregion - 1982

	Estimated Population		Estimated Area		
	Estimated Population				
	Number	Percent	Sq. Km.	Percent	Persons/ Sq. Km.
Northwest	14,429	8.4	6,656	10.9	2.2
Northeast	117,425	68.2	6,254	10.3	18.8
Uplands	19,238	11.2	25,376	41.6	0.8
Southwest	17,808	10.4	12,826	21.0	1.4
Southeast	3,100	1.8	9,895	16.2	0.3
TOTAL	172,000	100.0	61,007	100.0	2.8

Source: Consultant's estimates based on CAPMAS censuses of North and South Sinai Governorates (published in 1983), field surveys and delineation of five subregions for planning purposes. See Volume IV for more information about the area of subregions.

Size of Families in North and South Sinai, people per room, by Markas, 1982

	People/ family	People/ room
NORTH SINAI		
El Arish		
Inhabitants	6.0	
Bedouin	5.0	
Total	6.0	1.9
Rafah		
Inhabitants	6.8	
Bedouin	5.1	
Total	5.6	2.2
Nakhl		
Inhabitants	5.2	
Bedouin	4.7	
Total	4.7	2.1
El Hasana		
Inhabitants	5.2	
Bedouin	4.3	
Total	4.3	2.5
Sheikh Zuwayid		
Inhabitants	8.1	
Bedouin	4.7	
Total	5.1	2.4
Bir El Abd		
Inhabitants	7.1	
Bedouin	6.0	
Total	6.1	2.1
TOTAL Inhabitants	6.3	
Bedouin	5.0	
Total	5.5	2.0

SOUTH SINAI		
El Tor		
Inhabitants	4.0	1.3
Bedouin	4.4	2.9
Total	4.1	2.2
Ras Sudr		
Inhabitants	4.2	1.5
Bedouin	5.0	5.0
Total	4.8	3.4
Abu Zenima		
Inhabitants	4.1	1.7
Bedouin	4.6	3.1
Total	4.5	2.8
Abu Rudeis		
Inhabitants	3.1	1.4
Bedouin	4.6	3.7
Total	3.7	2.2
Sharm El Sheikh		
Inhabitants	2.5	1.0
Bedouin	3.7	3.6
Total	2.9	1.5
Dahab		
Inhabitants	*	0.8
Bedouin		5.0
Total		3.3

* Information not provided.

Source: Derived from unofficial translation of "Results of the Census of the Inhabitants of the North Sinai Governorate, 1982," and "Results of the Census of the Inhabitants of the South Sinai Governorate, 1982," published by CAPMAS in February 1982; North Sinai Volume, Table 8, p. 25 and South Sinai Volume, Table 9, p. 26.

North & South Sinai Governorates,
Percent of Population Under 12 Years of Age,
by Markaz

Governorate	Markaz	Inhabitants	Bedouin	Total
North Sinai		35.4	40.0	37.9
	El Arish	34.3	35.8	34.6
	Rafah	39.1	43.0	41.0
	Nakhl	37.6	37.9	37.9
	El Hasana	34.7	39.1	39.0
	Sheikh Zuwayid	38.0	38.2	38.2
	Bir El Abd	39.8	42.0	41.8
South Sinai		17.0	40.3	33.6
	El Tor	20.4	40.8	29.6
	Ras Sudr	23.4	36.1	33.4
	Abu Zenima	35.9	40.3	39.7
	Abu Rudeis	10.4	44.8	26.8
	Sharm El Sheikh	11.4	42.4	24.8
	Dahab	7.3	48.4	44.0
	Nuweiba	10.5	42.5	39.9
	St. Catherine	5.9	41.4	38.9

Source: Derived from unofficial translation of "Results of the Census of the Inhabitants of the North Sinai Governorate, 1982," and "Results of the Census of the Inhabitants of the South Sinai Governorate, 1982," published by CAPMAS in February 1982; North Sinai Volume, Table 4, p. 27 and South Sinai Volume, Table 2, pp. 10-11.

Bedouin and other Population
by Sex, by Subregion and Zone-1982

Subregion	Zone	Bedouin Population	Bedouin Percent Male	Non-Bedouin Population	Non-Bedouin Percent Male
Northwest	N	1,346*	N.A.	2,781*	N.A.
	C	3,304	59.5	5,998	52.1
	S	400*	N.A.	600*	N.A.
Northeast	E	36,100	52.1	60,504	49.8
	W	10,870	50.1	9,951	51.8
Uplands		18,586	46.9	652	59.8
Southwest	N	8,050	51.5	3,154	78.4
	S	4,458	53.4	2,146	71.2
Southeast	N	1,018	51.2	123	83.7
	S	1,245	51.6	713	82.3
TOTAL		85,378	50.3	86,622	54.6

N.A. = Not available.

*Estimated in the absence of recent survey or census data.

Source: Derived from Census of North Sinai and South Sinai Governorates, published by CAPMAS in February, 1983.

Population with/without electricity in home by Markaz
1982

	With electricity		Without electricity		Total
	%	No	%	No	No
NORTH SINAI					
El Arish					
Inhabitants	94.2	7550	5.8	466	8016
Bedouin	15.9	151	84.1	801	952
Total	85.9	7701	14.1	1267	8968
El Rafah					
Inhabitants	90.9	1020	9.1	102	1122
Bedouin	5.2	160	94.8	2892	3052
Total	28.3	1180	71.7	2994	4174
Nakhl					
Inhabitants	100.0	49	0	0	49
Bedouin	0	0	100.0	687	687
Total	6.7	49	93.3	687	736
El Hasana					
Inhabitants	100.0	60	0	0	60
Bedouin	0	0	100.0	3557	3557
Total	1.6	60	98.4	3557	3617
Sheikh Zuwayid					
Inhabitants	79.3	387	20.7	101	488
Bedouin	8.2	268	91.8	2987	3255
Total	17.5	655	82.5	3088	3743
Bir El Abd					
Inhabitants	77.5	189	22.5	55	244
Bedouin	31.8	1007	68.2	2162	3169
Total	35.0	1196	65.0	2217	3413
TOTAL NORTH SINAI					
Inhabitants	92.7	9255	7.3	724	9979
Bedouin	10.8	1586	89.2	13086	14672
Total	43.9	10841	56.1	13810	24651
SOUTH SINAI					
El Tor					
Inhabitants	78.1	356	21.9	100	456
Bedouin	27.9	91	72.1	235	326
Total	57.2	447	42.8	335	782
Ras Sudr					
Inhabitants	100.0	231	0	0	231
Bedouin	0	0	100.0	742	742
Total	23.7	231	76.3	742	973
Abu Zenima					
Inhabitants	100.0	78	0	0	78
Bedouin	0	0	100.0	481	481
Total	14.0	78	86.0	481	559
Abu Rudeis					
Inhabitants	84.1	492	15.9	93	585
Bedouin	1.7	8	98.3	464	472
Total	47.3	500	52.7	557	1057
Sharm El Sheikh					
Inhabitants	100.0	175	0	0	175
Bedouin	0	0	100.0	89	89
Total	66.3	175	33.7	89	264
Dahab					
Inhabitants	100.0	39	0	0	39
Bedouin	0	0	100.0	183	183
Total	16.6	39	83.4	183	222
TOTAL SOUTH SINAI					
Inhabitants	87.7	1371	12.3	193	1564
Bedouin	4.3	99	95.7	2194	2293
Total	38.1	1470	61.9	2387	3857

Source: Derived from unofficial translation of "Results of the Census of the Inhabitants of the North Sinai Governorate, 1982," and "Results of the Census of the Inhabitants of the South Sinai Governorate, 1982," by CAPMAS, published in February 1982; North Sinai Volume, Table 10, p. 27, and South Sinai Volume, Table 10, p. 37.

SUMMARY OF PUBLIC SCHOOL ENROLLMENTS, 1981

	North Sinai	South Sinai	Total
Number of primary, preparatory, and secondary schools	39	20	59
Number of students	16,087	1,089	17,176
Boys	8,938	814	9,752
Girls	7,149	275	7,424
Percent of age-group enrolled in school			
Primary (grades 1-6)	66	86	66
Preparatory (grades 7-9)	23	8	22
Secondary (grades 10-12)	11	6	10
Total number of teachers	569	127	696
Student-teacher ratio	28:1	9:1	25:1

Note: Does not include Sinai east of El Arish, Nakhl and St. Catherine.

SOURCE: Calculations by Dames & Moore, based on data from North and South Sinai Governorates and a 1981 survey of major settlements; see Working Paper No. 16, Recommended Physical Planning Standards for Development of Major Sinai Settlements, September, 1981, p. 4-14, for further details.

Levels of Literacy by Subregion and Zone - 1982

Subregion	Zone[1/]	Illiterate	Read and Write	Below College Education	College Education	Total
Northwest						
	N	n.a.	n.a.	n.a.	n.a.	n.a.
	C	50.9	24.8	20.7	3.6	100
	S	n.a.	n.a.	n.a.	n.a.	n.a.
Northeast						
	E	47.5	23.7	25.6	3.2	100
	W	62.9	22.8	12.2	2.1	100
Uplands		92.2	6.1	1.6	0.1	100
Southwest						
	N	65.1	19.8	11.1	4.0	100
	S	62.4	20.0	11.9	5.7	100
Southeast						
	N	81.2	9.3	5.2	4.3	100
	S	55.4	11.3	22.7	10.6	100
Total Bedouin		79.6	13.3	6.2	0.9	100
Total non-Bedouin		39.5	28.8	26.5	5.2	100

1/ Subregions have been divided into zones for some planning purposes. N = Northern; C = Central; S = Southern; E = Eastern; W = Western.

SOURCE: Consultant's calculations based on the 1982 CAPMAS census of North and South Sinai, published in February, 1983.

Al-Azhar University Medical School
Public Health Survey
Seven Sinai Communities

	Total Examined	Number Found Sick	Percent Found Sick
El Arish	3,977	1,624	40.8
Bir El Abd	522	171	32.8
Rabaa	224	132	58.9
Negila	244	121	49.6
El Kherba	356	163	45.8
El Hasana	95	39	41.1
Gifgafa	432	121	28.0
TOTAL	5,850	2,371	40.5

Source: Al-Azhar University Medical School Mission to North Sinai, June 1980.

Educational Status of Recent Male Migrants to Cairo,
by Percent of Age Groups, 1976

	Age group *			
	15-19	20-24	25-29	30-34
Illiterate	30.6	20.2	29.1	29.7
Read and Write	14.7	11.4	25.5	27.1
Formal Education	53.7	67.7	44.7	42.5
Unspecified	1.1	0.8	0.7	0.7
Total number of recent male migrants	11,927	23,596	21,807	12,871

* First and second columns add to 100.1 percent due to rounding.

SOURCE: Extracted from PADCO, Egypt: Urban Growth and Urban Data Report, National Urban Policy Study, July, 1982, Table II-15, page 79, original table based on NUPS analysis of 1976 census.

REFERENCES: POPULATION

An extensive list of references on population, immigration and manpower is provided as an Appendix to Volume VI, Settlement and Social Development, pages A-1 to A-14.

Other useful readings are:

Abu-Lughod, Janet L., "Urban-Rural Differences as a Function of the Demographic Transition," American Journal of Sociology, Vol. 69, No. 5 (March 1964), p. 476-490.

El Abd, Salah, "Land Reclamation and Resettlement in Egypt," Human Settlements on New Lands, Chapter 6 (Cairo: Social Research Center of the American University in Cairo, 1979), p. 103.

El Badry, M. A., "Internal Migration in the United Arab Republic," Contemporary Egypt, No. 319 (July 1965), p. 31-44.

Hassan, Ahmed Mohamed Nagib, Internal Migration in the United Arab Republic in 1960: A Demographic Study of Human Planning, Master's thesis presented to the Department of Geography, Faculty of Arts, Cairo University (1969).

Hassan, Shafik, and M. A. El Dayem, "Characteristics of Recent Migrants and Non-migrants in Cairo," Urbanization and Migration in Some Arab and African Countries (Cairo: Cairo Demographic Center, 1973), p. 205-224.

Ibrahim, Saad Eddin, Internal Migration in Egypt: A Critical Review (Cairo: The Population and Family Planning Board, January 1980), p. 61.

Internal Migration in the Arab Republic of Egypt (Cairo: Central Agency for Public Mobilization and Statistics (CAPMAS), 1971).

E. INFRASTRUCTURE AND COMMUNITY SERVICES (IN)

Major Service Facilities and Utilities in Sinai, 1981 1/

Health	No.	Beds
Hospitals, total	7	113
Northwest	1	16
Northeast	2	64
Uplands	0	--
Southwest	4	33 2/
Southeast	NS	--

Education	No.	Classrooms
Secondary Schools, total (10th to 12th Grades)	5	63
Northwest	0	--
Northeast	4	60
Uplands	0	--
Southwest	1	3
Southeast	NS	--

	No.	Classrooms
Preparatory Schools, total (7th to 9th Grades)	11	102
Northwest	1	6
Northeast	8	91
Uplands	0	0
Southwest	2	5
Southeast	NS	--

Utilities	Generators	Capacity 3	Potential 4
Electricity, total	33	11,630	12,605
Northwest	4	900	600
Northeast	13	8,800	11,000
Uplands	2	100	25
Southwest	14	1,830	980
Southeast	NS	NS	NS

	No.
Telephones, total	914
Northwest	108
Northeast	716
Uplands	0
Southwest	90
Southeast	NS

NS Not surveyed

1/ Survey was conducted in the summer of 1981 and does not include eastern Sinai (east of El Arish, Nakhl, and St. Catherine).

2/ Plus 60 bed facility under construction in El Tor in 1983.

3/ Peak capacity in kilowatts.

4/ Annual generating potential in megawatt hours.

Source: 1981 Survey by Consultant. Also see Section 3.2 of Volume VI.

Electric Power Generation - 1981

Community	No. of Generators	Rated Capacity (kW)	No. of Houses or Buildings Served	Average Daily Consumption (kWh)
North Sinai, Subtotal	19	9,807	11,588	39,475
El Arish	7	8,305	10,280	35,000
Bir El Abd	1	145	250	85
Negila	1	58	250	180
Rabaa	1	90	35	200
Romana	3	210	150	690
Baloza	2	149	281	390
Gilbana[a]	--	--	--	--
El Qantara	2	750	316	2,480
Gifgafa[a]	--	--	--	--
El Hasana	1	50	10[b]	150
Bir El Thamada[a]	--	--	--	--
Nakhl	1	50	16[b]	300
El Shatt[a]	--	--	--	--
South Sinai, Subtotal	17	22,825	981	3,250
Ayun Musa[a]	--	--	--	--
Ras Sudr	4	1,000	531	1,180
Abu Zenima[c]	3	21,000	--	--
Abu Rudeis[d]	--	--	--	--
Feiran Oasis	1	30	110	180
St. Catherine	4	300	200	1,440
El Tor[e]	5	495	140[f]	450
TOTAL	36	32,632	12,569	42,725

[a]No public electrical service provided to community.

[b]Government guesthouses.

[c]Three 7-megawatt gas turbine generators, inoperative.

[d]Approximately 25 percent of the community is provided with electricity by private companies.

[e]El Tor has two additional generators (rated capacity, 515 kilowatts) that are not used.

[f]Includes 120 guesthouses.

SOURCE: Canal Electricity Distribution Company (CEDCO)

North Sinai
Existing Electrical Generating System
1981

Location	Rated Capacity (kilowatts)	Actual Capacity (kilowatts)
El Arish	2 x 3,200	5,000
	3 x 460	900
	500	400
	25	20
SUBTOTAL (El Arish)	8,305	6,320
El Hasana	50	30
Nakhl	50	30
Bir El Abd region		
Bir El Abd	145	110
El Hezba	58	35
	91	91
Negila	58	40
Rabaa	90	72
Qatia	33	33
New Romana	2 x 120	240
Old Romana	90	70
Baloza	91	91
	58	45
Other sites	58	90
	91	91
	64	50
SUBTOTAL (Bir El Abd region)	1,167	1,058
TOTAL	9,572	7,438

SOURCE: Technical Office of the North Sinai Governorate,

CEDCO Projected Power Requirements for North Sinai
by Load Category (kilowatts)
1981-1990

Projected Power Requirement by Load Category	Through 1982	Through 1985	Through 1990
Tourism and hotels (letter from Deputy Minister of Tourism)	3,000	30,000	42,000
Ministry of Health	150	300	400
Military and other national security	1,500	1,900	1,900[a]
Ministry of Industry (El Maghara project)	400	2,000	2,000[a]
Training centers	200	400	400[a]
Private sector projects	1,500	2,000	6,000
Ministry of Irrigation (poultry, canning, livestock at El Arish)	1,500	1,500	3,000
Town of Bir El Abd	300	500	800
Industrial schools at El Arish	200	300	300[a]
Ministry of Supply (corn grinding and bakery at El Arish)	400	600	600[a]
Ice-production units at El Arish	500	1,000	2,000
Other ice-production units and governmental food shops	300	300	300
Ministry of Development--Housing	1,500	2,500	20,000
Ministry of Development--Land reclamation	2,000	4,400	30,000
TOTAL	13,450	47,700	109,700

[a]Assumed values, no estimate provided.

Source: Primary Study for the Electrical Projects Required for the Development of the North and South Sinai Governorates (Cairo: Ministry of Electricity and Energy/Canal Electricity Distribution Company, August 1981).

CEDCO Projected Power Requirements for South Sinai
by Load Category (kilowatts)
1981-2000

Projected Power Requirement by Load Category	Through 1982	Through 1985	Through 1990
Tourism and hotels (letter from Deputy Minister of Tourism)	1,000	2,000	2,000
Ministry of Health	100	150	150
Training centers (Ministry of Industry)	100	200	200[a]
Private sector projects	800	1,250	4,500
Ministry of Higher Education	200	200[a]	200[a]
Ministry of Supply (corn grinding and bakery)	200	300	300[a]
Ice-making and governmental food shops	300	600	2,500
Ministry of Development--Housing	1,500	2,500	20,000
Ministry of Development--Land reclamation	2,000	5,600	30,000
TOTAL	6,200	12,800	59,850
Power requirements for Sinai Manganese Company	--	20,000	20,000[a]

[a]Assumed values, no estimate provided.

Source: Primary Study for the Electrical Projects Required for the Development of the North and South Sinai Governorates (Cairo: Ministry of Electricity and Energy/Canal Electricity Distribution Company, August 1981).

Essential Distribution Network Requirements
North Sinai (October 1980 to June 1982)

Project	Cost (thousand LE)
Installation of a generating station (two 900-kilowatt diesels) at Romana Village, including step-up transformer and 11-kilovolt distribution network	950
Installation of 11-kilovolt transmission line from east to south of Romana (42 kilometers), including pole transformers and cabinets	900
Installation of electric generating station (three 900-kilowatt diesels, two 150-kilowatt diesels) at Bir El Abd, with step-up transformers and distribution network	1,950
Installation of 11-kilovolt transmission line, from east to west of Bir El Abd (50 kilometers), including pole transformers and cabinets	1,000
Construction of a new El Arish generating station, temporarily with one 7.5-megawatt and one 5-megawatt gas turbine with distribution network	5,000
Installation of 11-kilovolt transmission line plus cables (75 kilometers) and transformers in El Arish	1,500
Installation of four small generating stations at Bir El Thamada, Gifgafa, Nakhl, and Hassana (two 75-kilowatt and two 150-kilowatt units), including switchboard and step-up transformers	200
Installation of low-voltage electric network in various villages and towns (750 kilometers), including internal network and street lighting	6,000
TOTAL	17,500

Source: Primary Study for the Electrical Projects Required for the Development of the North and South Sinai Governorates (Cairo: Ministry of Electricity and Energy/Canal Electricity Distribution Company, August 1981).

Essential Distribution Network Requirements
South Sinai (October 1980 to June 1982)

Project	Cost (thousand LE)
Improvements to present electric generating station at St. Catherine (two 900-kilowatt and two 150-kilowatt units), complete with step-up transformer	1,050
Development of generating station in Feiran Oasis (two 150-kilowatt units) and switchboard	100
Development of present generating station at Ras Sudr (three 500-kilowatt units)	900
Installation of two 900-kilowatt units in Abu Rudeis, including transformers and switchboard	950
Installation of four 500-kilowatt units in El Tor, including transformers and switchboard	1,200
Installation of 11-kilovolt transmission line from generating stations, for 200-kilometer total length, including transformers and cabinets	4,000
Installation of low-voltage electric transmission lines for street lighting and internal network	5,600
TOTAL	13,800

Source: Primary Study for the Electrical Projects Required for the Development of the North and South Sinai Governorates (Cairo: Ministry of Electricity and Energy/Canal Electricity Distribution Company, August 1981).

Sources of Petroleum Fuels

SUBREGION/SETTLEMENT	Main Source of Gasoline, Diesel Fuel, and Kerosene	Main Source of Butagas
A. SUEZ CANAL (NW)		
Ayun Musa	Suez	N/A
Baloza	Romana	N/A
El Qantara	El Qantara West	Ismailia
El Shatt	Suez	N/A
El Teila	N/A	N/A
Gilbana	El Qantara	N/A
New Mit Abul Kom	N/A	N/A
Port Fouad	N/A	N/A
B. MEDITERRANEAN (NE)*		
Abu Aweigila	N/A	N/A
Bir El Abd	Bir El Abd	El Arish
Bir El Thamada [a]	N/A	N/A
Bir El Themed	N/A	N/A
El Arish	El Arish	El Arish
El Hasana	El Arish	El Arish
El Kuntilla	N/A	N/A
El Mazar	N/A	N/A
El Quseima	N/A	N/A
Gifgafa	El Arish	N/A
Nakhl	El Arish	El Arish
Negila	Romana	Ismailia or Arish
Qatia	N/A	N/A
Rabaa	Romana	El Arish
Rafah	N/A	N/A
Romana	Romana	N/A
Sheikh Zuwayid	N/A	N/A
C. GULF OF SUEZ (SW)		
Abu Rudeis	Abu Rudeis	Suez
Abu Zenima	Abu Rudeis	N/A
El Tor	El Tor or Suez	N/A
Feiran Oasis	St. Cath or El Belayim	Suez
Ras Misalla	N/A	N/A
Ras Sudr	Ras Sudr	N/A
St. Catherine	St. Catherine	N/A
D. GULF OF AQABAH (SE)		
Dahab	N/A	N/A
Nebq	N/A	N/A
Nuweiba	N/A	N/A
Ras Taba	N/A	N/A
Sharm El Sheikh	N/A	N/A

*Includes Uplands

N/A No reported use of energy fuels.

Source: Infrastructure Survey by Consultant, May-June 1981.

Estimated Daily Consumption Rates
of Petroleum Fuels
by Subregion and Settlement
(liters)

SUBREGION/SETTLEMENT 1981	Gasoline	Diesel	Kerosene	Butagas
A. SUEZ CANAL (NW), Subtotal	2,040	5,400	2,960	200
Ayun Musa	40	--	60	--
Baloza	--	400	750	--
El Qantara	2,000	5,000	1,000	200
El Shatt	--	--	150	--
El Teila	N/A	N/A	N/A	N/A
Gilbana	--	--	1,000	--
New Mit Abul Kom	N/A	N/A	N/A	N/A
Port Fouad	N/A	N/A	N/A	N/A
B. MEDITERRANEAN (NE & UP), Subtotal	13,400	28,270	14,600	408
Abu Aweigila	N/A	N/A	N/A	N/A
Bir El Abd	500	--	1,000	50
Bir El Thamada[a]	--	--	--	--
Bir El Themed	N/A	N/A	N/A	N/A
El Arish	5,200	16,000	4,100	345
El Hasana	1,500	2,000	1,000	--
El Kuntilla	N/A	N/A	N/A	N/A
El Mazar	N/A	N/A	N/A	N/A
El Quseima	N/A	N/A	N/A	N/A
Gifgafa	1,800	--	3,000	--
Nakhl	1,600	120	4,500	10
Negila	600	--	200	3
Qatia	N/A	N/A	N/A	N/A
Rabaa	200	150	300	--
Rafah	N/A	N/A	N/A	N/A
Romana	2,000	10,000	500	--
Sheikh Zuwayid	N/A	N/A	N/A	N/A
C. GULF OF SUEZ (SW), Subtotal	4,900	8,300	2,610	6
Abu Rudeis	1,000	2,000	400	2
Abu Zenima	--	--	1,000	--
El Tor	1,500	2,000	500	--
Feiran Oasis	--	1,000	200	4
Ras Misalla	N/A	N/A	N/A	N/A
Ras Sudr	2,200	3,000	450	--
St. Catherine	200	300	60	--
D. GULF OF AQABAH (SE), Subtotal	N/A	N/A	N/A	N/A
Dahab	N/A	N/A	N/A	N/A
Nebq	N/A	N/A	N/A	N/A
Nuweiba	N/A	N/A	N/A	N/A
Ras Taba	N/A	N/A	N/A	N/A
Sharm El Sheikh	N/A	N/A	N/A	N/A
TOTAL	20,340	41,970	20,170	614

[a]No reported use of energy fuels.

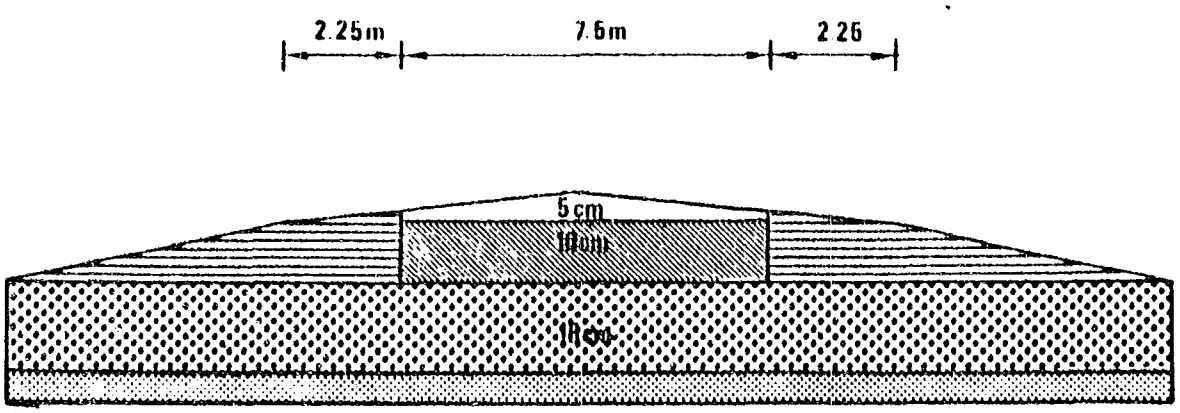
Source: Infrastructure Survey by Consultant, May-June 1981.

IN-TR-1

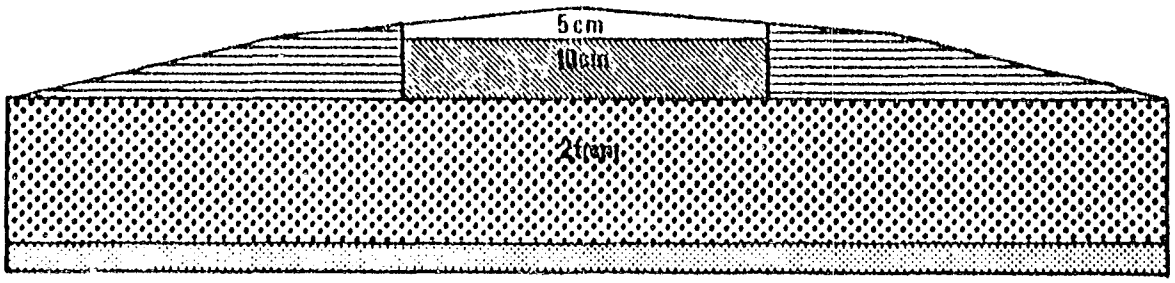
Approximate Distance Between Principal Sinai Settlements and Cairo, Ismailia, and Suez 1981 (kilometers)

Location	Distance (km)
Abu Rudeis-Abu Zenima	26
-Bir El Abd	346
-Bir El Thamada	207
-Cairo	287
-El Arish	380
-El Hasana	254
-El Qantara East	270
-El Tor	95
-Feiran Oasis	75
-Gifgafa	249
-Nakhl	228
-St. Catherine	120
-Ras Sudr	97
-Ismailia	224
-Suez	153
Abu Zenima-Bir El Abd	320
-Bir El Thamada	181
-Cairo	261
-El Arish	354
-El Hasana	228
-El Qantara East	244
-El Tor	121
-Feiran Oasis	101
-Gifgafa	223
-Nakhl	202
-St. Catherine	146
-Ras Sudr	71
-Ismailia	208
-Suez	127
Bir El Abd-Bir El Thamada	211
-Cairo	232
-El Arish	78
-El Hasana	164
-El Qantara East	76
-El Tor	441
-Feiran Oasis	421
-Gifgafa	197
-Nakhl	228
-St. Catherine	466
-Ras Sudr	249
-Ismailia	112
-Suez	193
Bir El Thamada-Cairo	247
-El Arish	133
-El Hasana	47
-El Qantara East	163
-El Tor	302
-Feiran Oasis	282
-Gifgafa	42
-Nakhl	32
-St. Catherine	327
-Ras Sudr	110
-Ismailia	127
-Suez	94
Cairo-El Arish	310
-El Hasana	291
-El Qantara East	156
-El Tor	382
-Feiran Oasis	362
-Gifgafa	205
-Nakhl	256
-St. Catherine	407
-Ras Sudr	190
-Ismailia	120
-Suez	134
El Arish-El Hasana	86
-El Qantara East	154
-El Tor	485
-Feiran Oasis	455
-Gifgafa	124
-Nakhl	150
-St. Catherine	500
-Ras Sudr	283
-Ismailia	190
-Suez	227
El Hasana-El Qantara East	207
-El Tor	349
-Feiran Oasis	329
-Gifgafa	86
-Nakhl	64
-St. Catherine	374
-Ras Sudr	157
-Ismailia	171
-Suez	141
El Qantara East-El Tor	365
-Feiran Oasis	345
-Gifgafa	121
-Nakhl	195
-St. Catherine	390
-Ras Sudr	173
-Ismailia	30
-Suez	117
El Tor-Gifgafa	344
-Feiran Oasis	364
-Nakhl	323
-St. Catherine	409
-Ras Sudr	192
-Ismailia	329
-Suez	248
Gifgafa-Feiran Oasis	324
-Nakhl	74
-St. Catherine	369
-Ras Sudr	152
-Ismailia	85
-Suez	136
Nakhl-Feiran Oasis	303
-St. Catherine	348
-Ras Sudr	131
-Ismailia	203
-Suez	122
Feiran Oasis-St. Catherine	389
-Ras Sudr	172
-Ismailia	309
-Suez	228
St. Catherine-Ras Sudr	217
-Ismailia	354
-Suez	273
Ras Sudr-Ismailia	137
-Suez	56
Ismailia-Suez	81

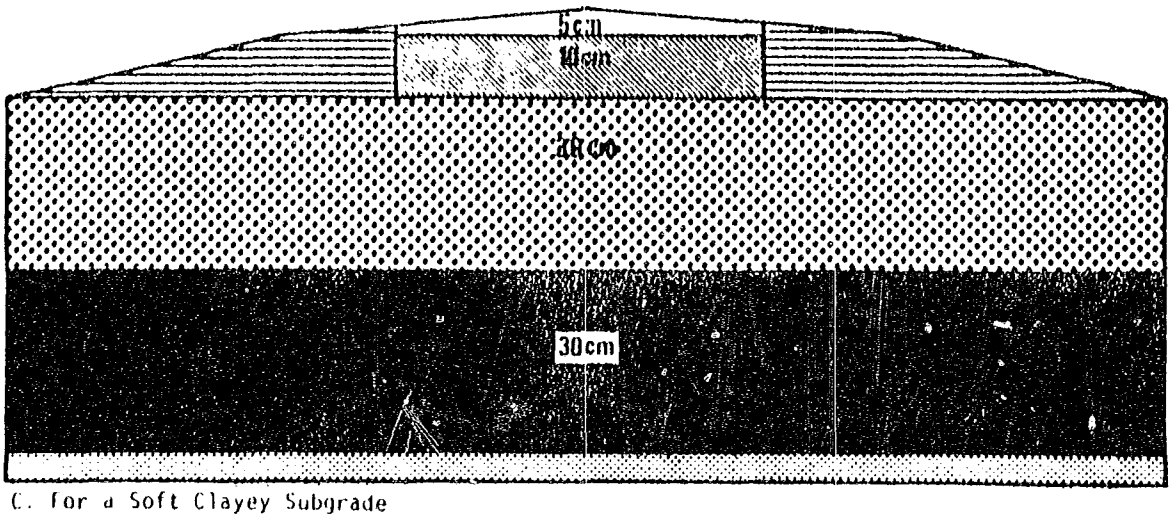
ALTERNATIVE CROSS SECTIONS FOR PRIMARY ROADS



A. For Either a Hard Rock or Very Firm Gravel Subgrade



B. For a Sandy Subgrade
Subgrade should be scarified, watered and compacted before placing base course



C. For a Soft Clayey Subgrade

- Compacted Pit Run Sand and Gravel Subbase
- Crushed Rock Base Course
- Asphalt Binder Course
- Asphalt Wearing Course
- Shoulder Material: Well compacted pit run sand and gravel (paving optional)

Illustrative Highway Design Criteria

Design Element	Design Class by Terrain									
	A		B		C		D		E	
	Flat	Rolling	Flat	Rolling	Flat	Rolling	Flat	Rolling	Flat	Rolling
ADT[a] on opening (mixed traffic)	Over 2,000		1,000 to 2,000		400 to 1,000		50 to 400		Under 50	
Design speed (km/h)	100	90	95	80	90	80	80	65	60	40
Surfacing width (m)	7.3	7.3	7.0	7.0	6.7	6.7	6.0	6.0	4.5	4.5
One shoulder width (m)	3.0	3.0	2.4	2.4	2.0	2.0	1.5	.15	1.0	1.0
Width between bridge parapets (m)										
200-m long or longer	13.3	13.3	11.8	11.8	10.7	10.7	9.0	9.0	4.0	4.0
less than 20-m long	9.3	9.3	9.0	9.0	8.2	8.2	7.7	7.7	4.0	4.0
Stopping sight distance (m)	160	135	150	115	135	115	115	80	70	40
Passing sight distance (m)	670	600	635	530	600	530	530	420	380	240
Maximum gradient (%)[b]	4.0	5.0	4.0	5.0	5.0	6.0	6.0	7.0	6.0	8.0
Horizontal curve minimum radius (m)	345	280	310	210	280	210	210	135	115	50
Vertical curve 'K' value										
Crest curves	128	91	113	66	91	66	66	32	25	8
Sag curves	38	31	35	25	31	25	25	16	13	6

	Secondary Roads	Tertiary Roads	Local Roads
Rural right-of-way width (m)	60	40	30
Rural minimum distance of services from center line of road (m)	25	15	10

a/ Average Daily Trips.

b/ Maximum gradients may be exceeded by 1% on short lengths of road.

KEY: A, B, C, etc. represent design-class, A being higher than B, etc., because of higher traffic volumes--that is to say, a higher average number of daily trips (ADT).

COMMUNITY WATER SUPPLY FOR 21 PLACES, 1981

SUBREGION/SETTLEMENT	Domestic Water Sources: No. of Wells in Use: Sweet	No. of Wells in Use: Brackish	No. of Public Faucets	Quantity Delivered by Tank Truck (m^3/day)	Average Daily Domestic Consumption (m^3/day)	Total Storage Capacity (m^3)	Consumption (m^3/day)
A. SUEZ CANAL							
Ayun Musa	3	--	--	1	1	--	0.002
Baloza	--	--	4	25	25	--	0.012
El Qantara	--	--	4	--	1,000	10	0.200
El Shatt	--	--	--	--	2	--	0.004
Gilbana	--	21	1	a/	24	--	0.005
B. MEDITERRANEAN							
Bir El Abd	--	1	--	16	16	--	0.001
Bir El Thamada	--	1	--	a/	24	--	0.040
El Arish	12	2	1	--	7,000	500	0.100
El Hasana	--	--	1	24	24	12	0.004
Gifgafa	--	--	2	--	96	--	0.024
Nakhl	2	2	--	4	4	32	0.003
Negila	--	10	--	28	28	--	0.016
Rabaa	3	3	--	16	16	--	0.013
Romana	--	4	--	16	16	--	0.009
C. GULF OF SUEZ							
Abu Rudeis c/	--	--	--	8	8	--	0.002
Abu Zenima	--	--	--	4	4	60	0.002
El Tor	3	13	5	4	700 d/	500	0.318
Feiran Oasis	4	--	14	--	250	25	0.167
Ras Sudr	b/	b/	--	40	40	--	0.008
St. Catherine	2	--	6	--	50	250	0.025
D. GULF OF AQABAH e/							
TOTAL	29	57	38	186	9,328	1,389	0.056

a/ Unknown.

b/ Ras Sudr has 46 wells -- 32 for agriculture and 14 for domestic use.

c/ Abu Rudeis also receives potable water by ship.

d/ El Tor exports water to Sharm El Sheikh.

e/ Consultant had no access to eastern Sinai when these data were collected.

SOURCE: Derived from Working Paper No. 33, submitted in April 1982.

Medical Facilities
1981

SUBREGION/SETTLEMENT	Hospitals	Beds	Health Centers	Health Units
A. SUEZ CANAL (NW), Subtotal	1	16	0	2
Ayun Musa	0	0	0	a/
Baloza	0	0	0	1
El Qantara	1	16	0	1
El Shatt	0	0	0	0
Gilbana	0	0	0	0
New Mit Abul Kom	N/A	N/A	N/A	N/A
B. MEDITERRANEAN (NE/UP), Subtotal	2	64	4	7
Abu Aweigila	N/A	N/A	N/A	N/A
Bir El Abd	0	0	0	1
Bir El Thamada	0	0	0	0
El Arish	2	64	4 a/	b/
El Hasana	0	0	0	1
El Kuntilla	N/A	N/A	N/A	N/A
El Mazar	N/A	N/A	N/A	N/A
El Quseima	N/A	N/A	N/A	N/A
Gifgafa	0	0	0	1
Nakhl	0	0	0	1
Negila	0	0	0	1
Qatia	N/A	N/A	N/A	N/A
Rabaa	0	0	0	1
Rafah	N/A	N/A	N/A	N/A
Romana	0	0	0	1
Sheikh Zuwayid	N/A	N/A	N/A	N/A
C. GULF OF SUEZ (SW), Subtotal	4	33	0	4
Abu Rudeis	1	4	0	0
Abu Zenima c/	0	0	0	0
El Tor d/	1	6	0	1
Feiran Oasis	0	0	0	1
Ras Misalla	N/A	N/A	N/A	N/A
Ras Sudr	1	12	0	1
St. Catherine	1	11	0	1
D. GULF OF AQABAH (SE), Subtotal	N/A	N/A	N/A	N/A
Dahab	N/A	N/A	N/A	N/A
Nebq	N/A	N/A	N/A	N/A
Nuweiba	N/A	N/A	N/A	N/A
Ras Taba	N/A	N/A	N/A	N/A
Sharm El Sheikh	N/A	N/A	N/A	N/A
TOTAL	7	113	4	13

a/ In addition to four public health centers, El Arish has 19 private clinics.

b/ Ambulance center.

c/ Medical facility provided by Sinai Manganese Company.

d/ Sixty bed unit in Five-Year Plan.

Source: Infrastructure Survey by the Consultant, May-June 1981.

STUDENT/TEACHER AND STUDENT/CLASSROOM RATIOS FOR PRIMARY SCHOOLS, BY GOVERNORATE, 1980

GOVERNORATE	STUDENT/TEACHER	STUDENT/CLASSROOM
Cairo	34.3	40.3
Alexandria	33.7	43.4
Port Said	16.6	38.8
Ismailia	34.3	41.3
Suez	34.6	39.1
Beheira	32.4	42.2
Gharbia	30.9	40.5
Kafr El Sheikh	32.8	40.9
Menoufia	36.6	39.3
Qalyubia	42.1	42.2
Dakahlia	32.2	38.8
Damietta	33.0	38.8
Sharkia	34.7	40.1
Giza	43.5	43.6
El Fayoum	29.6	37.8
Beni Suef	26.9	35.6
Minia	25.1	36.5
Assuit	32.2	39.7
Sohag	25.4	36.9
Qena	29.2	36.4
Aswan	30.9	38.7
Matruh	25.6	30.9
New Valley	19.0	28.2
Red Sea	21.1	33.6
North Sinai	26.7	39.1
South Sinai	8.1	13.3

SOURCE: Ministry of Education data in Egypt: Urban Growth and Urban Data Report prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Government of Egypt, U.S.A.I.D. Grant No. 263-0042, page 98.

NUMBER OF STUDENTS, TEACHERS, CLASSROOMS AND SCHOOLS BY GOVERNORATE, 1980

LEVEL/TYPE	STUDENTS	TEACHERS	CLASSROOMS	SCHOOLS	STUDENT/TEACHER RATIO	STUDENT/CLASSROOM RATIO
NORTH SINAI						
PRIMARY	10,480	393	268	30	26.7	39.1
PREPARATORY	2,832	117	71	7	24.2	40.0
GENERAL SECONDARY	1,943	100	53	4	19.4	36.7
TECHNICAL SECONDARY	298	37	9	2	8.0	33.1
TOTAL	15,553	647	401	43	24.0	38.8
UNIVERSITY*	--	--	--	--	--	--
SOUTH SINAI						
PRIMARY	1,061	131	80	27	8.1	13.3
PREPARATORY	31	21	3	1	2.6	10.3
GENERAL SECONDARY	21	6	1	--	3.5	21.0
TECHNICAL SECONDARY	--	--	--	--	--	--
TOTAL	1,113	158	84	28	7.5	13.3
UNIVERSITY*	--	--	--	--	--	--

* = 1978 Census.

NOTE: Cairo University figures are included in Giza due to its location within the administrative boundaries of Giza Governorate.

Source: Ministry of Education data in Egypt: Urban Growth and Urban Data Report prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Government of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 98.

Higher Education Facilities and Enrollments - 1981

	Secondary Schools					College/Tech. Schools				
	Fac'ties	Rms	Enrolled M	Enrolled F	Total	Fac'ties	Rms	Enrolled M	Enrolled F	Total
El Arish	3	46	900	499	1399	3	20	449	301	750
Rabaa	1	14	240	54	294	-	-	-	-	-
Ras Sudr	1	3	48	12	60	-	-	-	-	-
El Qantara	-	-	-	-	--	1	3	45	57	102
TOTAL	5	63	1188	565	1753	4	23	494	358	852

NOTE: Secondary school enrollments equal 1 percent of population.
College enrollments equal one-half of 1 percent of population.

SOURCE: Settlements Survey by Consultant, June 1981.

IN-SO-7

Religious Buildings and Public Meeting Places
by Subregion and Settlement
1981

SUBREGION/SETTLEMENT	No. of Mosques	No. of Churches	No. of Public Meeting Halls
A. SUEZ CANAL, Subtotal	7	1	2
Ayun Musa	--	--	--
Baloza	1	--	--
El Qantara	4	1	2
Gilbana	2	--	--
B. MEDITERRANEAN, Subtotal	23	1	11
Abu Aweigila	2	--	3
Bir El Abd	--	--	--
Bir El Thamada	--	--	--
El Arish	15	1	4
El Hasana	1	--	2
Gifgafa	--	--	--
Nakhl	1	--	2
Negila	1	--	--
Rabaa	1	--	--
Romana	2	--	--
C. GULF OF SUEZ, Subtotal	11	3	3
Abu Rudeis	1	--	--
Abu Zenima	1	--	1
El Tor	4	1	1
Feiran Oasis	3	1	--
Ras Sudr	1	--	--
St. Catherine	1	1	1

Source: Infrastructure Survey by Consultant, May-June 1981.

REFERENCES: INFRASTRUCTURE

The single most useful source, full of relevant, quite comprehensive, well presented information is Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study (NUPS) by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Government of Egypt, under U.S.A.I.D. Grant No. 263-0042 (July 1982). Companion volumes of NUPS contain additional data.

Other infrastructure references are listed below under three major headings -- Energy, Settlements and Housing, and Transportation.

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Joint Egypt/U.S. Report on Egypt/U.S. Cooperative Energy Assessment, DOE/1A-0002 (U.S. Department of Energy, April 1979).

Maghara Coal Project Report on Reserves and Relevant Geology (Cairo: Powell Duffryn Technical Services, Ltd., for the General Organization for Industrialization, May 1966).

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Of these, the report of the joint U.S./Egyptian assessment was probably the most important as a general overview of the Egyptian energy challenges--accommodating the elements of resources, national requirements, development time, and investment capital into a workable development plan. The assessment included analyses of costs and material and labor requirements for various development strategies built around a variety of emphases upon alternative energy sources, especially in the electric power field.

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Tenth of Ramadan Master Plan, New Industrial City (Cairo: SWECO, for Ministry of Housing and Reconstruction, 1976).

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F. ECONOMIC ACTIVITIES (EC)

Investments by Ministry for North and South Sinai, Summary
1982/83 - 86/87 Plan

Ministry	Number of Projects	Amount LE (million)	Percent distribution
TOTAL*	268	441.1	100.0
Agriculture	15	6.5	1.5
Industry and Mining	8	46.7	10.6
Petroleum	3	34.1	7.7
Electricity and Energy	3	23.8	5.4
Supply	10	24.4	5.5
Development	75	168.8	38.3
Education	2	13.0	3.0
Civil Aviation and Tourism	4	10.4	2.4
Health	12	6.1	1.4
Governorates	88	88.1	20.0
Others (12 Ministries or Agencies **)	48	19.2	4.2

* Of which 155 projects, valued at LE 237.8 million are in North Sinai and 133 projects (LE 203.3 million) in South Sinai.

** Each with less than 1 percent of the total

Source: Ministry of Planning, February 1983. These figures had not been approved by the National Assembly when this report was written.

Allocation of Development Expenditures to Sinai by Sector,

Summary 1982/83 Budget

	Amount (LE million)	Percent Distribution
TOTAL	83.8*	100.0
Agriculture	2.8	3.3
Irrigation	4.4	5.2
Industry	8.1	9.8
Petroleum	5.0	5.9
Electricity	9.8	11.6
Transport	24.2	29.0
Utilities	16.7	20.0
Services	8.2	9.7
Housing	3.8*	4.5
Others	0.8	1.0

* In addition LE 9.5 million is allocated for Housing Loans.

Source: Ministry of Planning, February 1983

Data on Some Businesses in El Arish - 1982

Type of Business	Market	Investment (LE)	Staff	Wages
Car repair[a]	All of North Sinai	30,000	5	% profit on repairs
Hardware store[b]	All of North Sinai	24,000	6	LE 40/mo
Olive oil production[b]	All of North Sinai	120,000	9[c]	LE 2-3/day
Transport[d] company	50% local 50% Cairo & Suez Canal	65,000 (1 truck)	2	LE 60/mo
Tile/brick manufacturing/ contracting[e]	75% El Arish 25% North Sinai	40,000 (Manufr) 100,000 (contr)	35	LE 30/mo unskilled LE 40-100/mo tilemakers LE 100/mo brickmakers
Clothing manufacturing b, f	25% El Arish 75% Cairo & Suez Canal	50,000	31	LE 28/mo assistant tailor LE 120/mo manager
Farm (vegetables, fruit)	Local	2,500	14	LE 1-5/day unskilled LE 8/day skilled
Needlework program	Cairo	5,000	3	LE 55/mo or LE 1/piece
Hotel/ restaurant[g]	Local (visitors)	10,000 (restaurant) 7,000 (hotel)	7	LE 15-40/mo unskilled (plus tips) LE 200-400/mo skilled

[a] Some labor from Nile Valley

[b] All local labor

[c] October to December only

[d] Annual sales of LE 3,000 to 3,500

[e] 50 percent of labor from Upper Egypt

[f] Annual sales of LE 58,000

[g] 80 percent of labor from Cairo

Source: Settlement Survey by Consultant (1981); see Working Paper No. 14

Agricultural Organizations in Northern Sinai, 1981

Organizations	Size and Functions
Wadi El Arish Agricultural Cooperative	350 member-families cultivate 3,600 feddans. Distributes animal feed, fertilizers, insecticides. Markets dates and olives.
Agricultural Cooperative for Vegetable & Fruit Production	400 members (some also in above cooperative). Seasonal activities - auctions of dates and olives, olive oil.
Bir El Abd Cooperative	Sells dates.
El Salaam Cooperative	344 feddans.
Agricultural Directorate - North Sinai Governorate	Agricultural extension, veterinary services. land tenure, legal affairs, statistics, pest control. Field offices El Arish, Bir El Abd, El Hasana, Nakhl, Sheikh Zuwayid, Rafah, 100 staff.
- Agricultural Extension Service	10 feddan demonstration farm: vegetables, seeds, nurseries. Approves fertilizer requests. Supervises pest control.
- Animal Production Dept.	Construction, management of poultry farms and livestock feed lots.
- Green Revolution Authority	Drills wells, provides technical assistance, distributes seedlings. 200 staff in El Arish.
- Principal Bank for Development and Agricultural Credit (PBDAC)	Loans for livestock, poultry, and fishing operations, tractors and trucks; warehousing; distribution of fertilizers; maintenance of irrigation systems.
Akkaria Company	Operates Hero Village reclamation site.
Arab Contractors	Operates New Mit Abul Kom reclamation site.
Governorate of Ismailia	Supports the Youth Farms in East Bitter Lakes
ISMAMEX	Exports fruit and vegetables from Ismailia Governorate; branch at Sarabium

Source: Conversations with officials of the North Sinai Governorate and other field interviews.

(B) Irrigated Crops in Sinai

Crop	Quantity (Feddans)	Location	Comments
Olives	700	El Arish, Ein Guderat near El Quseima	Used for pickling and oil. Traditional low density planting (40 trees/feddan). Young trees intercropped. Basin irrigation. Groundwater.
Vegetables	400	El Arish	Local consumption. Tomato, marrow, cucumber, peppers, okra, eggplant, potatoes. Drip irrigation. Groundwater.
Vegetables	320	El Arish	Local consumption. Farmers cooperative. A variety of vegetables; also olive trees and figs at cooperative. Drip irrigation. Groundwater.
Mixed	200	El Arish	Local consumption. Olives, apricots, apples, guava, grape-vines. Mostly olives. Drip irrigation. Groundwater.
Vegetables, Fruit	2,850	Sheikh Zuwayid	Local consumption, surplus for export. Mainly vegetables under plastic cloches. Drip irrigation. Groundwater.
Olives, citrus, guava, almonds, peas, grapes, vegetables	3,630	Rafah	Local consumption, surplus for export. Drip irrigation. Groundwater.
Grain, berseem, clover vegetables, fruit	3,000 (6,000 by 1984)	Hero Village, Bitter Lakes	Export to Canal Zone. Sprinkler irrigation, mainly center pivot. Nile water.
Vegetables, olives	500	Youth Farm, Bitter Lakes	Export to Canal Zone. Originally over 1,000 feddans. Nile water.
Barley, alfalfa, peanuts, sorghum, beans, sunflower	1,000 (5,000 by 1984)	New Mit Abul Kom	Export to Canal Zone. First phase of 11,000 feddan land reclamation scheme. Center pivot and drip irrigation. Nile water.

Source: Officials of the North Sinai Governorate and field interviews.

Rainfed Crops in North Sinai

Crop	Quantity	Location	Comments
Date Palm	350,000 trees yielding 10,500 tonnes	North Coast	Nutritious, storable Bedouin food; consumed locally
	650,000 trees	Elsewhere in Sinai	
Barley	Variable according to rainfall. Includes: 1,700 feddans Sheikh Zuwayid; 6,000 near Rafah; 1,200 near Hasana and Nakhl; 1,000 south of El Arish; 100 in wadi Sudr	Rafah Strip North Coast. Upland Hasana and Nakhl	Local grain and fodder
Berseem Alfalfa	Variable according to rainfall	Scattered wadi beds	Traditional methods of cultivation. Component of transhumant system
Watermelon	Variable according to rainfall. Includes: 1,500 feddans near Hasana and Nakhl; 1,400 near Bir El Abd	El Arish and elsewhere along North Coast. Uplands Hasana and Nakhl	Human and animal food
Castor Beans	Variable according to rainfall	El Arish and elsewhere along Coast	Used for oil

Source: Officials of the North Sinai Governorate and field interviews.

Agricultural Production in the El Arish Region, Oct. 79-Sept. 80

Item	Area, fd	Average Yield, MT/fd	Total Production, MT/yr	Local Production as % of Consumption a/
Palm trees	284,000 trees	75 kg/tree b/	21,300 b/	Export
Olives (irrigated)	1663	5 b/	8315 b/	Export
Tomatoes	180	15	2700	80%
Peppers	50	3	150	28%
Cucumbers	80	6	480	Excess
Potatoes	7	8	56	3%
Zucchini	80	8	640	100%
Eggplant	40	5	200	55%
Total vegetables	437	-	4226	60%
Total irrigated area	2100	-	-	-
Barley (rainfed)	225 c/	n.a.	n.a.	n.a.
Watermelons (non-irrigated)	200 c/	n.a.	n.a.	n.a.
Total agric. area	2525	-	-	-

a/ Consumption estimates from Table 1.2

b/ These numbers require verification

c/ Plus about 1800 fd of rainfed barley and 1600 fd of non-irrigated watermelons in the Bir el Abd region.

SOURCE: Agricultural Directorate, El Arish

Approximate Quantities of Vegetables Consumed in El Arish, 1980

Item	Origin	Season	Quantity, MT/day: Early & Late Season	Quantity, MT/day: Mid-Season	Estimated Annual Consumption, MT
Tomatoes	Local & Delta	May-Feb	15	25	3375
Pepper: hot	Local	May-Oct.	1	7	525
bell	Local	May-Oct.	0.1	0.2	15
Cucumbers	Local & Delta	April-June Oct.-Nov.	3.5	5	300
Potatoes	Delta	All year	5	5	1825
Dry Onions	Delta	All year	2	2	730
Garlic	Delta	March	-	50	50
Zucchini	Delta & Local	All year	2	3.5	640
Eggplant	Delta & Local	All year	1	2	365
Green Beans	Delta	Feb.-Apr.	0.2	0.3	10
Watermelons	Delta & Local	Apr.-Sept.	30	40	3000
Melons	Delta	June-Sept.	1.5	2.3	135
Total, annual consumption (an order-of-magnitude estimate)					10,970

SOURCE: El Arish wholesalers.

Prices of Vegetables Consumed in El Arish (pt/kg)

Item	Wholesale Min.	Wholesale Max.	Retail Min.	Retail Max.	Official Prices in El Arish, June 12, 1981 Wholesale	Official Prices in El Arish, June 12, 1981 Retail		Official Prices in Ismailia, June 13, 1981 Wholesale	Official Prices in Ismailia, June 13, 1981 Retail
Tomatoes	10-15	50-70	n.a.	n.a.	14	17	40%	10	12
Peppers, local	n.a.	n.a.	n.a.	n.a.	50	60		n.a.	n.a
Cucumbers	n.a.	n.a.	n.a.	n.a.	12	15		n.a.	n.a.
Potatoes	8-10	13-16	n.a.	16-19	13	15	18%	11	13
Dry Onions	5	8	n.a.	n.a.	9	11	28%	7	8.5
Garlic	5	15	n.a.	n.a.	16	20	7%	15	17
Zucchini:									
large	n.a.	n.a.	n.a.	n.a.	9	12	8%	5	7
small	n.a.	n.a.	n.a.	n.a.	11	14	37%	8	10
Green beans	n.a.	n.a.	n.a.	n.a.	13	15		6	8
Watermelons	9-18a/	18-12a/			n.a.	n.a.		26-112 a/	35-14 a/
Melons	15-20a/	30-35a/			n.a.	n.a.		n.a.	n.a.

a/ According to quality and size.

SOURCE: El Arish wholesalers; Price decrees of the North Sinai and Ismailia Supply Directorates.

Approximate Quantities and Prices of Fruit Consumed in El Arish, 1980

Item	Origin	Season	Quantity, MT/day: Early & Late Season	Quantity, MT/day: Mid-Season	Prices in El Arish, 1980 (pt/kg): Wholesale Min.	Wholesale Max.	Retail Min.	Retail Max.	Estimated Annual Consumption, MT
Grapes: Seedless	Delta	July-Oct.	n.a.	n.a.	30	35	33	38-50	n.a.
baladi	"	" "	n.a.	n.a.	18	20	n.a.	n.a.	n.a.
Total	"	" "	2 a/	3 a/	-	-		-	135
Oranges: Sukkari	"	Sept.-May	3	6	10.5	13.5	15	17	630
Juice	"	" "	3	6	10.5	13.5	15	17	630
Valencia	"	All year	3	6	13	16	13	16	1640
Navel	"	Sept.-May	3	6	14	17	20	25	630
Mandarine	"	" "	3	6	12.5	15.5	15	18	630
Total	"		15	30	-	-	-	-	4160
Apples: U.S.		winter	n.a.	n.a.	180	250	n.a.	n.a.	n.a.
Lebanon		"	n.a.	n.a.	130	170	n.a.	n.a.	n.a.
Total			0.2	0.3					15
Peaches	"	July-Aug.	1	2	25	35	n.a.	n.a.	60
Pears	"	July-Sept.	2	3	25	35	n.a.	n.a.	90
Mangoes: fine	"	July-Sept.	1	2	70	90	110	150	60
current	"	" "	0.3	0.5	35	50	n.a.	n.a.	15
Total, annual consumption (an order-of-magnitude estimate)									4535

a/ Almost all grapes consumed are seedless

Note: Consumption of guavas and figs is insignificant owing to transport difficulties.

SOURCE: El Arish wholesalers.

Fertilizers Distributed by the Sinai Agricultural Development Bank in 1980

Item	Price, LE per 50-kg bag	Quantity, MT	Total Value, LE
Ammonium nitrate (33.5% N)	3.300)	16.400	1,044
	3.065)		
Super phosphate (15% P)	1.470	5.700	168
Ammonium sulphate (20.6% N)	2.160	92.750	4,007
Potassium sulphate (48% K)	2.205	8.450	373
Urea (46% N)	4.576	134.300	12.291
		257.600	17.883

SOURCE: North Sinai Development and Agricultural Credit Bank.

Estimated Crop Production in part of North Sinai (1981)

Crop	Number of trees or plants	Area (feddans)	Yield/Production per feddan 1/ (tons)	Yield/Production total 1/ (tons)	Location
Irrigated:					
Tree					
Olive	69,783	700	(3.6)	2,500	North Sinai (El Arish to El Qantara)
Grape	2,072	-	-	2.5	
Pomegranate	1,512	-	-	1.5	
Almond	468	4	(0.075)	0.3	
Citrus	3,395	30	(0.2)	6	
Guava	973	-	-	3	
Fig	1,198	-	-	0.75	
Vegetable					
Tomato	-	180	15	(2,700)	North Sinai (El Arish to El Qantara)
Cucumber	-	80	6	(480)	
Squash	-	80	8	(640)	
Peppers	-	50	3	(150)	
Eggplant	-	40	5	(200)	
Potato	-	7	8	(56)	
Watermelon	-	3	15	(45)	
Okra	-	3	5	(15)	
Green Pepper	-	3	7	(21)	
Rainfed					
Palm Trees (Dates)	347,425	-	-	10,400	North Coast
Small Grains	-	2,052	-	-	North Sinai
Barley	-	300	-	-	El Arish
Barley	-	180	-	-	El Hasana
Beans	-	300	-	-	El Arish
Beans	-	180	-	-	North Coast
Watermelon	-	200	-	-	El Arish
Watermelon	-	1,600	-	-	Bir El Abd and vicinity

1/ Estimates in parentheses are imputed values

Source: Officials of North Sinai Governorate, the Ministry of Agriculture, and the Green Revolution Society.

Enterprise Analysis: Modern Chicken Production
(in LE except as otherwise noted)

New chicks (number)	60,000
(Losses @ 2½%) (number)	1,500
Mature chickens (number)	58,500
Gross revenue (@ 1.5 kg/bird, LE 1.15/kg)	100,912
Variable costs	
New chicks (@ LE 0.42 each)	25,200
Feed (@ LE 0.63/chick)	37,800
Water (600 m^3 @ LE 0.15/m^3)	90
Straw	720
Electricity	240
Medicines	2,400
Heating	180
Labor (4 persons @ LE 60/mo)	2,880
TOTAL VARIABLE COSTS	69,510
Fixed Costs	
Land	81
Depreciation	1,488
(equipment @ 10 yr S.L.)	(600)
(buildings @ 20 yr S.L.)	(888)
TOTAL FIXED COSTS	1,569
Other costs (contingencies, overhead, vehicles, maintenance, interest, and other--@ 10% of variable costs.)	6,951
Management charge[a]	6,000
TOTAL COSTS	84,030
Returns to capital	16,882

[a]The owner-operator of this enterprise manages a nearly identical public-sector operation for LE 6,000 per year.

SOURCE: Calculations by the Consultant.

Enterprise Budget: Desert Watermelon--
El Arish, 1981
(in LE, except as otherwise noted)

Melons (no./feddan)	1,167.0
Price[a]	.08
Gross revenue (watermelon)	93.0
Lib lib (seeds @ LE 0.90/kg)[b]	12.0
Fodder value[c]	56.0
TOTAL GROSS REVENUE	161.0
Variable costs	
Land preparation[d]	12.0
Labor planting and harvest[e]	12.0
TOTAL VARIABLE COSTS	24.0
Fixed costs	
Rent[f]	9.0
Return to management and capital	128.0
Net farm income[g]	152.0

[a]Price is for an average-sized melon of 1½ kilograms.

[b]Estimate that seeds are produced from 10 percent of the melon. One kilogram of seeds requires roughly 10 melons.

[c]The principal fodder crop is berseem, imported from the Delta. One LE 3 bundle is good for about 6 days. It takes 5 to 7 watermelon plants for 1 day's feed. Thus, the feed value of a watermelon plant is about LE 0.08 per plant; total imputed fodder value is LE 56.

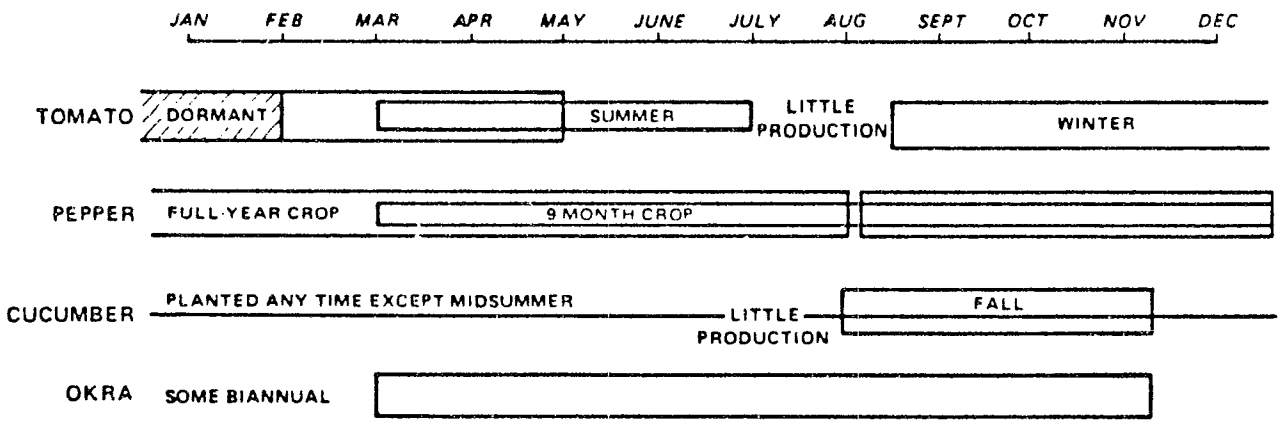
[d]It takes 4 person-days to clear the land of the winter grassy growth. Impute at LE 3 per day.

[e]Planting is said to take only 2 to 3 hours per feddan. Harvesting is carried out over a period of 1 month. Estimate total time for both to be 4 days.

[f]Rent is imputed based on a reported case near Bir El Abd in which 20 feddans were rented explicitly for watermelon at LE 180.

[g]Net farm income represents the return actually retained by the farmer if he is supplying the labor costs. Add back the imputed labor costs to the return to management and capital.

SOURCE: Calculations by the Consultant.



VEGETABLE CROPPING PATTERNS IN EL ARISH
(1981)

Dames & Moore

Enterprise Budget: Modern Olives,
115 Trees per Feddan--El Arish, 1981

Trees (no./feddan)	115
Yield (kg/tree)	150
Total yield (kg/feddan)	17,250

Oil yield	(kg @ 15%)	2,588.0	(kg @ 20%)	3,450.0
Price (LE/kg)		1.25		1.25
Gross revenue (LE, if oil)		3,235.0		4,313.0

	LE
Gross revenue (if salted olives, LE 0.30/kg)	5,175
Variable costs	
Chemical fertilizer (@ LE 1.5/tree)	173
Manure (@ LE 1.25/tree)	144
Water (16 m^3/feddan/day, LE 0.01/m^3)	58
Labor[a]	195
Harvesting (@ LE 0.05/kg)	862
TOTAL VARIABLE COSTS	1,432
Fixed costs	
Land	81
Depreciation[b]	33
Returns to management and capital	
Oil @ 15%	1,689
Oil @ 20%	2,767
Salted olives	3,629
Net farm income	
Oil @ 15%	2,746
Oil @ 20%	3,824
Salted olives	4.686

[a]Estimate that a 4-feddan olive farm will require one full-time person. Salary is estimated from the day rate of LE 3.0 per day to be LE 780 per year.

[b]Depreciation is on LE 200 worth of drip lines replaceable every 5 years. Annualize the cost at 10 percent interest.

SOURCE: Calculations by the Consultant.

Enterprise Budget: Modern Olives,
60 Trees per Feddan--El Arish, 1981

Trees (no./feddan)	60
Yield (kg/tree)	150
Total yield (kg/feddan)	9,000

Oil yield	(kg @ 15%)	1,350.0	(kg @ 20%)	1,800.0
Price (LE/kg)		1.25		1.25
Gross revenue (LE, if oil)		1,687.0		2,250.0

	LE
Gross revenue (if salted olives, LE 0.30/kg)	2,700
Variable costs	
Chemical fertilizer (@ LE 1.5/tree)	90
Manure (@ LE 1.25/tree)	75
Water (8 m^3/feddan/day, LE 0.01/m^3)	29
Labor[a]	195
Harvesting (@ LE 0.05/kg)	450
TOTAL VARIABLE COSTS	839
Fixed costs	
Land	81
Depreciation[b]	33
Returns to management and capital	
Oil @ 15%	734
Oil @ 20%	1,297
Salted olives	1,747
Net farm income	
Oil @ 15%	1,379
Oil @ 20%	1,942
Salted olives	2,392

[a]Estimate that a 4-feddan olive farm will require one full-time person. Salary is estimated from the day rate of LE 3.0 per day to be LE 780 per year.

[b]Depreciation is on LE 200 worth of drip lines replaceable every 5 years. Annualize the cost at 10 percent interest.

SOURCE: Calculations by the Consultant.

Enterprise Budget: Traditional Olives, 40 Trees per Feddan--El Arish, 1981

Trees (no./feddan)	40
Yield (kg/tree)	75
Total yield (kg/feddan)	3,000

Oil yield	(kg @ 15%)	450.0	(kg @ 20%)	600.0
Price (LE/kg)		1.25		1.25
Gross revenue (LE, if oil)		562.0		750.0

	LE
Gross revenue (if salted olives, LE 0.30/kg)	900
Variable costs	
Trimming (@ LE 0.5/tree)	20
Bunding (@ LE 0.3/tree)	12
Harvesting (@ LE 0.05/kg)	150
Manure (@ LE 1.25/tree)	50
Water	14
Irrigation labor (@ 2 days/month and LE 3.0/day)	72
TOTAL VARIABLE COSTS	318
Fixed costs (land)[a]	81
Returns to management and capital	
Oil @ 15%	163
Oil @ 20%	351
Salted olives	501
Net farm income	
Oil @ 15%	417
Oil @ 20%	605
Salted olives	755

[a]An annual price for land was obtained by annualizing LE 1,200 per feddan over 20 years at 3 percent interest.

SOURCE: Calculations by the Consultant.

Enterprise Budget: Okra--
El Arish, 1981

Yield (tons)	5.0
Price (LE/kg)	0.22
Gross returns (LE)	1,100.0
Variable costs (LE)	
Land preparation[a]	50.0
Seeds	5.0
Chemical fertilizer	25.0
Manure[b]	73.0
Pesticides	25.0
Transport of product[c]	50.0
Water[d]	38.0
Labor[e]	520.0
TOTAL VARIABLE COSTS	786.0
Fixed costs (LE)	
Depreciation[f]	46.0
Land[g]	54.0
Interest[h]	18.0
TOTAL FIXED COSTS	118.0
Return to management and capital (LE)	196.0
Net farm income (LE)[i]	716.0

NOTE: Estimated that okra is on the field 8 months.

[a]A major expense for farmers is hauling soil--sand to go on heavy clayey soils, and occasionally the converse. Although not a cost borne by all, it can be LE 200 to 300 per year. Estimated here at LE 50 per crop.

[b]Manure is a major, and presently a key, input to El Arish agriculture. One truckload of 15 m^3/feddan is LE 220. The estimate used here is that each farmer applies one truckload per year to his 2 cropped feddans. This cost is then prorated over the crops on the basis of how long they are on the land.

[c]Transport to the wholesale El Arish market is LE 0.10 per 10-kilogram box of produce. Many farmers have trucks or donkey carts of their own, and thus have a somewhat lower average cost. More properly, this cost should be deducted from the wholesale market price to give the farmgate price. But since prices discussed are most often the wholesale price, we will include a transport cost in calculating the gross margins to avoid confusion.

[d]Private vegetable farmers are now paying LE 0.01 per cubic meter for water; the plan is to use this price on the El Salaam cooperative and on the 1,200-feddan reclamation area. Cost is calculated on the basis of 16 m^3/feddans/day, and on the given crop's growing season.

[e]The typical El Arish vegetable farm is 4 feddans with drip equipment for 2. Interview findings are that no less than two persons are employed full time. The rate for farm day labor is LE 3 per day. From this, a total yearly wage bill of LE 780 per feddan is estimated and used to impute a labor cost for each crop.

[f]Depreciation is figured on the drip equipment only, as most farmers do not have sizable amounts of other capital. The drip lateral lines must be replaced every 3 to 5 years. We use here an estimate of 2,800 meters per feddan of lines, costing LE 0.15 per meter, replaced every 5 years. All fixed costs are annualized with an interest rate of 10 percent, which in this case is an annual payment of LE 69. This amount is then prorated over the individual crops. Note that drip lines cost somewhat less for vegetables than for tree crops: LE 0.15 per meter compared to LE 0.20 per meter.

[g]Many farmers in this region have paid off their farms. Others received their land before 1967 but never began payment. They are now expected to pay the original cost of LE 400 per feddan over 20 years at 3 percent interest. Others who are receiving their land now must pay LE 1,200 per feddan, also over 20 years at 3 percent interest. The latter case was used in the budgets, as this is closer to the present value and opportunity cost of the land. The annual payment of LE 81 is prorated.

[h]One farm-budgeting convention is to charge an interest cost on the total amount of the cash variable costs as, in a sense, an opportunity cost is being paid. Many studies do not include such a cost and, at any rate, it usually is not large. Interest at 10 percent was computed on the total variable cash costs over the period the crop is on the field.

[i]Net farm income represents the return actually retained by the farmer if he is supplying the labor costs. Add back the imputed labor costs to the return to management and capital.

Enterprise Budget: Peppers--
El Arish, 1981

Yield (tons)	6.0
Price (LE/kg)	0.23
Gross returns (LE)	1,380.0
Variable costS (LE)	
Land preparation[a]	50.0
Seeds	30.0
Chemical fertilizer	25.0
Manure[b]	82.0
Pesticides	20.0
Transport of product[c]	60.0
Water[d]	43.0
Labor[e]	585.0
TOTAL VARIABLE COSTS	895.0
Fixed costs (LE)	
Depreciation[f]	52.0
Land[g]	61.0
Interest[h]	24.0
TOTAL FIXED COSTS	137.0
Return to management and capital (LE)	348.0
Net farm income (LE)[i]	933.0

NOTE: Estimated that peppers are on the field 9 months.

[a]A major expense for farmers is hauling soil--sand to go on heavy clayey soils, and occasionally the converse. Although not a cost borne by all, it can be LE 200 to 300 per year. Estimated here at LE 50 per crop.

[b]Manure is a major, and presently a key, input to El Arish agriculture. One truckload of 15 m^3/feddan is LE 220. The estimate used here is that each farmer applies one truckload per year to his 2 cropped feddans. This cost is then prorated over the crops on the basis of how long they are on the land.

[c]Transport to the wholesale El Arish market is LE 0.10 per 10-kilogram box of produce. Many farmers have trucks or donkey carts of their own, and thus have a somewhat lower average cost. More properly, this cost should be deducted from the wholesale market price to give the farmgate price. But since prices discussed are most often the wholesale price, we will include a transport cost in calculating the gross margins to avoid confusion.

[d]Private vegetable farmers are now paying LE 0.01 per cubic meter for water; the plan is to use this price on the El Salaam cooperative and on the 1,200-feddan reclamation area. Cost is calculated on the basis of 16 m^3/feddans/day, and on the given crop's growing season.

[e]The typical El Arish vegetable farm is 4 feddans with drip equipment for 2. Interview findings are that no less than two persons are employed full time. The rate for farm day labor is LE 3 per day. From this, a total yearly wage bill of LE 780 per feddan is estimated and used to impute a labor cost for each crop.

[f]Depreciation is figured on the drip equipment only, as most farmers do not have sizable amounts of other capital. The drip lateral lines must be replaced every 3 to 5 years. We use here an estimate of 2,600 meters per feddan of lines, costing LE 0.15 per meter, replaced every 5 years. All fixed costs are annualized with an interest rate of 10 percent, which in this case is an annual payment of LE 69. This amount is then prorated over [illegible] individual crops. Note that drip lines cost somewhat less for vegetables than for [illegible] crops: LE 0.15 per meter compared to LE 0.20 per meter.

[g]Many farmers in this region have paid off their farms. Others received their land before 1967 but never began payment. They are now expected to pay the original cost of LE 400 per feddan over 20 years at 3 percent interest. Others who are receiving their land now must pay LE 1,200 per feddan, also over 20 years at 3 percent interest. The latter case was used in the budgets, as this is closer to the present value and opportunity cost of the land. The annual payment of LE 81 is prorated.

[h]One farm-budgeting convention is to charge an interest cost on the total amount of the cash variable costs as, in a sense, an opportunity cost is being paid. Many studies do not include such a cost and, at any rate, it usually is not large. Interest at 10 percent was computed on the total variable cash costs over the period the crop is on the field.

[i]Net farm income represents the return actually retained by the farmer if he is supplying the labor costs. Add back the imputed labor cost to the return to management and capital.

Enterprise Budget: Cucumbers--
El Arish, 1981

Yield (tons)	8.0
Price (LE/kg)	0.2
Gross returns (LE)	1,600.0
Variable costs (LE)	
Land preparation[a]	50.0
Seeds	20.0
Chemical fertilizer	25.0
Manure[b]	30.0
Pesticides	30.0
Transport of product[c]	80.0
Water[d]	14.0
Labor[e]	195.0
TOTAL VARIABLE COSTS	444.0
Fixed costs (LE)	
Depreciation[f]	17.0
Land[g]	20.0
Interest[h]	6.0
TOTAL FIXED COSTS	43.0
Return to management and capital (LE)	1,113.0
Net farm income (LE)[i]	1,308.0

NOTE: Estimated that cucumbers are on the field 3 months.

[a]A major expense for farmers is hauling soil--sand to go on heavy clayey soils, and occasionally the converse. Although not a cost borne by all, it can be LE 200 to 300 per year. Estimated here at LE 50 per crop.

[b]Manure is a major, and presently a key, input to El Arish agriculture. One truckload of 15 m^3/feddan is LE 220. The estimate used here is that each farmer applies one truckload per year to his 2 cropped feddans. This cost is then prorated over the crops on the basis of how long they are on the land.

[c]Transport to the wholesale El Arish market is LE 0.10 per 10-kilogram box of produce. Many farmers have trucks or donkey carts of their own, and thus have a somewhat lower average cost. More properly, this cost should be deducted from the wholesale market price to give the farmgate price. But since prices discussed are most often the wholesale price, we will include a transport cost in calculating the gross margins to avoid confusion.

[d]Private vegetable farmers are now paying LE 0.01 per cubic meter for water; the plan is to use this price on the El Salaam cooperative and on the 1,200-feddan reclamation area. Cost is calculated on the basis of 16 m^3/feddans/day, and on the given crop's growing season.

[e]The typical El Arish vegetable farm is 4 feddans with drip equipment for 2. Interview findings are that no less than two persons are employed full time. The rate for farm day labor is LE 3 per day. From this, a total yearly wage bill of LE 780 per feddan is estimated and used to impute a labor cost for each crop.

[f]Depreciation is figured on the drip equipment only, as most farmers do not have sizable amounts of other capital. The drip lateral lines must be replaced every 3 to 5 years. We use here an estimate of 2,800 meters per feddan of lines, costing LE 0.15 per meter, replaced every 5 years. All fixed costs are annualized with an interest rate of 10 percent, which in this case is an annual payment of LE 69. This amount is then prorated over the individual crops. Note that drip lines cost somewhat less for vegetables than for tree crops: LE 0.15 per meter compared to LE 0.20 per meter.

[g]Many farmers in this region have paid off their farms. Others received their land before 1967 but never began payment. They are now expected to pay the original cost of LE 400 per feddan over 20 years at 3 percent interest. Others who are receiving their land now must pay LE 1,200 per feddan, also over 20 years at 3 percent interest. The latter case was used in the budgets, as this is closer to the present value and opportunity cost of the land. The annual payment of LE 81 is prorated.

[h]One farm-budgeting convention is to charge an interest cost on the total amount of the cash variable costs as, in a sense, an opportunity cost is being paid. Many studies do not include such a cost and, at any rate, it usually is not large. Interest at 10 percent was computed on the total variable cash costs over the period the crop is on the field.

[i]Net farm income represents the return actually retained by the farmer if he is supplying the labor costs. Add back the imputed labor costs to the return to management and capital.

Enterprise Budget: Tomatoes--
El Arish, 1981

Yield (tons)	15.0
Price (LE/kg)	0.10
Gross returns (LE)	1,500.0
Variable costs (LE)	
Land preparation[a]	50.0
Seeds[b]	75.0
Chemical fertilizer	25.0
Manure[c]	55.0
Pesticides	50.0
Transport of product[d]	150.0
Water[e]	29.0
Labor[f]	390.0
TOTAL VARIABLE COSTS	824.0
Fixed costs (LE)	
Depreciation[g]	35.0
Land[h]	40.0
Interest[i]	22.0
TOTAL FIXED COSTS	97.0
Return to management and capital (LE)	579.0
Net farm income (LE)[j]	969.0

NOTE: Estimated that tomatoes are on the field 6 months.

[a]A major expense for farmers is hauling soil--sand to go on heavy clayey soils, and occasionally the converse. Although not a cost borne by all, it can be LE 200 to 300 per year. Estimated here at LE 50 per crop.

[b]Tomato seeds may be local or Israeli. The latter are expensive, but preferred. Local seeds are under LE 10 per feddan; Israeli, LE 75 to 100 per feddan.

[c]Manure is a major, and presently a key, input to El Arish agriculture. One truckload of 15 m^3/feddan is LE 220. The estimate used here is that each farmer applies one truckload per year to his 2 cropped feddans. This cost is then prorated over the crops on the basis of how long they are on the land.

[d]Transport to the wholesale El Arish market is LE 0.10 per 10-kilogram box of produce. Many farmers have trucks or donkey carts of their own, and thus have a somewhat lower average cost. More properly, this cost should be deducted from the wholesale market price to give the farmgate price. But since prices discussed are most often the wholesale price, we will include a transport cost in calculating the gross margins to avoid confusion.

[e]Private vegetable farmers are now paying LE 0.01 per cubic meter for water; the plan is to use this price on the El Salaam cooperative and on the 1,200-feddan reclamation area. Cost is calculated on the basis of 16 m^3/feddans/day, and on the given crop's growing season.

[f]The typical El Arish vegetable farm is 4 feddans with drip equipment for 2. Interview findings are that no less than two persons are employed full time. The rate for farm day labor is LE 3 per day. From this, a total yearly wage bill of LE 780 per feddan is estimated and used to impute a labor cost for each crop.

[g]Depreciation is figured on the drip equipment only, as most farmers do not have sizable amounts of other capital. The drip lateral lines must be replaced every 3 to 5 years. We use here an estimate of 2,800 meters per feddan of lines, costing LE 0.15 per meter, replaced every 5 years. All fixed costs are annualized with an interest rate of 10 percent, which in this case is an annual payment of LE 69. This amount is then prorated over the individual crops. Note that drip lines cost somewhat less for vegetables than for tree crops: LE 0.15 per meter compared to LE 0.20 per meter.

[h]Many farmers in this region have paid off their farms. Others received their land before 1967 but never began payment. They are now expected to pay the original cost of LE 400 per feddan over 20 years at 3 percent interest. Others who are receiving their land now must pay LE 1,200 per feddan, also over 20 years at 3 percent interest. The latter case was used in the budgets, as this is closer to the present value and opportunity cost of the land. The annual payment of LE 81 is prorated.

[i]One farm-budgeting convention is to charge an interest cost on the total amount of the cash variable costs as, in a sense, an opportunity cost is being paid. Many studies do not include such a cost and, at any rate, it usually is not large. Interest at 10 percent was computed on the total variable cash costs over the period the crop is on the field.

[j]Net farm income represents the return actually retained by the farmer if he is supplying the labor costs. Add back the imputed labor costs to the return to management and capital.

Enterprise Budget: Date Palm--
El Arish, 1981
(in LE, except as otherwise noted)

Trees (no./feddan)	85
Nonproducing trees (no./feddan)[a]	8
Producing trees (no./feddan)	77
Yield (kg/tree)	125.0
Price (kg)	0.12
Gross revenue (dates only)	1,155.0
Byproducts[b]	
Palm leaves (no./tree)	10.0
Price (per leaf)	0.04
Gross revenue (leaves)[c]	31.0
Palm branches (no./tree)	5.0
Price (per branch)	0.25
Gross revenue (branches)	96.0
TOTAL GROSS REVENUE	1,282.0
Variable costs	
Fertilizer[d]	220.0
Fertilization labor[e]	43.0
Harvest labor[f]	153.0
TOTAL VARIABLE COSTS	416.0
Return to management, land[g]	866.0
Net farm income[h]	1,062.0

[a]Due to poor fertilization and other causes, some 10 to 20 percent of the trees in a date palm stand may not produce in a given year. The estimate used here is 10 percent.

[b]There is active trading in the leaves and branches of the palms. Not everyone takes advantage of this, however. Including the byproducts will give an upper limit on possible returns.

[c]Taken at 77 date-bearing trees per feddan. This is because the branches and leaves are usually harvested at the same time as the dates.

[d]Estimate that one load of manure is used per feddan-year at LE 220 per load.

[e]Estimate at LE 0.5 per tree. Fertilization of a date tree involves digging a hole next to it and burying the manure.

[f]Trees are harvested in stages. Estimate that each tree is climbed three times at a cost of LE 0.60 each time.

[g]No charge to land is included because, although date trees are usually owned, the land on which they grow is typically neither owned nor rented.

[h]Net farm income represents the return actually retained by the farmer if he supplies the labor costs. Add back the imputed labor costs to the return to management and capital.

SOURCE: Calculations by the Consultant.

Estimated Numbers of Livestock in Sinai,
1950, 1967, 1978 and 1981

Type	1950	1967	1978	1981
Goats (*Capra* spp.)	9,000	15,600	66,200	120,600
Sheep (*Ovis* spp.)	7,500	9,500	25,400	38,000
Camels (*Camelus dromedarius*)	5,000	8,500	9,050	20,050
Donkeys (*Equus asinus*)	3,250	1,300	unreported	6,300
Horses (*Equus caballus*)	100	250	250	300
Cattle (*Bos* spp.)	800	1,250	160	100
TOTAL	25,650	36,400	101,060	185,350

SOURCE: For 1950, Ministry of Agriculture; 1967, General Desert Development Organization; 1978, the Israeli Occupied Territories Authorities; and 1981, Desert Institute Field Survey. EC-AG 19 provides more detail and less "rounded" estimates for 1981.

Estimated Livestock Population
North and South Sinai
1981

Location	Sheep	Goats	Camels	Donkeys	Horses
North Sinai					
El Arish	6,052	21,227	539	157	--
Bir El Abd	11,114	35,924	1,654	107	--
El Hasana and Nakhl	7,993	18,562	1,573	966	--
SUBTOTAL	25,159	75,713	3,766	1,230	--
South Sinai					
Ras Sudr	1,611	3,595	239	70	11
Abu Suweira	1,636	4,116	223	95	--
Gharandal	604	,230	864	183	3
El Bagha	140	670	147	240	2
Abu Gaada	289	594	751	267	7
Wadi El Ranya	134	237	357	480	3
Wadi El Yanis	51	504	481	363	17
El Ramla and Wadi El Beda	110	153	620	400	9
Bir El Nassib	131	1,093	1,375	178	6
Ain Sudr	384	1,665	140	380	6
Abu Rudeis	1,372	3,155	1,980	274	9
Wadi Hylfia	420	740	240	335	4
Wadi Feiran	1,421	5,967	3,720	298	57
Wadi El Tor	379	4,175	1,480	197	12
El Tor	2,127	6,249	590	86	--
El Nehayat	620	2,292	631	238	19
Wadi El Dalal	467	2,513	700	482	72
El Malha	240	1,830	960	375	51
St. Catherine	562	4,139	784	151	14
SUBTOTAL	12,698	44,917	16,282	5,092	302
TOTAL	37,857	120,630	20,048	6,322	302

SOURCE: Ministry of Agriculture, 1981.

EC-FS-7

Government Approved Projects
Agricultural Sector

Project	Budgeted Amount (thousand LE)
Agriculture SUBTOTAL	2,180
Animal Protection	22
Extension Services	200
Institutional Support	315
Veterinary Center	180
Institute for Zoological Research	2
Desert Institute	40
Green Revolution Authority	320
Land Reclamation	248
Village Development	328
Cattle Fattening	75
Chicken Production	85
Fishing Industry--Water Resources	295
Olive Processing and Canning Plant	70
Irrigation and Drainage SUBTOTAL	2,260
Agro-Industries SUBTOTAL	2,060
Bakery and Grain Storage, El Arish	1,410
Ice Plant, El Arish	500
Ice Plant, North Sinai	30
Ice Plant, South Sinai	30
Fish Processing	90
Electricity SUBTOTAL	120
Electricity for Land Reclamation	100
Electricity for Food Processing	20
Transportation and Communication SUBTOTAL	755
Green Revolution Society	60
Ministry of Agriculture	195
Completion of El Arish Refrigeration Plant	250
Completion of El Tor Refrigeration Plant	250
Trading and Finance SUBTOTAL	215
Food Warehouses	100
Transportation Center for Fish Marketing Company	115
Housing SUBTOTAL	90
Construction of Units for Green Revolution Society	
Labor SUBTOTAL	60
Training Center for Green Revolution Society	
TOTAL agricultural-sector projects	7,740
GRAND TOTAL, approved projects for Sinai	54,982

Share of agricultural-sector projects in total investment budget is 14 percent.

Note: This table understates agriculture-related investments by omitting investment in Agricultural Directorate and Agricultural Bank buildings and other facilities.

SOURCE: Ministry of Development and Ministry of Planning, 1981

EC-F$-8

Mineral Exploration Cost Estimates

1981 (LE)

Mineral	1981 LE
Metallic minerals	1,000,000
Uranium	875,000
Iron	560,000
Copper sandstone	430,000
Turquoise	420,000

Note: These costs are for an accelerated program to develop proven turquoise and cupriferous resources and to delineate areas in which the other minerals may be subjected to district exploration. Estimates are based on the use of both expatriate and domestic professionals at an approximate 1:1 ratio. Costs include the purchase of Israeli geophysical and radiometric data, but do not include exploration drilling.

SOURCE: Estimates by the Consultant. See Working Paper No. 37, Page 4-15.

Mine Development/Production Forecast
1981

Mine Type	No. of Mines	Annual Production[a]	First Year of Full Production[b]
Cement	1	500,000 tons	1995
Coal	2	300,000 tons	1985
Construction aggregate	6	100,000 m^3	1988
Copper (sandstone)	1	1,750 tons	1988
Ferromanganese	2	30,000 tons[c]	1990
Glass sand	3	62,000 tons	1985
Gypsum	2	225,000 tons	1987
Kaolin	2	50,000 tons	1983
Open pit metal	1	7,500 tons	1994
Salt	1	1,000,000 tons	1983
Turquoise	4	20,000 lb	1983
Uranium	1	750,000 lb	1993

[a]Production per average mine unit; multiply by number of mines to calculate total Sinai production.

[b]Initial production year for single mine supplies; for multiple mine unit commodities, one-half of total capacity is predicted to be available by this year.

[c]Iron and manganese.

SOURCE: Calculations by the Consultant. See Working Paper No. 37, Page 5-6.

Development and Cost/Benefit Forecast for Sinai Minerals, 1982 to 2000[a,b]

Mineral Commodity, Median Startup Year, and No. of Mines/Plants	Total Capital for Mine and Plant (LE)	Annual Production (Gross Value)[c]	Average Annual Exploration Cost (LE)	Average Annual Ore Delineation Cost (LE)	Average Annual Operations Cost (LE)	Annual Freshwater Consumption (m^3)	Electricity (MW)	Benzene Plus Diesel (liters)	Btu's for Natural Gas, Electricity, or Coal	Roads (km)[d]
Construction aggregate 1988 6	5,700,000	600,000[e] 2,500,000	50,000	30,000	630,000	0.01×10^6	<0.2	0.4×10^6		18 60
Kaolin 1986 2	9,650,000	100,000[f] 7,000,000	64,000	50,000	2,500,000	0.15×10^6	1.3	0.5×10^6	$8,542 \times 10^6$	4 40
Gypsum 1987 2	19,740,000	420,000[f] 13,558,000	50,000	45,000	5,300,000	6,750	5.0	0.5×10^6	$400,000 \times 10^6$	5 10
Coal 1988 2	94,000,000	600,000[f] 35,000,000	700,000	2,750,000	12,250,000	0.25×10^6	4.3	?	0	10 60
Glass sand 1985 3	10,500,000	180,000[f] 3,600,000	45,000	45,000	1,080,000	0.05×10^6	<0.2	0.18×10^6	$7,800 \times 10^6$	3 30
Ferromanganese/iron 1990 2	21,200,000	56,000[f] 16,250,000	300,000	112,000	7,200,000	0.5×10^6	20.0	5.4×10^6	66×10^6 m^3	10 50
Salt 1985 1	7,700,000	1,000,000[f] 3,700,000	0	0	1,400,000	1,500	0.5	$0.[illegible] \times 10^6$	?	5 5
Cement 1995 1	76,000,000	500,000[f] 12,500,000	45,000	50,000	4,125,000	0.3×10^6	10.0	2×10^6	0.25×10^6	10 40
Uranium 1993 1	8,800,000	750,000[g] 11,250,000	175,000	160,000	3,500,000	1×10^6	0.2	0.16×10^6	?	0 40
Cupriferous sandstone 1988 1	11,200,000	1,750[f] 1,750,000	75,000	350,000	575,000	1.5×10^6	0.5	1.4×10^6	?	0 60
Turquoise 1990 4	500,000	20,000[g] 400,000	20,000	60,000	250,000	0	0.0	40,000	0	0 80
Open pit metal[h] 1994 1	36,000,000	20,000[f] 4,000,000	125,000	1,000,000	1,320,000	0.5×10^6	0.3	1.0×10^6	?	15 40
TOTAL	280.993×10^6	109.200×10^6	1,649,000	4,712,000	40.130×10^6	4,270,000	40–43	12.5×10^6		88 515

[a] Order-of-magnitude estimates.

[b] Average employment levels for the 12 mineral commodities are as follows: construction aggregate, 132; kaolin, 300; gypsum, 698; coal, 600; glass sand, 120; ferromanganese/iron, 750; salt, 65; cement, 200; uranium, 270; cupriferous sandstone, 150; turquoise, 60; open pit metal, 500.

[c] Gross value calculated for FOB mine; the second figure for each entry is the gross value of annual production, in Egyptian pounds (LE).

[d] The first number represents paved roads from site to public highway system; the second number represents unpaved roads.

[e] Cubic meters.

[f] Tons.

[g] Pounds.

[h] Tungsten, tin, niobium, etc.

SOURCE: 1981 calculations by the minerals Consultant. See Working Paper No. 37, Pages 5-5 through 5-8.

Recommended Refinery and Chemical Products Development in the Southwest Subregion

Industry	(Feddans)	Annual Capacity (000 Tons)	Startup Phase	Jobs	Power (KW)	Water (m^3/Day)	Investment Foreign (LE 000)	Investment Local (LE 000)
Fertilizer Complex:								
Ammonia	(14)	660	II	60	2,440	20,000	80,000	25,000
Urea	(10)	825	II	60	5,000	17,280	55,000	25,000
Nitric Acid	(10)	230	II	50	4,000	3,000	16,000	9,000
CAN[a]	(14)	330	II	100	3,000	1,500	22,000	23,000
Support Facilities	(30)	--	II	300	1,000	15	8,000	23,000
Caustic Soda, Chlorine	(60)	240	II	120	96,000	7,000	70,000	30,000
Soda Ash	(60)	100	II	200	3,000	1,200	45,000	35,000
Oil Refinery	(650)	5,000	II	550	20,000	9,600	225,000	75,000
Petrochemical Complex:								
Initial	(700)	400	II	1,250	54,000	45,000	320,000	170,000
Expansion	(1,800)	800	II	4,100	256,000	105,000	780,000	480,000
			TOTAL	6,790	444,440	209,595	1,621,000	895,000

a/ Calcium ammonium nitrate.

SOURCE: Estimates by the Consultant.

TOURISM

MAJOR TOURISM LANDMARKS OF SINAI

WITH DESCRIPTIVE COMMENTARY

Dahab Lighthouse--on a shallow, rocky surface fringed with bush-like corals. The lighthouse is a landmark for a beach area along the Gulf of Aqabah.

El Arish--largest city in Sinai (population, 70,000) and the regional capital of North Sinai. El Arish has a beautiful beach lined with palm trees and offers perfect weather for year-round recreational activities. A large Bedouin market is held every Thursday. Along the coast is an active fishing village with a large fleet of boats. Several tourism developments are planned for El Arish, including a plaza commemorating Sadat's raising of the flag after the second-stage Israeli withdrawal and a plaza and tourist center near the old Allenby railroad.

El Tor--main town of South Sinai, from the Byzantine period until the Six Day War (1967); known in church sources as Raieto, a center for monks and pilgrims. Some of the hermits lived in the caves of Bir Abu Suweira (north) and in Gebel Umm Shomar (east). Until 1967, it was the base and marine connection to St. Catherine's Monastery. However, most of its buildings were the quarantine station for Moslem pilgrims returning from Mecca. El Tor's pilgrims' port, also a fishermen's anchorage, and a large sand-filled fishing boat add a picturesque quality to the beach. El Tor has a church, two mosques, several coral-stone buildings, and many more wooden huts. In 1982, El Tor will become the capital of South Sinai. El Tor is also a markaz capital; a Bedouin market is open on Thursdays.

Faraun Island (Gezira Faraun)--small island in the northern Gulf of Aqabah, near Ras Taba. On its two hills are ruins of Crusader and Mameluk citadels, with walls and towers of an earlier period. Some identify the ruins with King Solomon. The Crusaders called it Ile de Graye, and it is also known as Pharoah's Island.

Gebel Musa (Mount Sinai)--elongated, granite mountain with numerous ravines, at an elevation of 2,285 meters, composed of volcanic rock. Its western peak, Ras Safsafa, reaches an altitude of 2,168 meters. Traditionally, it is recognized as Mount Sinai. Arabs honored it with the name of Moses, Gebel Musa. Following this tradition, the Christians located many holy sites on the mountain and its surroundings. On the summit is a chapel built over ruins of an older church. Next to the chapel is a mosque. On the shoulder of the mountain, next to a large, old cypress tree, is the chapel of the prophet Elijah, who fled to the desert after his dispute with the prophets of Baal on Mount Carmel. There are 750 steps leading from this chapel to the summit.

Manmade paths on the mountain lead to small, hidden valleys. West of Elijah's chapel, in a valley abundant with vegetation, is the chapel of John the Baptist. A valley nearby has a large building, a well, and a large almond tree from which the valley got its name, Wadi El Lusa.

On the west, in Wadi Safsafa, is a large "safsafa" (willow) tree, from which the western summit was named. The valley has a chapel known as "Kanisat Safsafa," Chapel of the Virgin's Girdle.

At the top of the path leading down Wadi Shereis to the southwest is "Kanisat El Akhmar" (the Red Church), known as the Chapel of Saint Panteleimon.

Along Wadi Shereis are chapels, iron crosses fixed to rocks, rock inscriptions, and hand-built paths and orchards, all produced by hermits.

The panorama from the summit is fantastic, especially at sunrise or sunset. From Ras Safsafa, one can see the El Rakha Plain, traditionally the place of the Israelites' encampment when waiting for Moses to come down with the Tablets of the Law.

The highlight of any trip to Sinai is climbing Gebel Musa.

Hammam Faraun--hot springs off the Gulf of Suez. According to legend, the Israelites crossed the sea at this point, and here Pharaoh and his chariot sank into deep water. Pharaoh's anger makes the water boil, and the steam can still be seen in a nearby cave.

Hammam Saidna Musa--hot water spring that runs into a well-constructed indoor bathing pool. Next to the stone building of the pool is a date palm plantation that belongs to St. Catherine's Monastery and is cultivated by local Bedouins.

Lake Bardawil--large saltwater lagoon, an important stopover for birds migrating between Africa and Eurasia. It is about 74 kilometers long and 20 kilometers wide. A barrier beach separates Lake Bardawil from the Mediterranean Sea. This lake has also been related by some theorists to the "Yam Suph" or "reed sea" of the biblical Exodus.

The influx of water from the Mediterranean is very important to the ecology of the Lake Bardawil system because it maintains the salt concentration at tolerable levels. The eastern island-cove complex is an internationally recognized breeding, resting, and feeding area for wintering and migratory birds. While the lagoon in the central area is a good source of fish, the western marshes provide excellent habitat for wintering flamingo, avocet, shoveler, and shelduck (merganser), as well as waders.

Marsa Bareika--inlet of the large bay north of Ras Mohammad, with sandy beaches and fine coral reefs. The road along the shore is difficult, even with a four-wheel drive.

Marsa El Att--a very spacious sandy bay north of Sharm El Sheikh, with a fine beach and coral reef. The northern edge drops 10 to 40 meters and has large fan-like corals. The Israelis established this site as a resort, with bathing and diving facilities, restaurants, a snack bar, hotels, and glass-bottom boats.

Nuweiba--village along the Gulf of Aqabah near Wadi Watir. Nuweiba has a bathing beach with facilities, diving club, restaurant, hotel, camping site, dispensary, and gas station, on the Eilat-Sharm El Sheikh highway.

Qalat El Gindi--at the entrance to Wadi Sudr, through which the ancient road Darb Esh Shawi runs. Saladin built a large fortress, surrounded by a high wall, to provide travelers with protection against marauding Bedouin. Below the mosque in the fortress courtyard is a large underground cistern with pointed Moorish arches.

Ras Mohammad--southernmost tip of the Sinai Peninsula. Ras Mohammad is a raised petrified coral reef; its cracked side contains seawater which feeds the inland salina. The southern edge is separated by a crack that has become a

seawater channel with Avicennia mangroves. On the western side of Ras Mohammad is a canyon with ospreys (fish hawks) and ruins of a Roman citadel. There are two interesting observatories. The coral reefs are the finest in Sinai, and nearby are attractive warm water beaches along the Gulf of Aqabah. Ras Mohammad can be reached in any type of vehicle.

Rod El Eir--inscriptions and drawings in rock that date to the ancient Egyptians. They include drawings of boats and animals. The inscriptions are located at Wadi Rod El Eir (Path of the Donkey), near Bir Nasib, and the site can be reached by foot up the wadi or from Sarabit El Khadim.

Sarabit El Khadim--ruins of ancient Egyptian temple in the Umm Bugma region. Built about 4000 years ago by pharaohs of the 12th dynasty, the temple, built in honor of Hathor, the cat-eared, green-blue-eyed goddess of turquoise, has a tomb of an important mine official. It is decorated with hieroglyphics that contain information about the operation of the mines. In 1906, Petrie found many more rock drawings and inscriptions in the mining area; he also discovered two inscriptions using the Proto-Sinaic alphabet, amazingly similar to the old Hebrew alphabet. Because of the rapid erosion of the sandstone, protective measures were taken and paths marked around the temple by the Israelis.

Sharm El Sheikh--resort development in South Sinai, northeast of Ras Mohammad. A raised petrified coral reef separates Sharm El Sheikh Bay from Shermel El Moiya, forming a boot-shaped peninsula.

The eastern bay, Sharm El Moiya (moiya means water), is named after the only two wells in the region (salty but good for watering herds). East of this bay, on the plateau of Ras Umm Sidd, is the residential area of Sharm El Sheikh. Ras Umm Sidd is an elevated plateau that borders the two bays on the east and the Red Sea on the west. Sharm El Sheikh has restaurants, hotels, a gas station, a garage, a dispensary, a police station, a bus station, and an airport. Visitors should bring most food staples.

At the entrance to Sharm El Sheikh, to the right of the road, is the Kennedy Rock, a mushroom-shaped stone that eroded into the shape of the head of the late president of the United States.

Wadi Feiran--drains a wide basin of the high mountain region of South Sinai into the Gulf of Suez. Its continuation above Naqb Buweib is called Wadi El Sheikh, where it runs mainly through metamorphic rock. Feiran Oasis is 8 kilometers long with wells, palms, gardens, and houses of Bedouins who represent all the tribes of South Sinai. Feiran has a rural center with a dispensary, stores, shops, and a gas station. On the side of the wadi are terraces of chalky, marl deposits that prove the existence of ancient lakes dammed in by dikes. The terraces still contain underground water reservoirs refilled by seasonal floods. Tel El Makhrad in Feiran was a flourishing town during the Byzantine period, identified as biblical Rephidim. The new church (1969) and the amazing gardens belong to St. Catherine's Monastery. On the sides of the wadi are caves dug into the marl, which were used by monks in ancient days. These caves gave the wadi its name, which translates "Valley of Mice."

The motor road starts at the Abu Rudeis-El Tor road and runs along the wadi to St. Catherine's, with side roads branching out to Wadi El Akhdar, Wadi Sahab, Wadi Solaf, and Wadi Gharba.

Wadi Hebran--descends from Gebel Tarbush to the El Qaa Plain. The Egyptian Abbas Pasha in the 1860's ordered the construction of a "chariot" road (Sikkat Abbas Pasha) from El Tor to St. Catherine's Monastery, parts of which can still be seen. The oasis and tomb of Sheikh El Irdasiya and the canyon of gardens with springs along the way make Wadi Hebran a recommended route for walking or camel riding, and today it is passable with a four-wheel drive.

Wadi Isla--gradually descends from Gebel Umm Shomar to the El Qaa Plain. From the Byzantine period, the wadi served as a camel caravan route to St. Catherine. Near the springs are palm groves, canes ("Phragmites" and "arunda"), juncus, mint ("mentha"), and cane huts belonging to the Awland Said tribe. Distant tribes also come to Wadi Isla to collect cane.

Wadi Maghara--descends into Wadi Sidri at Sheikh Soliman Nafia. In the 1840's Major MacDonald rediscovered the old turquoise mines in the wadi and wanted to renew operations but failed. Ruins of his camp's stone building are at the mouth of the wadi. Across the mouth of the wadi is a wall built by the ancient Egyptians. In 1905, the archaeologist Petrie removed from the canyon walls about 40 ancient Egyptian inscriptions that were sent to the Cairo Museum. Only one Egyptian inscription of Semerkhat has remained, with some short, mostly Nabatean inscriptions.

Wadi Mukattab--sandy, upper tributary of Wadi Sidri, approachable from Wadi Feiran (old road to Abu Rudeis) with a four-wheel drive. In the wadi are many drawings and inscriptions cut into the rock.

SOURCE: List prepared by Consultant from various sources. See Volume IV, Appendix D; also Working Paper No. 39, where Appendix A lists 295 points of interest.

Estimated Existing Tourism Facilities in Sinai

1983

Location	Facility	Capacity
El Arish	Marriott**	150
	Sinai Beach	50
St. Catherine	Monastery	100
	Airport-El Salaama	100
Sharm El Sheikh	Hotel-Cliff Top	27
	Hostel	36
Marsa El Att	Marina Hotel	135
Dahab	Village	42
Nuweiba	Village	90
Taba*	Sonesta	400

* Current ownership under dispute. Under Israeli control at present.

** Under construction.

Source: Field survey by Consultant in February, 1983.

EC-TO-3

North Sinai Coast, Estimated Tourism Capacity and Use Potential

		1983-1987	1988-1992	1993-2000
		(thousands of visitor-day)		
Potential Use				
	High	2,294	3,279	6,844
	Low	833	1,116	2,043
		(cumulative new accommodation rooms)		
Potential Capacity				
	High	4,600	6,558	13,688
	Low	1,666	2,232	4,086

Source: Estimates by the Consultant.

EC-TO-4

North Sinai Coast, Achievable Capacity and Usage Targets

	1983-1987	1988-1992	1993-2000
Cumulative Accommodation Rooms	400	1,050	2,450
Usage (thousands of visitor-days)	200	525	1,225
Potential Market (thousands of visitor-days)	833	1,116	2,043
Usage as percent of potential market	24	47	60

Source: Estimates by the Consultant.

EC-TO-5

Gulf of Aqabah, Estimated Tourism Capacity and Use Potential

		1983-1987	1988-1992	1993-2000
		(thousands of visitor-days)		
Potential Use				
	High	1,403	2,010	4,076
	Low	615	845	1,387
		(cumulative new accommodation rooms)		
Potential Capacity				
	High	2,806	4,020	8,152
	Low	1,230	1,690	2,774

Source: Estimates by the Consultant.

EC-TO-6

Gulf of Aqabah, Achievable Capacity and Usage Targets

	1983-1987	1988-1992	1993-2000
Cumulative Accommodation Rooms	330	1,080	2,580
Usage (thousands of visitor-days)	165	540	1,290
Potential Market (thousands of visitor-days)	615	845	1,387
Usage as percent of potential market	27	64	93

Source: Estimates by the Consultant.

Projected Sinai Cultural/Sightseeing Tourism Markets Potential

1985-2000

Tourist Segment		1985	1990	1995	2000
		(no. of visitor-days)			
OECD countries	High	290,000	370,000	472,000	600,000
	Low	120,000	150,000	196,000	250,000
Domestic	High	100,000	150,000	200,000	268,000
	Low	40,000	60,000	82,000	112,000
Other Arab	High	44,000	56,000	72,000	90,000
	Low	18,000	22,000	30,000	40,000
Israel	High	100,000	128,000	164,000	210,000
	Low	40,000	52,000	66,000	84,000
TOTAL	High	534,000	704,000	908,000	1,168,000
	Low	218,000	284,000	374,000	486,000
Hotel rooms	High	1,068	1,408	1,816	2,336
	Low	436	568	752	972

SOURCE: Ministry of Tourism, Egyptian Travel Industry.

Ranges of Potential Visitor Days and Hotel Rooms for Various Sinai Tourism Markets

Market	1990 Visitor Days (Million)	1990 Hotel Rooms	2000 Visitor Days (Million)	2000 Hotel Rooms
Warm Water Beach - Southern Sinai	0.6 - 1.7	1,120 - 3,480	1.0 - 3.7	2,000 - 7,420
Regional Beach - Northern Sinai	0.8 - 2.7	1,640 - 5,370	1.5 - 5.9	3,090 -11,690
Domestic Beach	0.5 - 1.0	980 - 1,970	0.8 - 1.7	1,660 - 3,335
Middle Eastern	0.3 - 0.5	500 - 1,000	0.4 - 0.8	830 - 1,660
Cultural Tourism	0.3 - 0.7	568 - 1,408	0.5 - 1.2	972 - 2,336
Coral/Scuba	0.2	330	0.3	530

Source: Estimates by the Consultant.

Comparative Financial Averages
Hotels in Egypt and Other Mediterranean Countries
(millions of U.S. dollar equivalents)
1979-1980

	Five Egyptian Hotels		Twelve Other Mediterranean Region Hotels	
	1980	1979	1980	1979
Revenues				
Rooms	28.1	25.0	56.4	42.0
Food (incl. other income)	24.6	20.6	34.0	27.6
Beverages	8.6	8.0	13.2	10.8
Casino	5.9	4.8	32.8	27.5
Telephone	3.5	2.6	6.1	4.3
Other operated depts.	1.6	1.3	1.6	1.4
Rentals and other income	2.7	1.8	4.6	2.7
TOTAL	75.0	64.1	148.7	116.3
Departmental Expenses				
Rooms	4.8	4.0	13.6	10.0
Food and beverages	20.7	17.8	36.7	29.3
Casino	4.4	3.4	29.5	24.0
Telephone	2.3	1.8	4.5	3.4
Other operated depts.	0.7	0.5	0.9	0.7
TOTAL	32.9	27.5	85.2	67.4
Undistributed Operating Expenses				
Administrative and general	3.4	2.8	8.1	6.3
Management fee	3.6	3.7	3.8	2.9
Marketing	1.5	1.2	4.1	2.7
Franchise fees	0.0	0.0	0.0	0.2
Guest entertainment	0.0	0.2	0.0	0.0
Property oper. and maint.	4.0	3.1	8.3	6.7
Energy costs	0.9	0.9	4.9	3.5
TOTAL	13.4	11.9	29.2	22.3
Income before fixed charges	28.7	24.5	34.4	26.3
Property Taxes and Insurance				
Property taxes	0.6	0.1	0.5	0.4
Insurance	0.1	0.1	0.2	0.2
TOTAL	0.7	0.2	0.7	0.6
Income before other fixed charges	28.1	24.4	33.8	25.8
Other Fixed Charges				
Rent	6.9	5.6	11.5	10.2
Interest	0.0	0.0	1.0	0.7
Depreciation and amortization	1.1	1.0	5.0	3.3
TOTAL	8.0	6.6	17.5	14.2
Income before additions	20.1	17.9	16.3	11.6
Other additions	1.7	0.6	-0.5	-0.5
Income before income taxes	21.9	18.4	15.8	11.1
Income taxes	0.7	0.5	0.6	0.6
Net income or loss	21.2	17.9	15.2	10.5
Profit on sales	28.2%	28.0%	10.2%	9.0%

Source: Data assembled by Pannell Kerr Forster for 1980.

Estimated Charter Airfares from London to Selected Mediterranean Resorts

1982
(U.S. dollar equivalents)

Destination	Airfare[a]	Increment in Airfare to El Arish as a Percentage of Total Package Price[b]
El Arish	360-420	--
Cairo	390-450	--
Tel Aviv	280-300	--
Cyprus	250-300	11
Tenerife	200-300	--
Las Palmas	200-270	--
Morocco	280-300	13
Tunisia	260-290	17
Corfu	200-280	--

Note: 1) For El Arish, assumes one flight per week, a flight load factor of more than 85 percent, and Boing 727 or DC-10 aircraft. Other destination fares are estimated by subtracting the accomodation/food component and service charge from the typical package price.

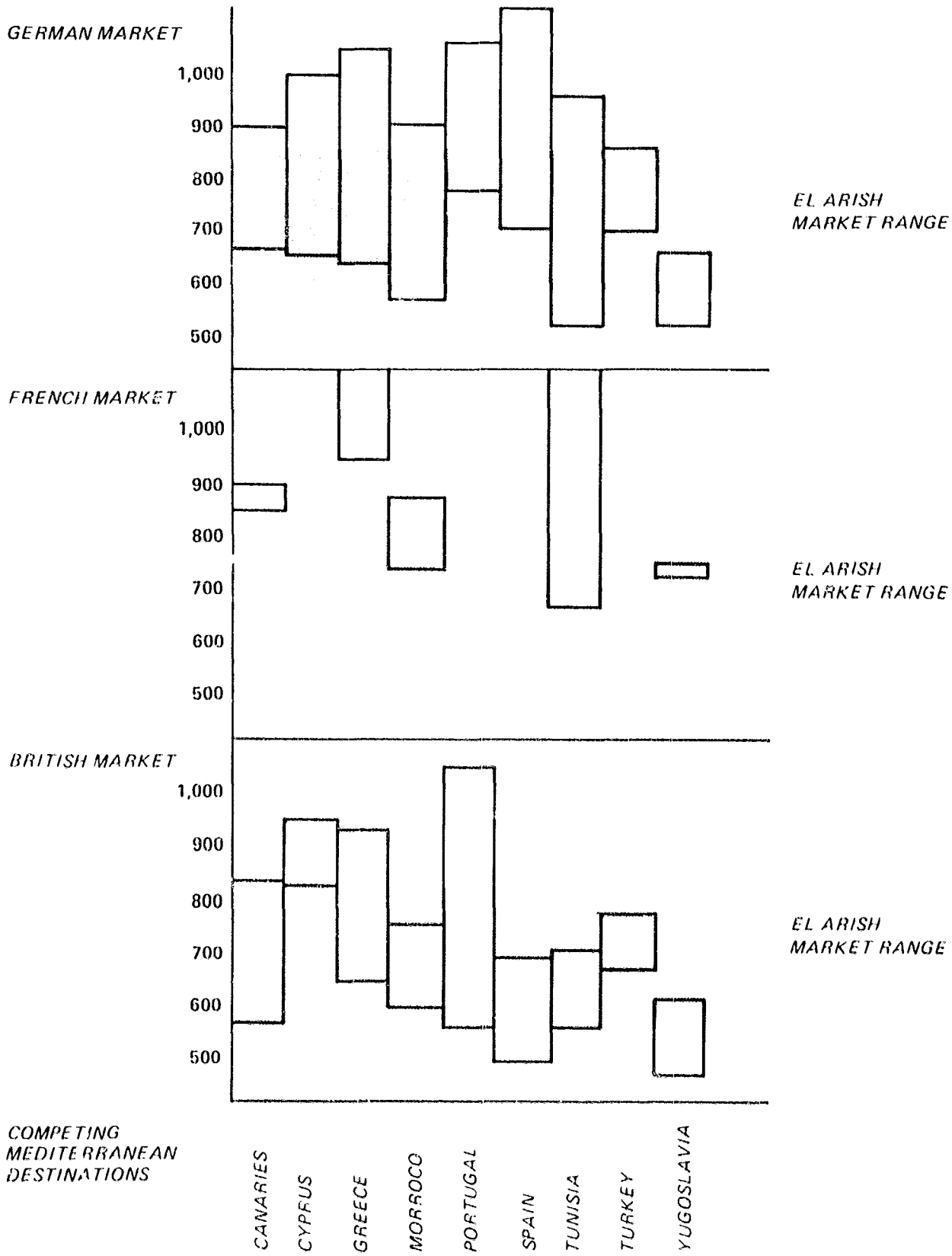
2) Airfare increment assumes that total package is midpoint of Cosmos range (adjusted to reflect 1982 prices) for three destinations. Airfare is midpoint of July-August 1981 package fares. Also assumes for purposes of each comparison, that nonairfare component in El Arish equals that of the respective country being compared.

Source: Quotations from London-based airlines and tour operators.

Selected Tours from Israel to Sinai
Fall, 1981

Tour Operator	Location	Length of Tour	Description
Society for Preservation of Nature	Tel Aviv	Varies	Trips tailored by region and degree of difficulty, using a mixture of sedan cars, trucks, and camels; discounts given to tourists willing, qualified, and licensed to carry a rifle; highly regarded
United Tours	Jerusalem Tel Aviv Haifa Netanya Eilat	1 day	Sharm El Sheikh, Gebel Musa, and Eilat for $335 (air conditioned bus)
Neot Hakikar	Settlement south of Dead Sea	5 days 2 days 4 days	$240 (in 20-seat open trucks) $105 (Gebel Musa) $195 (camel tour, nights under stars)
Johnny Desert Tours	Eilat	3 days 2 days 1 day	$211 (sleeping bags under stars) $137 (Gebel Musa) $36-$80
Jabaliya Trecking	Jerusalem	5-20 days 11 days 6 days	Camel trips with mountain climbing (price?) $250-$300 $450
Kopel Tours	Tel Aviv	6 days 5 days 3 days	$235 (by private car, camping under stars) $215 $120

Source: David Shipler, "The Sinai: Suspended in Time," New York Times, Section 10 (November 15, 1981), p.20.



EL ARISH PACKAGE PRICE RANGE COMPARED
TO COMPETING MEDITERRANEAN DESTINATIONS
(in U.S. dollar equivalents)

Dames & Moore

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G. PUBLIC ADMINISTRATION & GOVERNMENT PLANS

Prime Minister's Decree No. 427 of 1982

The Prime Minister has, after perusal of the Constitution, and of Presidential Decree No. 4 of 1982, forming the government, and after the approval of the Council of Ministers, decreed:

Article 1--Formation of a Committee for the reconstruction of Sinai, under the chairmanship of the Prime Minister and the membership of each of the following:

Deputy Prime Minister and Minister of Foreign Affairs

Deputy Prime Minister for Production and Minister of Petroleum

Deputy Prime Minister for Services and Minister of Local Government

Deputy Prime Minister for Economic and Financial Affairs and Minister of Investment Affairs and International Cooperation

Minister of Defense and Military Production

Minister of Reconstruction and Minister of State for Housing and Land Reclamation

Minister of Transportation, Communications and Maritime Transportation

Minister of Electricity and Energy

Minister of Supply and Home Trade

Minister of the Council of Ministers Affairs and Minister of State for Administrative Development

Minister of State for Information

Minister of Planning

Minister of Industry and Mineral Wealth

Minister of Tourism and Civil Aviation

Minister of State for Agriculture

Governor of North Sinai

Governor of South Sinai

Article 2--The Sinai Reconstruction Committee will be concerned with:

1) Drawing up the general policy for the reconstruction of Sinai, approval of the programs and plans required for the purpose in accordance with

the economic and social development plan and within the scope of the general policy of the State.

2) Approval of distribution of investment credits allocated to reconstruction projects and determination of priorities of execution.

3) Consideration of studies and researches submitted to it concerning the most suitable sites for the cities and villages the establishment of which is decided.

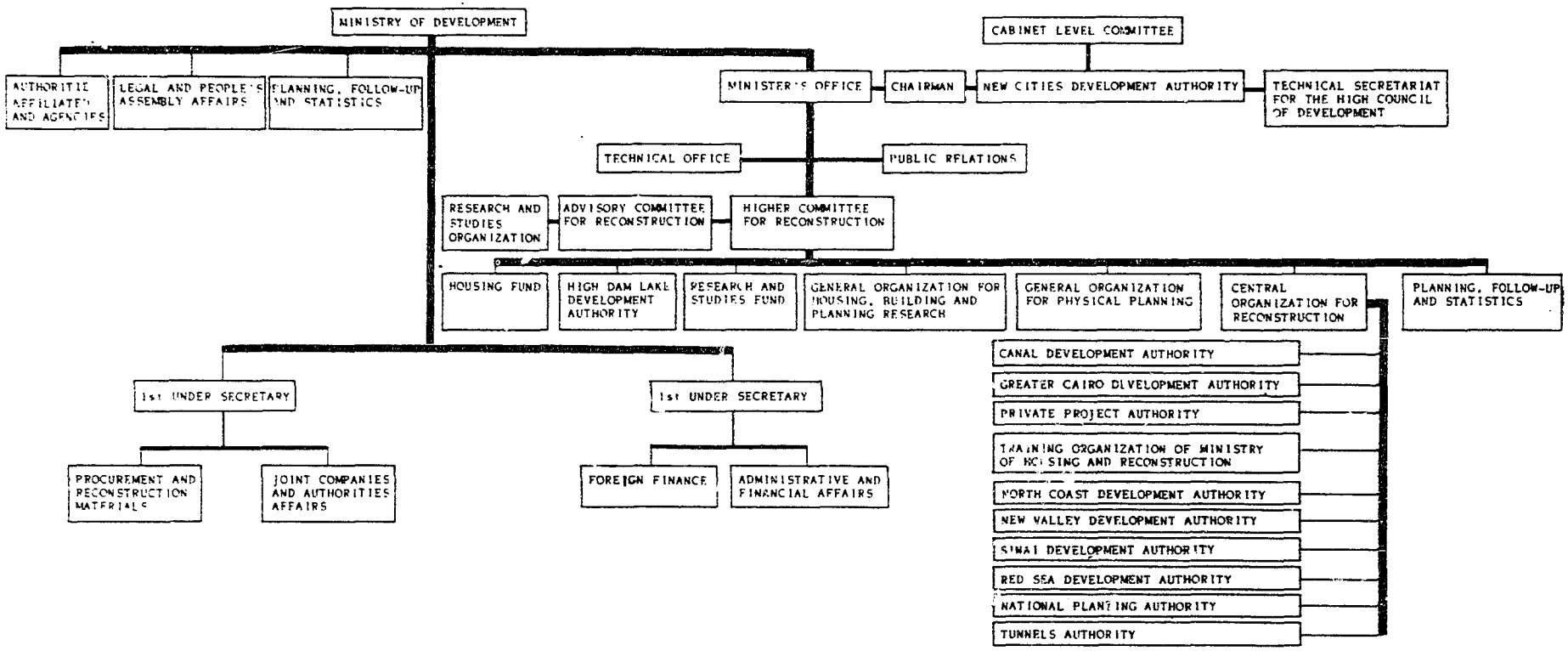
4) Coordination between Ministries, Authorities and organizations engaged in reconstruction activities and in pertaining spheres.

5) Follow up of execution of programs and plans for reconstruction, overcoming financial and thechnical obstacles encountered by execution and evaluation of completed jobs.

Article 3--The Committee's decision will be binding, and it is up to the Ministers, Authorities, and organizations concerned to take necessary action for their implementation.
Article 4--This decree is to be published in the official gazette.

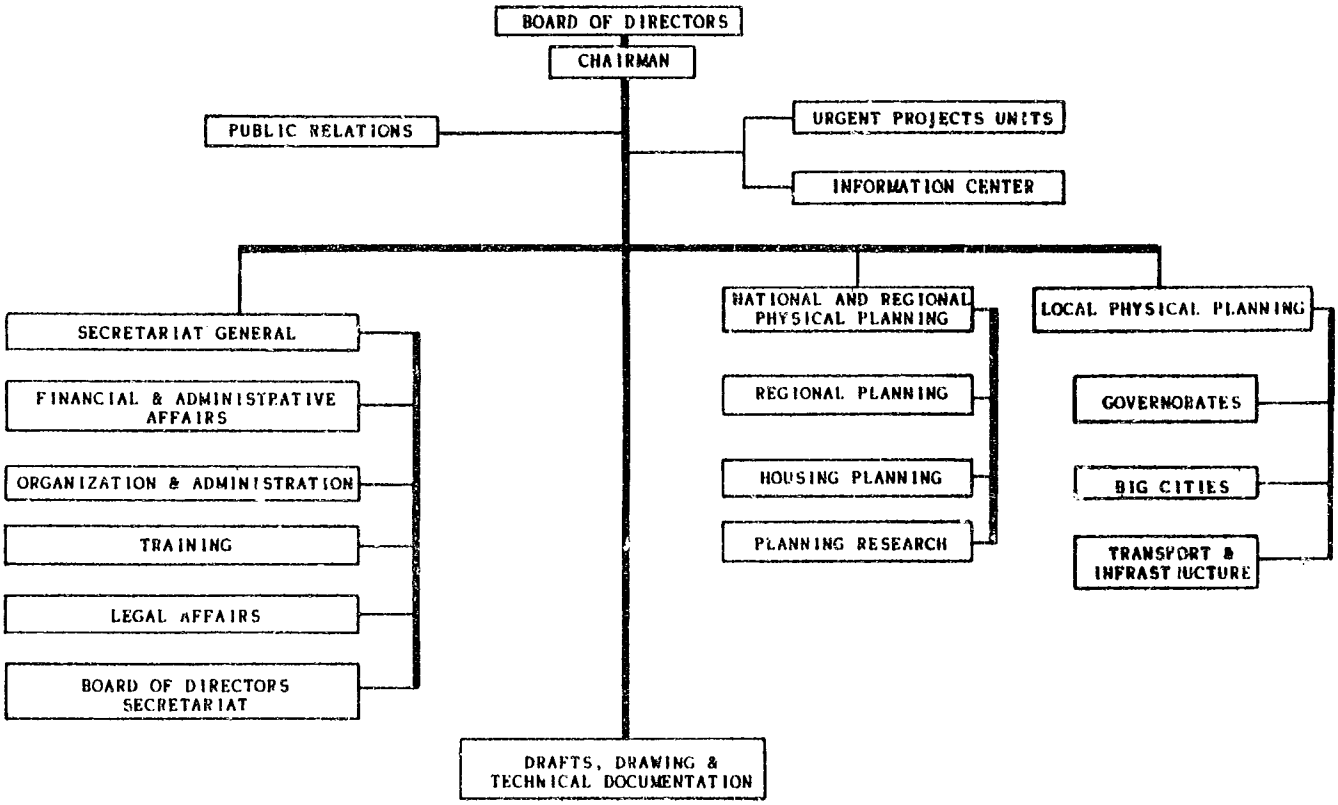
Issued on May 8, 1982
Dr. Fuad Mohyi Eddin
Translated from Arabic by A.M.M.

ORGANIZATIONAL STRUCTURE OF THE MINISTRY OF DEVELOPMENT



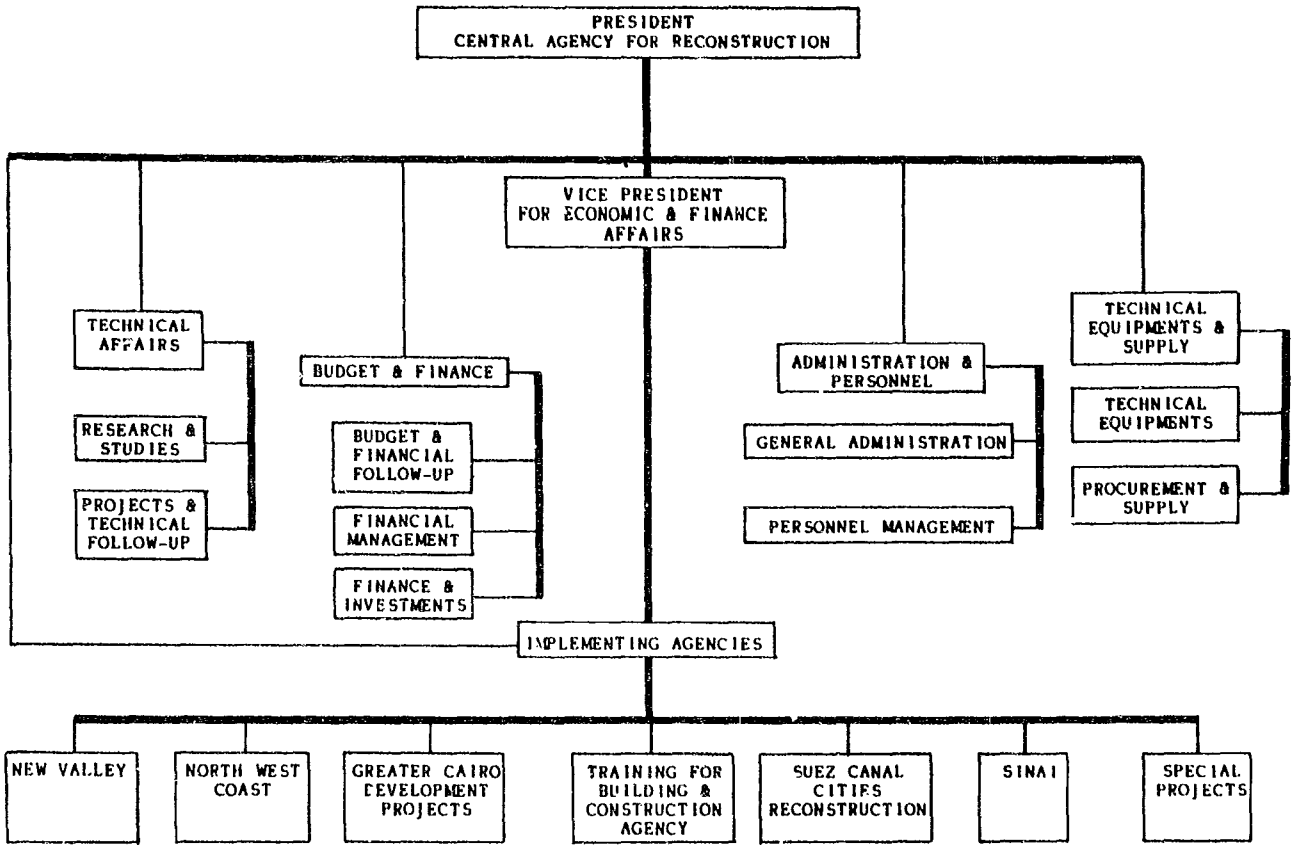
Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 434.

ORGANIZATIONAL STRUCTURE OF GENERAL ORGANIZATION FOR PHYSICAL PLANNING

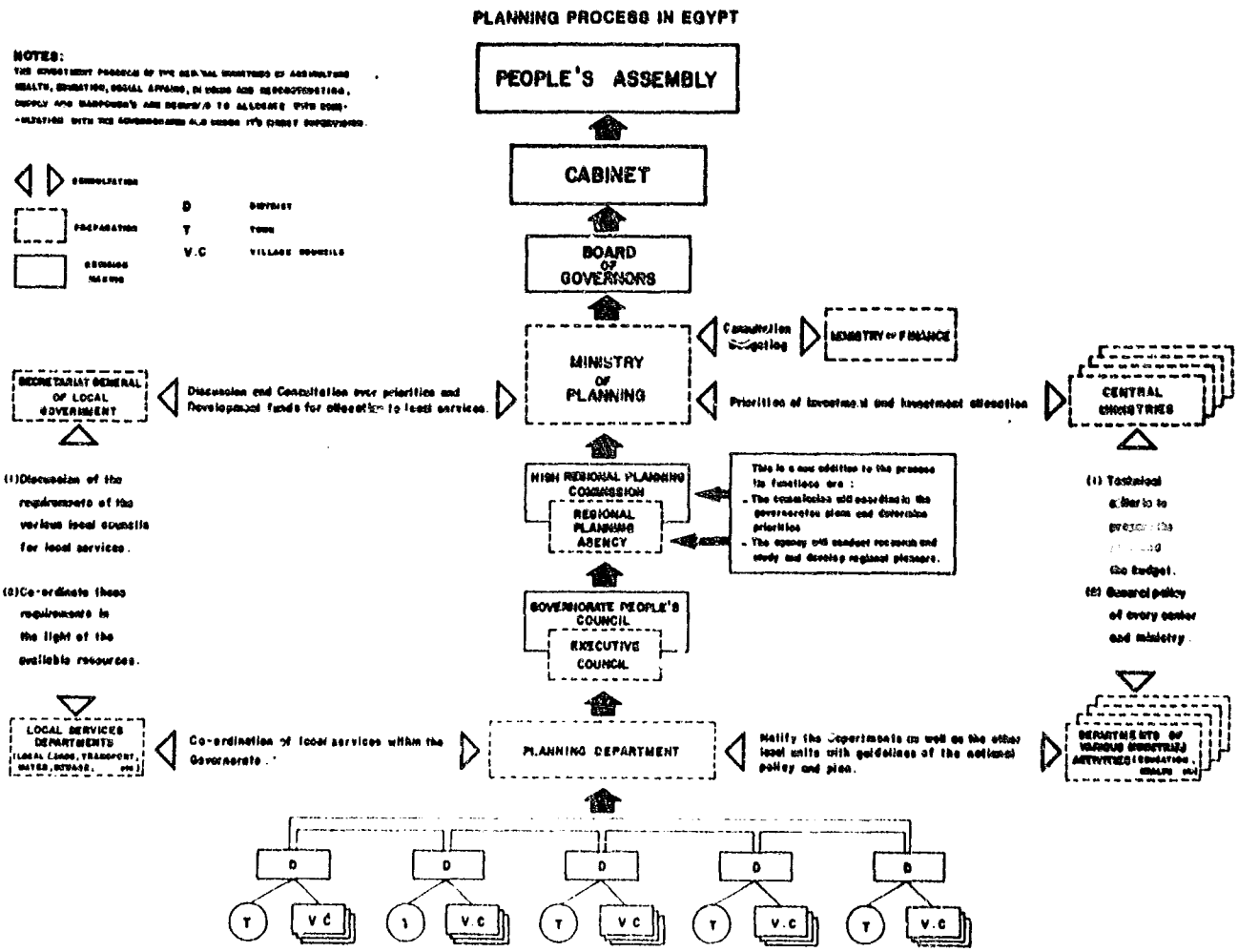


Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 435.

ORGANIZATIONAL STRUCTURE OF THE CENTRAL AGENCY FOR RECONSTRUCTION

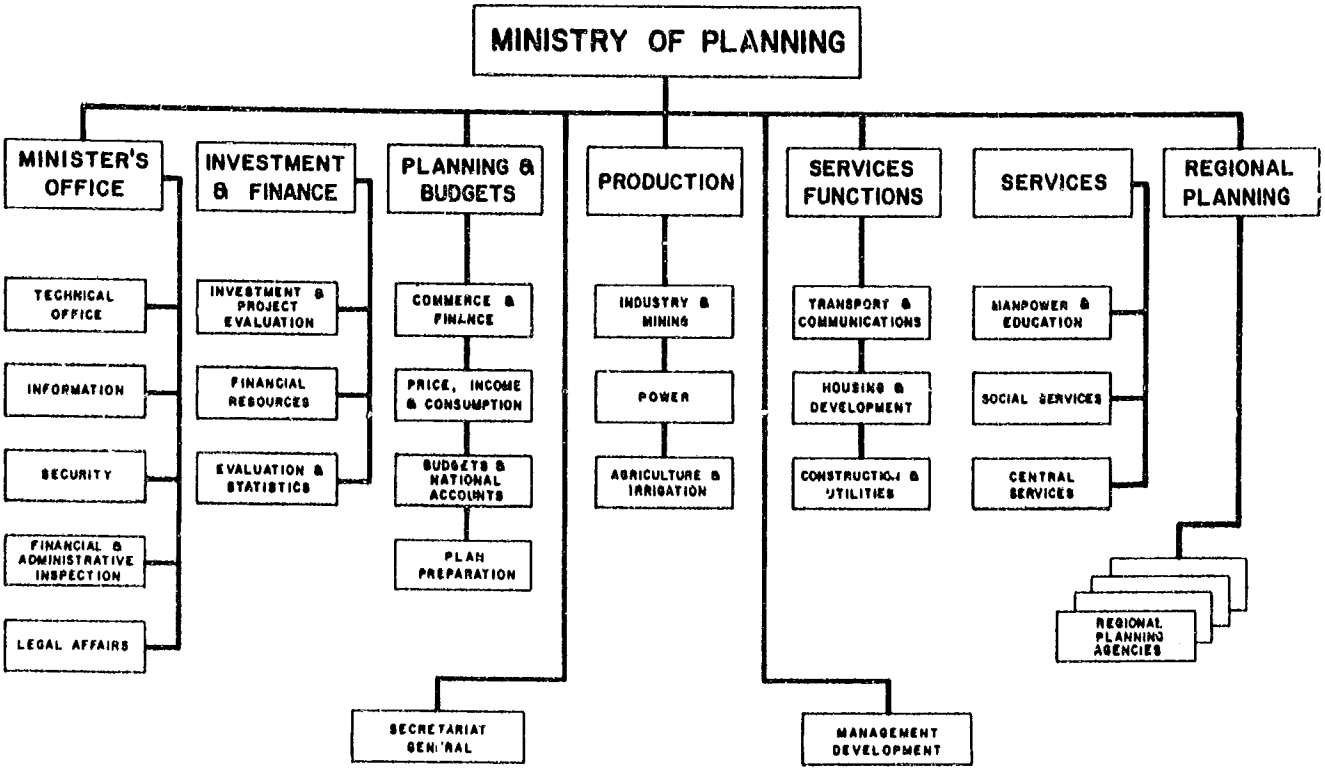


Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 436.



Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 428.

ORGANIZATIONAL STRUCTURE OF THE MINISTRY OF PLANNING



Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 429.

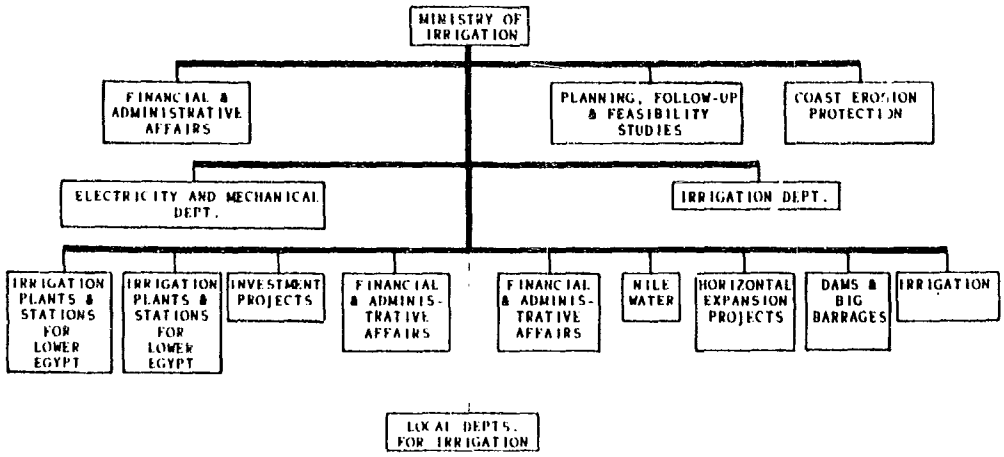
The Eight Planning Regions of Egypt

Region	Population/ Cultivated Area	Economic Features
Greater Cairo	9,100,000/ 49,000 feddans under cultivation	Characteristic urban services, seat of Central Government (Governorate of Cairo); some agriculture environment (Governorates of Giza and Qalyubiyah); rapid population growth
Alexandria	4,600,000/ 835,000 feddans under cultivation	Urban services (Governorate of Alexandria); agricultural environment (Governorate of Beheira); desert environment (proposed Governorate of Nubariya)
Suez Canal	3,800,000/ 702,000 feddans under cultivation	Urban services, international shipping (Port Said, Ismailia, and Suez); strong development potential (Governorates of Sharkiya and N. and S. Sinai, part of Governorate of the Red Sea); integral military unit, mineral resources, tourism potential
Delta	8,240,000/ 1,914,000 feddans under cultivation	Agricultural environment, low standard of living (Governorates of Dakahlia, Damietta, Kafr El Sheikh, Gharbiya, and Menufia)
Matruh	131,000/ 5,000 feddans under cultivation	Development potential, low population density, rich in resources (Governorate of Matruh)
Northern Upper Egypt	3,950,000/ 1,032,000 feddans under cultivation	Agricultural environment, low standard of living (Governorates of Fayoum, Beni Suef, Minya, and part of Governorate of the Red Sea)
Assiut	1,600,000/ 349,000 feddans under cultivation	Agricultural environment, rich in resources, low standard of living, large areas suitable for reclamation (Governorates of Assiut and New Valley)
Southern Upper Egypt	4,150,000/ 649,000 feddans under cultivation	Rich in resources, industrial development potential (Governorates of Suhag, Qena, and Aswan, part of Governorate of the Red Sea)

Source: Presidential Decree, 1977.

PA-OR-6

ORGANIZATIONAL STRUCTURE OF THE MINISTRY OF IRRIGATION



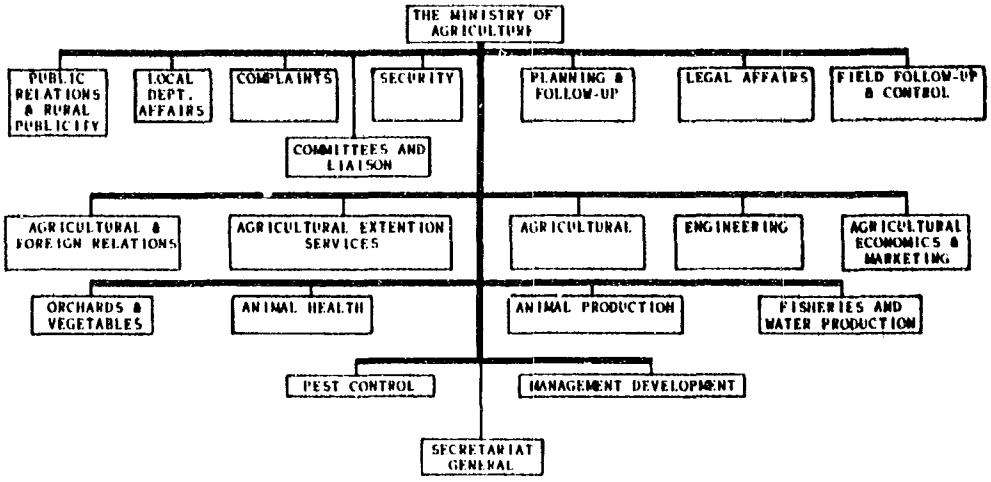
PA-OR-7

MINISTRY OF IRRIGATION AND ITS AFFILIATED AGENCIES

Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, pp. 440-41.

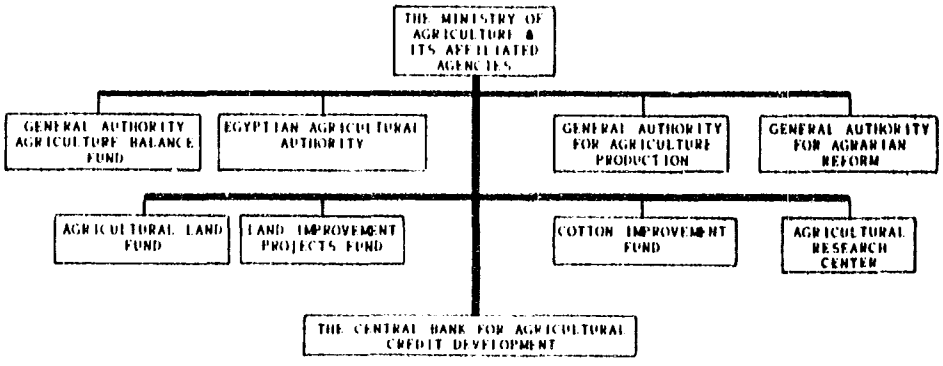
PA-OR-8

ORGANIZATIONAL STRUCTURE OF THE MINISTRY OF AGRICULTURE



PA-OR-9

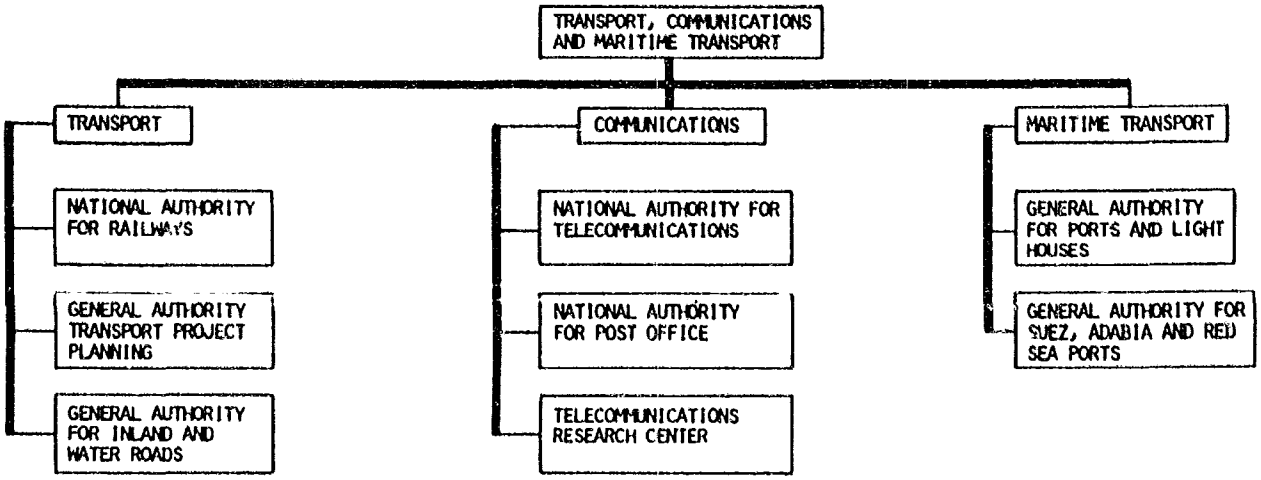
MINISTRY OF AGRICULTURE AND ITS AFFILIATE AGENCIES



Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 440.

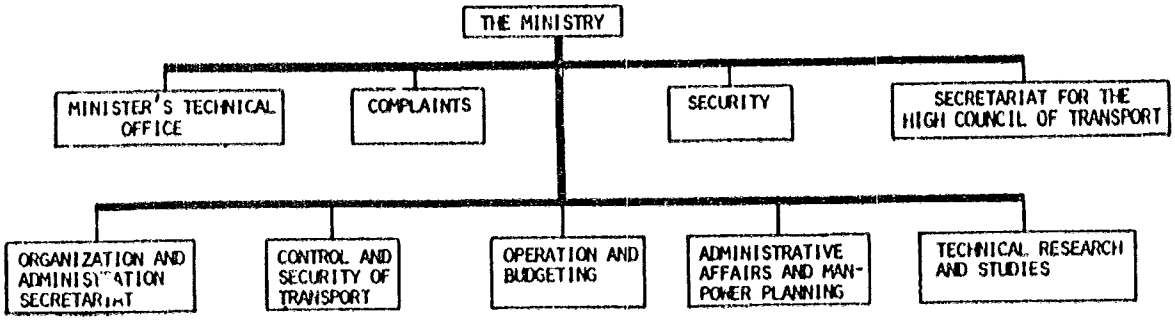
PA-OR-10

MINISTRY OF TRANSPORT, COMMUNICATIONS AND MARITIME TRANSPORT AND ITS AFFILIATED AGENCIES



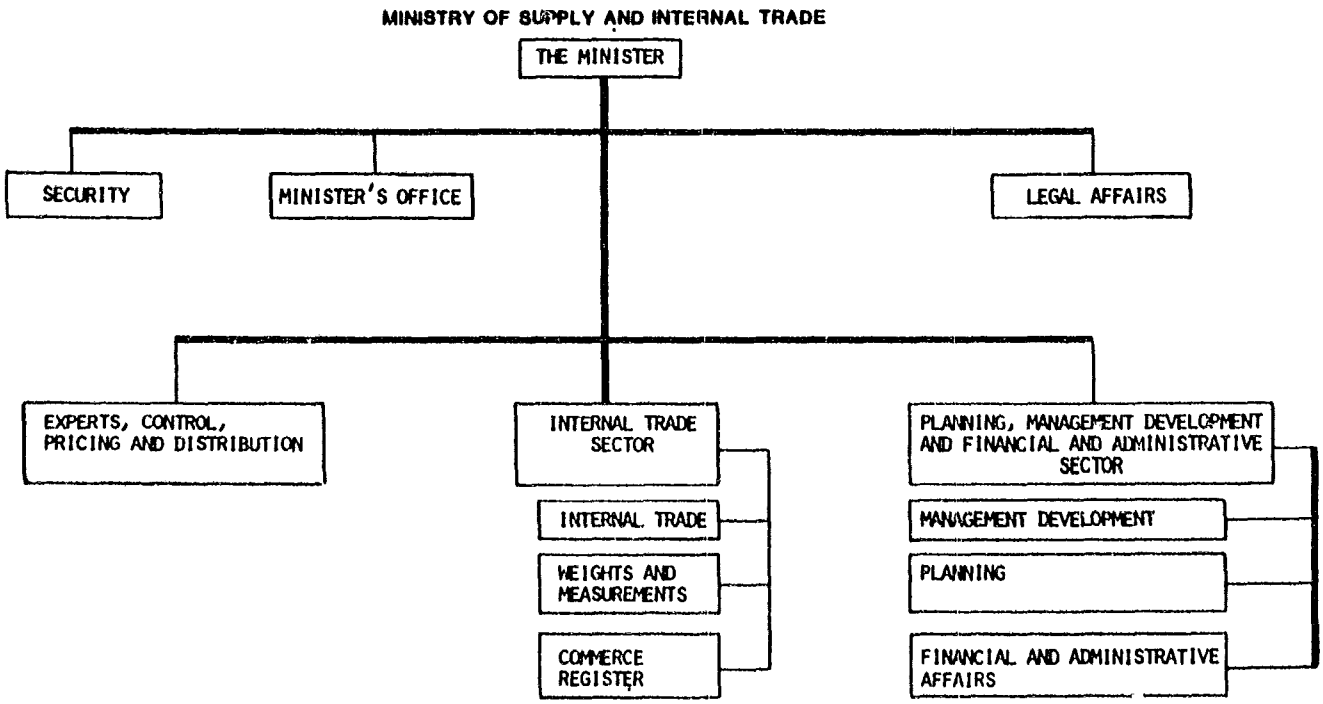
PA-OR-11

ORGANIZATIONAL STRUCTURE OF THE HEADQUARTERS OF THE MINISTRY OF TRANSPORT, COMMUNICATIONS AND MARITIME TRANSPORT

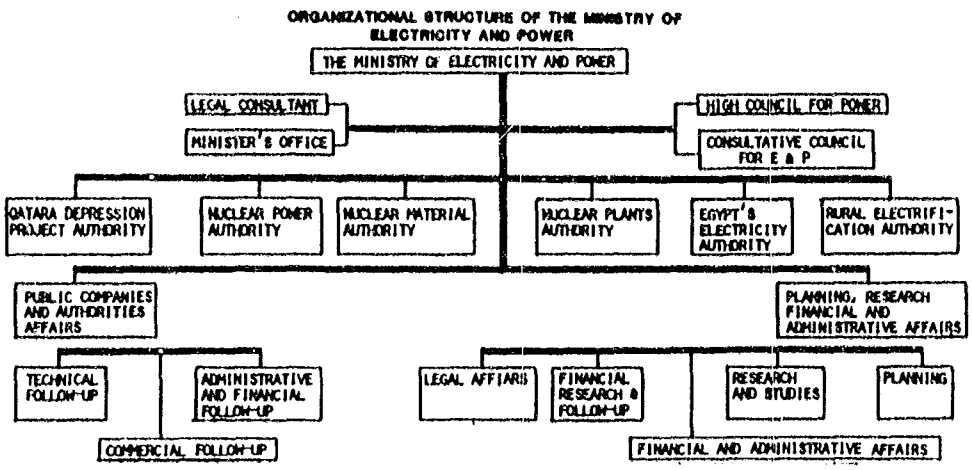


Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 446.

PA-OR-12

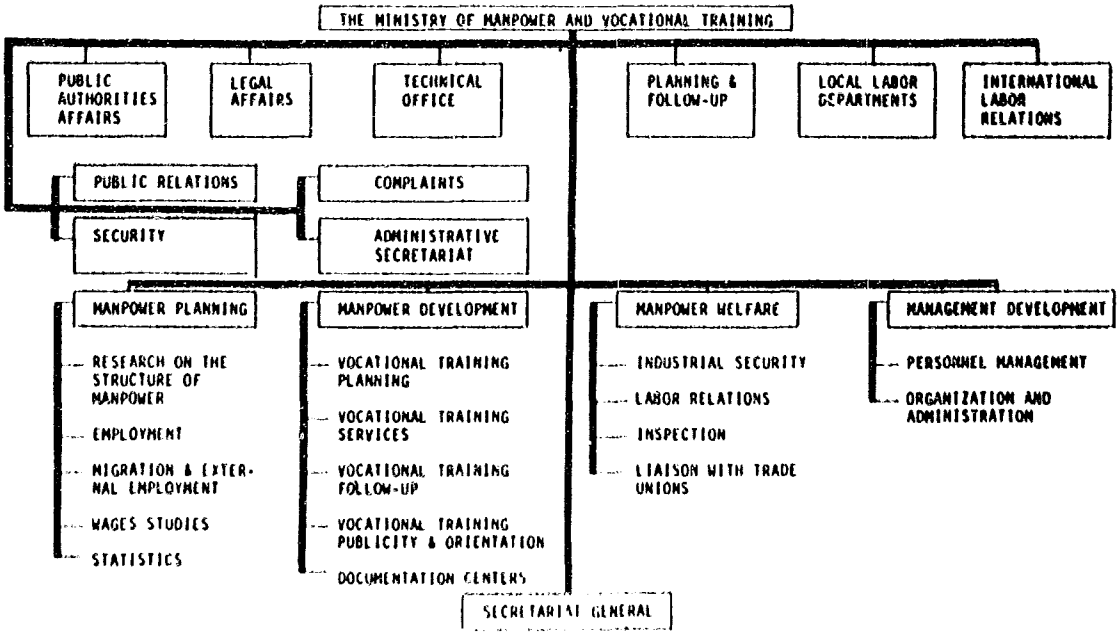


PA-OR-13



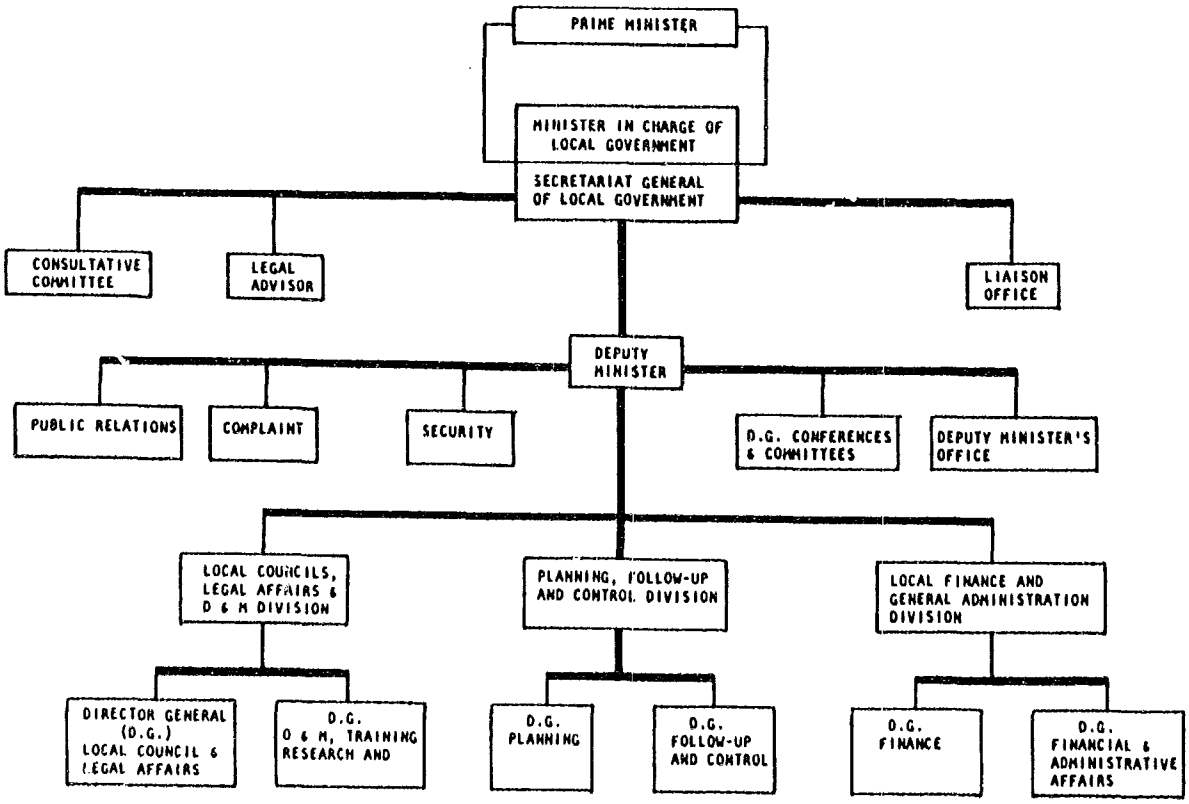
Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, pp. 447 and 450.

ORGANIZATIONAL STRUCTURE OF THE MINISTRY OF MANPOWER AND VOCATIONAL TRAINING

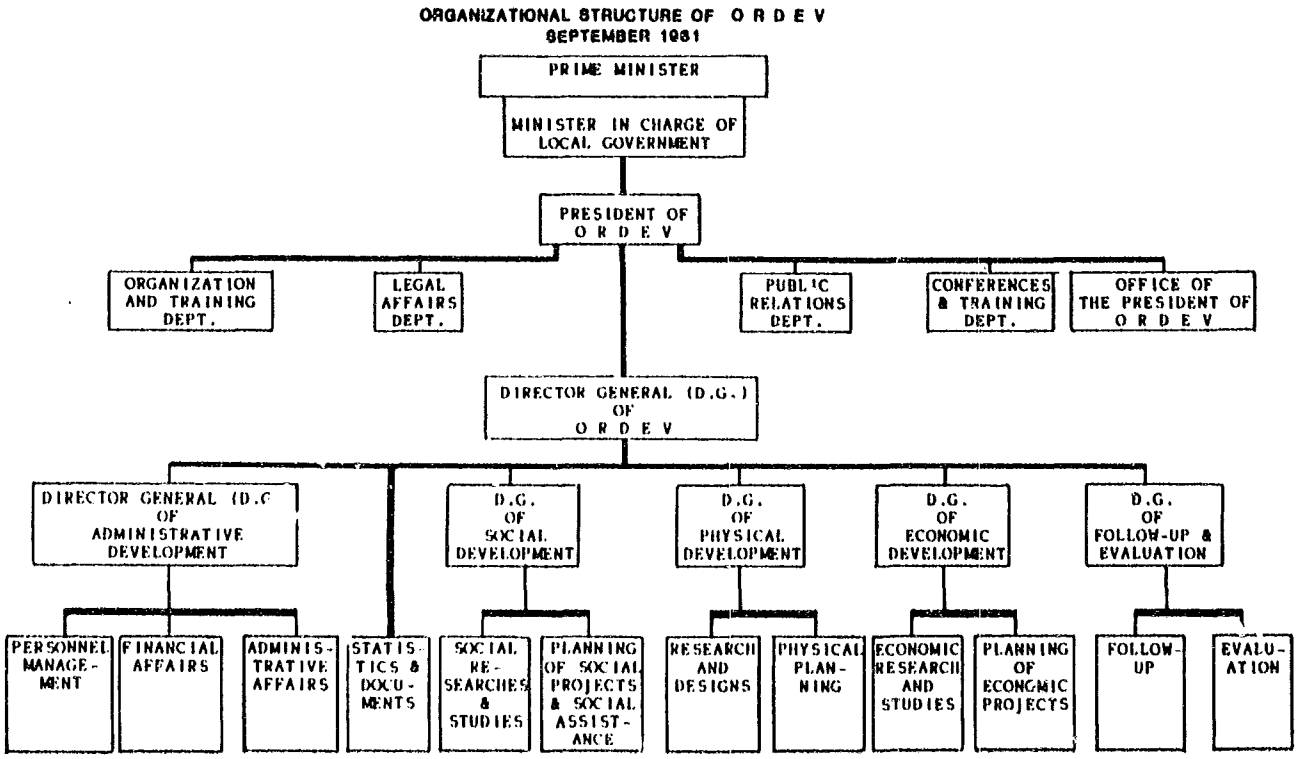


Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 433.

ORGANIZATIONAL STRUCTURE OF THE SECRETARIAT GENERAL OF LOCAL GOVERNMENT
SEPTEMBER 1981

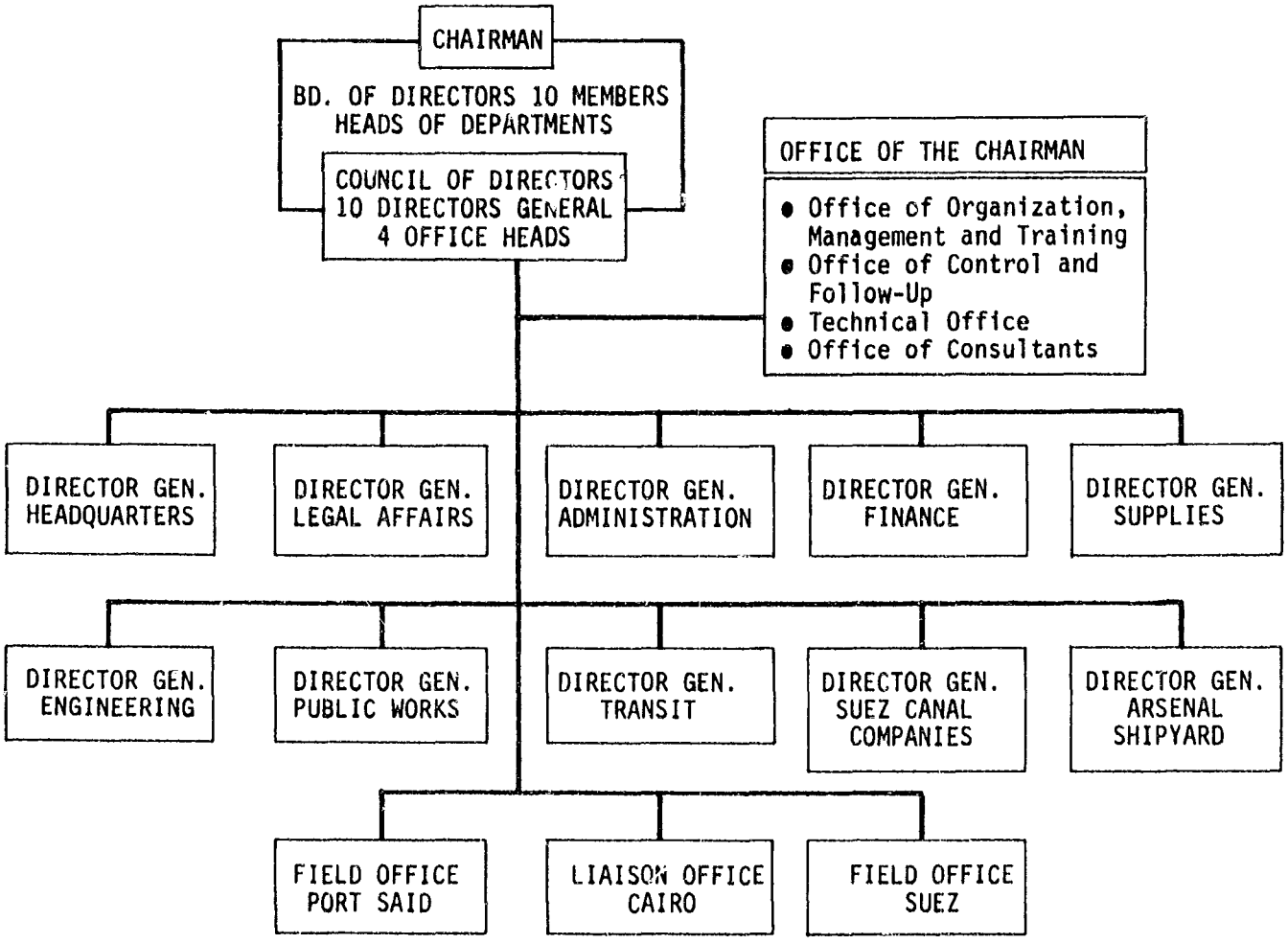


Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 466.



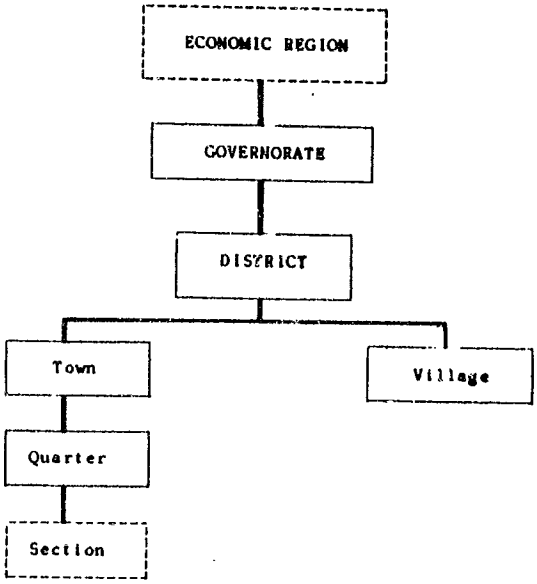
Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 466.

Suez Canal Authority



Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 463.

UNITS OF LOCAL GOVERNMENT AND ITS TIERS



---Administrative unit without legal entity.

NUMBER AND DISTRIBUTION OF LOCAL GOVERNMENT UNITS
JANUARY 1980

Governorate Name	Governorate	Districts	Towns	Quarters	Villages	Total
Cairo	1	--	--	7		8
Alexandria	1	--	--	4		5
Port Said	1	--	--	4		5
Ismailia	1	4	5	2 (Ismailia)	10	22
Suez	1	--	--	3		4
Qalyubia	1	7	9	--	37	54
Sharkia	1	12	13	--	71	97
Dakahlia	1	10	12	2 (Mansoura)	72	97
Damietta	1	4	6	--	24	35
Menoufia	1	8	9	--	64	82
Gharbia	1	8	8	--	53	70
Kafr El Shiekh	1	9	9	--	43	62
Beheira	1	12	14	--	67	94
Giza	1	5	8	3 (Giza)	39	56
El Fayoum	1	5	5		37	48
Beni Suef	1	7	7	--	38	53
Minia	1	9	9	--	57	76
Assiut	1	10	10	--	49	70
Sohag	1	11	11	--	51	74
Qena	1	11	11	--	48	71
Aswan	1	4	6	--	22	33
Matruh	1	3	6	--	10	20
New Valley	1	2	2	--	10	15
Red Sea	1	--	4	--	--	5
North Sinai	1	4	4	--	6	15
South Sinai	1	5	5	--	--	11
	26	150	173	25	808	1,182

SOURCE: Secretariat General of Local Government.

Source: Egypt: Urban Growth and Urban Data Report, prepared as part of the National Urban Policy Study by PADCO for the Advisory Committee for Reconstruction, Ministry of Development, Arab Republic of Egypt, U.S.A.I.D. Grant No. 263-0042, p. 464.

Current Revenues and Expenditures,
North Sinai Governorate

1981

Revenues	1981-1982 (LE)	1980-1981 (LE)
Local revenues	3,296,000	2,173,000
Current revenues	140,746	116,980
Grants-in-aid	3,611,439	3,375,064
TOTAL	7,048,185	5,665,044

Expenditures	1981-1982 (LE)	1980-1981 (LE)
Salaries, wages, and compensation	5,219,680	4,125,003
Other current expenses	1,828,505	1,393,061
TOTAL	7,048,185	5,518,064

SOURCE: The State Budget 1981-1982, Ministry of Finance, Cairo, August 1981.

Analysis of Current Revenues,
North Sinai Governorate

1981

Source of Revenue	1981-1982 (LE)	Percent of Total
Local Revenues		
Taxes on vehicles	357,000	
Joint fund	1,679,000	
Add-on taxes on Suez Canal Authority	1,260,000	
SUBTOTAL	3,296,000	46.7
Current Revenues		
Utilities	43,000	
Local duties	11,600	
Miscellaneous	32,100	
Quarries	7,000	
Local activities	47,046	
SUBTOTAL	140,746	3.2
Central Grants	3,610,435	50.1
TOTAL	7,047,181	100.0

SOURCE: The State Budget 1981-1982, Ministry of Finance, Cairo, August 1981.

Current Revenues and Expenditures,
South Sinai Governorate

1981

Revenues	1981-1982 (LE)	1980-1981 (LE)
Local revenues	2,099,000	1,315,000
Current revenues	--	--
Grants-in-aid	330,893	541,526
TOTAL	2,429,893	1,856,526

Expenditures	1981-1982 (LE)	1980-1981 (LE)
Salaries, wages, and compensation	1,483,700	1,207,390
Other current expenses	946,193	649,136
TOTAL	2,429,893	1,856,526

SOURCE: The State Budget 1981-1982, Ministry of Finance, Cairo, August 1981.

Analysis of Current Revenues,
South Sinai Governorate

1981

Source of Revenue	1981-1982 (LE)	Percent of Total
Local Revenues		
Taxes on vehicles	165,000	
Joint fund	674,000	
Add-on taxes on Suez Canal Authority	1,260,000	
SUBTOTAL	2,099,000	80.0
Current Revenues		
	--	
Central Grants	330,893	20.0
TOTAL	2,429,893	100.0

SOURCE: The State Budget 1981-1982, Ministry of Finance, Cairo, August 1981.

Analysis of the 1981-1982 Capital Plan for Sinai
by Sector, Institution, and Type of Program

Sector	Approved Budget (LE)	Percent of Sector Total	Percent of Total Budget
AGRICULTURE SUBTOTAL	4,778,000	100.0	8.9
Ministry of Agriculture			
• Plant protection program	50,000	1.0	
• Livestock protection program	50,000	1.0	
• Agriculture extension services	170,000	3.6	
• Agricultural research	57,000	1.2	
General Organization for the Reconstruction and Development of the Egyptian Village (ORDEV)	306,000	6.4	
Ministries of Development and Land Reclamation (Sinai Development Authority and other MOD agencies)	3,220,000	67.4	
Secretariat-General of Local Government (governorate head-quarters)	925,000	19.4	
INDUSTRY/MINING SUBTOTAL	7,740,000	100.0	14.4
Ministry of Industry			
• Reopening of ferro-manganese mines	1,400,000	18.1	
• Gypsum mine at Ras Malaab	900,000	11.6	
• Coal mine at Maghara	450,000	5.8	
• Coal mine	150,000	1.9	
• Geological survey and studies	1,000,000	12.8	
Secretariat-General of Local Government (governorate headquarters)	910,000	12.1	
Ministry of Development	180,000	2.3	
Ministry of Supply			
• Flour-grinding mills	1,500,000	19.3	
• Automatic bakeries	500,000	6.5	

Sector	Approved Budget (LE)	Percent of Sector Total	Percent of Total Budget
INDUSTRY/MINING (cont'd)			
• Ice factory and refrigerator (El Arish)	400,000	5.2	
• Ice factory and refrigerator (El Tor)	350,000	4.4	
PETROLEUM SUBTOTAL	2,550,000	100.0	4.7
Ministry of Petroleum			
• Natural gas exploitation	1,000,000	39.2	
• Exploratory drilling	400,000	15.7	
• Productive drilling	500,000	19.6	
• New projects	150,000	5.9	
• Replacement and renewal projects	500,000	19.6	
CONSTRUCTION SUBTOTAL	250,000	100.0	0.04
Ministry of Housing	250,000	100.0	
ELECTRICITY SUBTOTAL	4,320,000	100.0	8.1
Ministry of Electricity			
• Gas turbine units	450,000	10.4	
Ministry of Development	2,250,000	52.1	
Secretariat General of Local Government (governorate headquarters)	1,620,000	37.5	
TRANSPORT AND COMMUNICATIONS SUBTOTAL	9,725,700	100.0	18.2
Ministry of Transport and Communications			
• Telecommunication centrals	700,000	7.1	
• Post offices	2,700	0.1	

Sector	Approved Budget (LE)	Percent of Sector Total	Percent of Total Budget
TRANSPORT AND COMMUNICATIONS (cont'd)			
Ministry of Civil Aviation			
• St. Catherine airport	340,000	3.5	
• Meteorological studies	83,000	0.8	
Broadcasting/TV Union			
• TV networks	513,000	5.3	
• Microwave networks	202,000	2.1	
• Broadcasting	205,000	2.1	
Ministry of Development (Sinai Development Authority)	4,500,000	46.3	
Secretariat General of Local Government (governorate headquarters)	3,180,000	32.7	
UTILITIES SUBTOTAL	12,150,000	100.0	22.7
Governorate Headquarters			
• Potable water, mechanical equipment	7,150,000	58.8	
Ministry of Development	5,000,000	41.2	
TRADE AND FINANCE SUBTOTAL	775,000	100.0	1.4
Customs House			
• Construction of offices	50,000	6.5	
Ministry of Supply			
• Storage area	125,000	16.1	
Ministry of Social Insurance			
• Construction of offices	10,000	1.3	
Ministry of Petroleum			
• Gas stations	590,000	76.1	

Sector	Approved Budget (LE)	Percent of Sector Total	Percent of Total Budget
HOUSING SUBTOTAL	3,020,000	100.0	5.6
ORDEV	20,000	0.7	
Ministry of Development	3,000,000	99.3	
SERVICES SUBTOTAL	8,082,500	93.6	15.1
Ministry of Tourism			
• El Arish motel project	1,450,000	17.9	
Ministry of Education			
• Primary education	518,000	6.4	
• Preparatory education	325,300	4.0	
• Transfer some of primary education classes to basic education	10,500	0.1	
• Transfer some of preparatory education classes to basic education	3,000	0.04	
• Secondary education	17,100	0.2	
• Technical secondary education	30,600	0.4	
• Teachers training institutes	103,800	1.3	
• Special education	800	0.01	
• Adult education	1,000	0.01	
• Equipment	65,900	0.84	
Al Azhar			
• Al Azhar Institutes	90,000	1.1	
Ministry of Planning			
• Vocational training	20,000	0.2	
Ministry of Culture and Information			
• Popular culture	100,000	1.2	
• Information center	135,000	1.7	
Ministry of Health			
• Development of El Arish hospital	105,000	1.3	
• Rural health units and training	85,000	1.1	

Sector	Approved Budget (LE)	Percent of Sector Total	Percent of Total Budget
SERVICES (cont'd)			
• Dental unit	12,000	0.1	
• Transport facilities	65,000	0.8	
• Development of El Tor hospital	100,000	1.2	
• Development of Sudr hospital	40,000	0.5	
Ministry of Social Affairs			
• Social units	225,000	2.8	
• Community development associations	4,000	0.04	
• Productive family projects	5,000	0.06	
• Children and family	40,000	0.5	
• Others	35,000	0.4	
Ministry of Awkaf			
• Construction of mosques	120,000	1.5	
Youth and Sports			
• Youth camps (completion)	30,000	0.4	
• Youth centers	20,000	0.2	
• Transport facilities	6,000	0.06	
• Equipment	40,000	0.5	
• Training centers	4,000	0.04	
Ministry of Industry			
• Services to workers	40,000	0.5	
Ministry of Development	2,520,000	31.4	
Secretariat-General of Local Government (governorate headquarters)	1,665,000	20.6	
ORDEV	50,500	0.6	
TOTAL	53,391,200		

SOURCE: Personal communication, Ministry of Planning, 1981.

Number and Distribution of Civil Servants in the Headquarters of the North Sinai Governorate

1981

Administrative Unit	Top Management	Technical Professionals	Managerial Professionals	Clerical Personnel	Technicians	Supporting Services	Total	Remarks
Governor, Secretary General, and Assistant Secretary General	3	--	--	--	--	--	3	
Secretariat of the Governor	--	--	2	2	1	3	8	Two are seconded from the Army
Legal affairs	--	1	3	4	3	5	16	Five are seconded
Planning and follow-up	--	1	1	4	5	3	14	One is seconded
Mass communications and complaints	--	1	1	4	4	4	14	
Environment	--	1	1	2	14	3	21	One is seconded
Migrant affairs	--	1	9	3	2	2	17	Three are seconded
Committees and conferences	--	3	3	3	4	5	18	
Finance and administration	--	1	2	15	20	20	58	Two are seconded
Public relations	--	1	3	4	5	4	17	Three are seconded
TOTAL	3	10	25	41	58	49	186	

SOURCE: Secretary General of the Governorate, summer 1981.

Headquarters Investments, North Sinai Governorate
1981-1982

Item	Expenditure (LE)
POPULAR DEVELOPMENT	
Agriculture (food security)	
• Cattle fattening	70,000
• Milk projects	180,000
• Poultry	40,000
• Water resources	210,000
SUBTOTAL	500,000
Industry	
• Sand bricks (Taflah)	300,000
• Ice and refrigerating plants	40,000
• Automatic bakeries	53,000
• Olive processing units	87,000
SUBTOTAL	480,000
SUBTOTAL (Popular development)	980,000
INFRASTRUCTURE	
Electricity	
• Strengthening and completion of networks	120,000
• Network extension	350,000
• Lighting equipment	450,000
SUBTOTAL	920,000
Transport and Communications	
• Pavement of regional roads (within the governorate)	550,000
• Pavement of roads within towns	400,000
• Replacement and renewal of pavement equipment	540,000
• Strengthening the banks of canals	50,000
• Local public transmit	60,000
SUBTOTAL	1,600,000
Utilities	
• Public cleanliness	480,000
• Planning and regulation	200,000
• Vehicles and mechanical equipment	420,000
• Municipal establishments	1,435,000
• Swamps and sewers	165,000
• Potable water	1,380,000
• Potable water (artesian wells)	350,000
SUBTOTAL	4,430,000
Services	
• Security, fire brigades, and traffic	270,000
• Youth establishments	500,000
• Urban development	50,000
• Tourism	180,000
• Studies and research	25,000
• 10% maintenance of USAID (DD) equipment	75,000
SUBTOTAL	1,100,000
SUBTOTAL (Infrastructure)	8,050,000
HOUSING (to be financed by low-interest rate loans)	
Housing	
• Construction and completion of housing units	2,800,000
SUBTOTAL	2,800,000
TOTAL	11,830,000

SOURCE: Ministry of Planning, Cairo, 1981

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Number and Distribution of Civil Servants in the Functional Departments of the South Sinai Governorate[a]

1981

Directorate	Top Management	Technical Professionals	Managerial Professionals	Clerical Personnel	Technicians	Total
Agriculture	1	9[b]	--	10	10	30
Housing	1	7[c]	--	--	--	8
Health	1	5	--	1	14	21
Education	1	10	--	20[d]	--	31
Social Affairs	1	5	15	10	--	31
Supply	1	--	10	10	--	21
Manpower	1	--	5	--	--	6
Organization and Administration	1	--	1	5	--	7
TOTAL	8	36	31	56	24	155

[a]This table is not strictly comparable to Table 1-2 for North Sinai, which shows headquarters' staffing rather than functional departments.

[b]Seconded from Ismailia Governorate.

[c]Seconded from Sinai Development Authority.

[d]Two are seconded from the Ministry of Finance.

SOURCE: Secretary General of the Governorate, summer 1981.

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Headquarters Investments, South Sinai Governorate
1981-1982

Item	Expenditure (LE)
POPULAR DEVELOPMENT	
Agriculture (food security)	
• Cattle fattening	150,000
• Poultry	200,000
• Vegetables and fruit farms	75,000
SUBTOTAL	425,000
Industry	
• Ice and refrigerating plants	140,000
• Automatic bakeries	60,000
• Fish processing units	135,000
SUBTOTAL	335,000
SUBTOTAL (Popular development)	760,000
INFRASTRUCTURE	
Electricity	
• Strengthening and completion of networks	250,000
• Network extension	200,000
• Lighting equipment	150,000
• Lighting disadvantaged areas	100,000
SUBTOTAL	700,000
Transport and Communications	
• Pavement of regional roads (within the governorate)	252,000
• Pavement of roads within towns	380,000
• Pavement completion	225,000
• Replacement and renewal of pavement equipment	723,000
SUBTOTAL	1,580,000
Utilities	
• Public cleanliness	180,000
• Planning and regulation	25,000
• Vehicles and mechanical equipment	445,000
• Municipal establishments	900,000
• Swamps and sewers	200,000
• Potable water	970,000
SUBTOTAL	2,720,000
Services	
• Security, fire brigades, and traffic	200,000
• Youth establishments	50,000
• Urban development	25,000
• Tourism	190,000
• Studies and research	25,000
• 10% maintenance of USAID (DD) equipment	75,000
SUBTOTAL	565,000
SUBTOTAL (Infrastructure)	5,565,000
HOUSING (to be financed by low-interest rate loans)	
Housing	
• Construction and completion of housing units	2,700,000
SUBTOTAL	2,700,000
TOTAL	9,025,000

SOURCE: Ministry of Planning, Cairo. 1981

Key Elements of The Sinai Economy 1983 and 2000

1983

Traditional economy

- pastoral activities
- nomadic population
- rainfed agriculture
- dependence on nutritional supplements
- low activity rates

- high dependency ratios
- urban centers focus on distribution activities
- labor-intensive methods
- informal finance
- high illiteracy levels

Modern economy

- petroleum exploration
- petroleum extraction
- imported labor
- without families
- cultural tourism
- beach tourism

- air travel
- intensive agriculture
- drip irrigation
- sprinkler irrigation
- capital-intensive methods

- widespread primary education

2000

Traditional economy

- pastoral activities
- range management
- rainfed agriculture
- surface runoff conservation
- local handicraft production

Modern economy

- manufacturing industry
- irrigated agriculture
- large-scale land reclamation
- exports
- food self-sufficiency

- private domestic and international investment
- commercial banking
- large-scale domestic and international tourism
- high accessibility
- urbanization

- balanced rural communities
- plentiful power supply
- exploitation of many minerals
- intra-subregional linkages
- inter-subregional linkages

- sophisticated transportation services
- reliable potable and irrigation water supply
- permanent settlement of all labor, with families
- high literacy levels
- advanced education

- management and vocational training
- sophisticated medical services
- technology- and capital-intensive agriculture
- marketing networks

EIGHT NATIONAL STRATEGIC GOALS FOR DEVELOPMENT IN SINAI

National integration: To integrate Sinai fully into the economic, cultural, and political life of Egypt while creating a "life style" appropriate to the special circumstances of the peninsula and reducing the current disparity in social services relative to Nilotic Egypt.

Population absorption: To attract, through jobs and amenities, enough people to reduce pressures of overpopulation near the Nile, and to reach a total population in Sinai of about one million by the year 2000.

Resource development: To develop natural resources, including petroleum and other minerals, land suitable for agriculture or industrial sites, surface and underground water, trade routes, and beaches and other tourist attractions, in ways that serve the national economy as well as the growing population in Sinai itself.

Development/attraction of manpower: To attract and/or train workers who have the requisite skills in agriculture, mining, industry, construction, tourism, and other sectors, to perform in ways that result in high productivity for the enterprises and communities where they work.

Economic viablity: To develop by the year 2000 a viable, self-sustaining economy that produces goods and services that meet national and export needs; encourages cost-recovery; and follows a least-cost path toward desired goals, while keeping financial risks associated with public and private investment within manageable limits.

Dispersed settlement system: To foster the enhancement and creation of permanent, interdependent settlements--both large towns and small villages--that are widely dispersed throughout the Sinai Peninsula, with ample amenities to attract and retain a rapidly growing population.

Improved communications and transport: To build and maintain highways, ports, a telecommunications network, and other infrastructure components that serve essential economic as well as national security requirements and provide convenient links from Egypt through Sinai to the Middle East, and from Sinai to Egypt and to export markets.

Enhanced environment: To enhance the environment of Sinai by introducing Nile water, small sea ports, and perennial vegetation, and to conserve the unique environment and resources of the Sinai, including scarce water resources, outstanding coral reefs, historical and religious monuments, and grazing lands.

Source: Goals drafted by Consultant in March 1983 after intensive discussions with the Steering Committee.

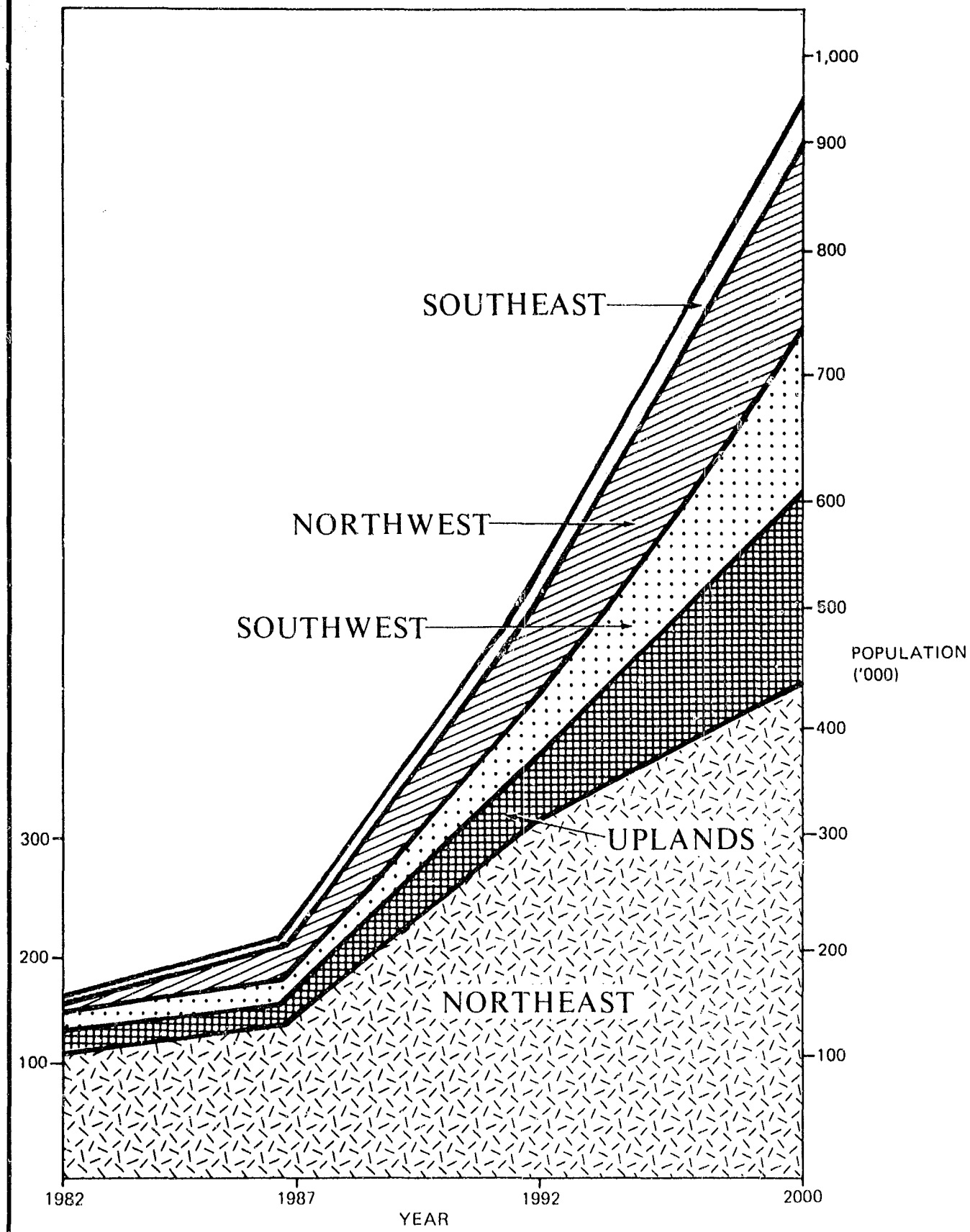
Recommended Strategy: Projected Land Use by Subregion, Year 2000
(in square kilometers)

LAND USE	NW	NE	UP	SW	SE	TOTAL	PERCENT
Nature/culture conservation[a/]	--	455	2,398	2,665	2,664	8,182	13.3
(Coral, km shore line)	(23)	(53)	(--)	(92)	(85)	(253)	(37)
Enhanced grazing[a/]	--	200	5,125	1,775	175	7,275	11.8
Irrigated agriculture	303	231	240	73	5	852	1.4
Tourism	17.5	5.3	0.1	7.4	5.7	36	0.1
Industry	1.8	4.5	0.3	2.6	0.3	9.5	--
Settlements	105	204	77	86	52	524	0.8
Regional infrastructure	12.6	14.5	35.1	10.4	5.8	78.4	0.1
Total area	6,656	6,254	25,376	12,826	9,895	61,007	100.0
Total area developed	440	1,114	7,875	4,619	2,908	16,957	27.8
(Percent)	(6.6)	(17.8)	(31.0)	(36.0)	(29.4)	(27.8)	--

Key: NW = Northwest, NE = Northeast, UP = Uplands, SW = Southwest, SE = Southeast
-- Less than one-tenth of one percent.

[a/] Conservation and grazing overlap to some extent.

SOURCE: Estimates by the Consultant.



RECOMMENDED STRATEGY:
PROJECTED POPULATION BY PHASE AND SUBREGION

Dames & Moore

Estimated Number of Migrants Needed for Settlement in Sinai, by Phase, 1982/83 - 2000
(in thousands)

	Migrants from Nilotic Egypt				Children of Migrants
	1982/83-1986/87	1987/88-1991/92	1991/92-2000	Cumulative	
TOTAL	22	265	313	600	130
Agricultural	11	107	109	227	55
Non-Agricultural	11	158	204	373	75

SOURCE: Calculations by Consultant. Note that all such estimates are rough orders of magnitude and subject to wide variation as underlying assumptions are changed. For instance, if more migration occurs in the early years and consists mainly of young couples, more children will be born in Sinai and the total number of migrants needed could be substantially less than 600,000, while the number of children requiring school and other facilities would be greater than 130,000 noted here.

Projected Additional Employment in Leading Sectors, by Phase and Subregion

(Increments, each Phase)

Subregion	I Agr	I Ind	I Tou	II Agr	II Ind	II Tou	III Agr	III Ind	III Tou	Total (leading sectors) Agr	Ind	Tou	Total
NW	5,700	500	0	10,200	2,615	350	11,200	5,880	500	27,100	8,995	850	36,945
NE	1,650	3,550	400	28,950	8,850	1,300	16,800	10,100	2,800	47,400	22,500	4,500	74,400
UP	100	50	0	6,300	1,100	100	25,700	200	0	32,100	1,350	100	33,550
SW	600	690	220	2,400	3,740	400	9,300	8,670	600	12,300	13,100	1,220	26,620
SE	100	0	0	600	480	1,500	1,700	830	3,000	2,400	1,310	4,500	8,210
Total	8,150	4,790	620	48,450	16,785	3,650	64,700	25,680	6,900	121,300	47,255	11,170	179,725
All three sectors		13,560			68,885			97,280			179,725		

(Cumulative)

Subregion	I Agr	I Ind	I Tou	II Agr	II Ind	II Tou	III Agr	III Ind	III Tou
NW	5,700	500	0	15,900	3,115	350	27,100	8,995	850
NE	1,650	3,550	400	30,600	12,400	1,700	47,400	22,500	4,500
UP	100	50	0	6,400	11,150	100	32,100	1,350	100
SW	600	690	220	3,000	4,430	620	12,300	13,100	1,220
SE	100	0	0	700	480	1,500	2,400	1,310	4,500
Total	8,150	4,790	620	56,600	21,575	4,270	121,300	47,255	1,170
All three sectors		13,560			82,445			179,725	

Source: Projections by Consultant.

Recommended Strategy: Projected Regional Pattern of Employment*

SUBREGION ZONE	Employment Projected for 1987	Increase in Employment 1988-1992	Increase in Employment 1993-2000	Projected Total Year 2000
Northwest, subtotal	10,590	22,677	30,524	63,791
North	340	3,705	11,070	14,945
Central	10,250	12,148	15,890	38,288
South	--	6,824	3,564	10,388
Northeast, subtotal	10,795	70,785	55,460	137,040
East	10,080	48,680	49,280	108,040
West	715	22,105	6,180	39,000
Uplands, subtotal	240	11,610	38,910	50,760
Southwest, subtotal	2,716**	11,950	33,240	47,906
North	1,500	7,540	27,620	36,660
South	1,216	4,410	5,620	11,246
Southeast, subtotal	150	4,464	9,444	14,058
South	--	2,964	8,004	10,968
North	150	1,500	1,440	3,090
Total, all Sinai	24,491	121,486	167,578	313,555***

SOURCE: Dames & Moore projections, based on economic activities described in Volume III.

*Includes leading sector employment generated by agriculture, industry, and tourism as well as other "indirect" or derived employment.

**Understates employment in petroleum subsector because of the "transient" status of many of the workers involved, pending creation of permanent settlements which could attract them and their families to take up residence in Sinai.

***Throughout this report this figure is generally rounded to 313,000.

Recommended Strategy: Sinai Settlements in the Year 2000

Location	Primary Function	Subregion
Cities/Growth Pole (over 50,000)	(Two)[a]	Subregion
El Arish	Industry/Tourism/Agriculture/Administration	Northeast
Abu Rudeis (New site)	Industry/Agriculture/University	Southwest
Suez	Industry/Administration	Across west border
Ismailia	Administration/Agriculture	Across west border
Port Said	Commerce/Industry	Across west border
Large Towns (25,000-50,000)	(Five)	
El Qantara	Industry/Transport	Northwest
Rafah	Agriculture/Transport	Northeast
Bir El Abd	Agriculture/Industry	Northeast
Bir El Thamada (New)	Agriculture/Industry	Uplands
Sharm El Sheikh	Tourism/Administration/Industry	Southeast
Small Towns/Service Center (5,000-25,000)	(Twelve)	
Baloza	Agriculture	Northwest
Gilbana	Agriculture	Northwest
El Tina (New)	Agriculture/Fishing	Northwest
New Mit Abul Kom	Agriculture/Tourism	Northwest
Ayun Musa (New)	Industry/Tourism/Agriculture	Northwest
Sheikh Zuwayid	Agriculture/Industry	Northeast
Romana	Agriculture/Tourism	Northeast
Gifgafa	Agriculture	Uplands
Ras Sudr	Industry/Transport	Southwest
El Tor	Agriculture/Fishing/Tourism	Southwest
Ras Taba (New)	Tourism/Transport/Industry	Southeast
Nuweiba	Tourism/Administration	Southeast
Settlements/Market Center (Under 5,000)	(Eighteen)	
Firdan-East (New)	Agriculture/Transport	Northwest
Hamdi-East (New)	Transport	Northwest
El Mazar	Agriculture	Northeast
Negila	Agriculture	Northeast
Rabaa	Agriculture	Northeast
Abu Aweigila (New)	Agriculture	Northeast
El Quseima	Agriculture/Tourism/Transport	Uplands
El Kuntilla	Agriculture	Uplands
El Themed	Agriculture	Uplands
Nakhl	Agriculture/Transport	Uplands
El Hasana (New site)	Agriculture/Administration	Uplands
El Sirr (New)	Agriculture	Uplands
El Maghara (New)	Mining/Tourism/Agriculture	Uplands
Abu Zenima	Tourism/Industry	Southwest
Feiran Oasis	Agriculture	Southwest
St. Catherine	Tourism	Southwest
Dahab	Tourism	Southeast
Nebq	Tourism	Southeast

[a] Three cities west of the Suez Canal, just outside Sinai, also serve as Growth Poles for the peninsular economy.

Summary of Investment Plan, 1983-2000
(LE million)

	Gross investment		
	Total	1983-91/92	1992/93-2000
National System, subtotal	6,816	2,258	4,558
Production sectors, subtotal	3,100	450	2,650
Petrochemical complex	2,500	300	2,200
Other heavy industry	600	150	450
Service sectors, subtotal	3,716	1,808	1,908
Main highways, harbors	185	125	60
Telecommunications	204	54	150
Electricity generation*	1,000	1,000	--
Bulk water conveyances	2,235	585	1,650
University	80	40	40
Parks/nature reserves	12	4	8
Regional System, subtotal	4,452	2,103	2,349
Production sectors, subtotal	2,662	1,335	1,327
Agriculture	912	400	512
Industry and mining**	750	495	255
Tourism	350	140	210
Other production and services	650	300	350
Service sectors, subtotal	1,790	768	1,022
Roads, harbors, airports	110	60	50
Telecommunications	204	49	155
Electricity/gas (mostly distribution)	508	289	219
Higher education***	24	6	18
Hospitals***	291	66	225
Community infrastructure	134	62	72
Housing	519	236	283
Production sectors, subtotal	5,762		
Service sectors, subtotal	5,506		
Grand total	11,268		

*Mostly for distribution west of the Suez Canal
**Excluding petroleum
***Other education and health care are included in community infrastructure

Sources: Estimates by the Consultant. For details see Volume III, Chapter 6, and Volume VI, Chapter 3.

Summary of Investment Plan, 1983-2000 (LE million)

Sector	Gross Investment (LE million)	Remarks
NATIONAL SYSTEM, subtotal	6,816	
Production sectors, subtotal	3,100	No large extra cost due to location in Sinai; verify in feasibility studies.
Petrochemical complex	2,500	
Other heavy industry	600	Cement, steel, minerals among "other" possibilities.
Service sectors, subtotal	3,716	Several items justified partly for national defense reasons.
Main highways, transport	185	Part of the national system; some costs already incurred, 1979-83.
Telecommunications	204	Split cost 50/50 with regional system.
Electricity generation	1,000	Mostly for distribution to west of the Suez Canal.
Bulk water conveyances	2,235	Major national financial commitment to Sinai.
Higher education	80	Mainly university.
Parks/nature reserves	12	Minimal maintenance and recreation facilities.
REGIONAL SYSTEM, subtotal	4,452	
Production sectors, subtotal	2,662	Mainly private sector investment, financed partly with loans from Government-assisted development financing institutions, which are repaid from earnings. Petroleum not included.
Agriculture/rural development	912	User fees could cover costs of field irrigation equipment plus the cost of operation and maintenance of water distribution system.
Industry and mining	750	
Tourism	350	
Other production	650	Includes construction, workshops, services and many other activities.
Service sectors, subtotal	1,790	
Roads, harbors, airports	110	User fees estimated to cover over 80 percent of costs nationally.
Telecommunications	204	Split cost 50/50 with national system.
Electricity and natural gas	508	Could be self-financing from industrial/commercial user fees.
Higher education	24	Grades 10 and above; also vocational/technical colleges.
Hospitals	291	Major capital cost in a largely low-cost system, based mainly on primary health care units.
Community infrastructure	134	Streets plus basic water, sanitation and other services; costs could be covered partly by local improvement assessment.
Housing	519	90 percent in private sector, assisted by government-sponsored long-term mortgage and hire-purchase schemes.
TOTAL	LE 11,268 MILLION	

(Production Sectors LE 5,762 million; Service Sectors LE 5,506 million).

Cost of Major Transportation Investments, by Phase

	Subregion	Investment Cost (LE Million) National	Regional	Total
PHASES I & II (through 1991/92), Subtotal	--	125	60	185
Roads, Subtotal	--	90	35	125
El Qantara - El Shatt**	NW	11	--	
Hadj Highway	UP	27	--	
Ras Taba - Ras El Naqb	SE	8	--	
Ras El Naqb - El Quseima	UP	21	--	
Bir El Abd-Gifgafa	NE	--	6	
El Tor - Sharm El Sheikh	SW	4	--	
Abu Rudeis - Umm Bugma	SW	--	7	
Rural roads*	ALL	--	10	
Others to be identified	ALL	19	12	
Harbors, Subtotal	--	35	25	60
Ras Taba	SE	15	--	
El Tor	SW	--	15	
Ras Sudr	SW	15	--	
Others to be identified		5	10	
PHASE III (1992/93-2000), Subtotal	--	60	50	110
Roads, Subtotal	--	48	27	75
El Tina - Rafah**	NE	18	--	
Bir El Thamada - El Hasana	UP	--	4	
El Quseima - Border	UP	--	1	
Rural roads	ALL	--	10	
Others to be identified	ALL	30	12	
El Qantara Airport	NW	--	15	15
Ports and other Transportation	ALL	12	8	20
TOTAL		185	110	295

*All or partially in current Five-Year Plan.
**Dualing of coastal highway and Canal crossing.

SOURCE: Estimates by Consultant, based on review of Plan and Budget documents and discussion with Governors and other officials.

Summary of Investment Requirements in Leading Production Sectors, by Subregion and Phase[a]

Subregion	Phase 1982/83-86/87	Phase 1987/88-91/92	Phase 1992/93-2000	Total	Percent
Agriculture, subtotal	15.6	386.2	511.8	913.6[b]	100.0
Northwest	12.8	133.7	114.3	260.8	28.5
Northeast	1.9	169.2	90.9	262.0	28.7
Uplands	0.1	79.7	221.9	301.7	33.0
Southwest	0.7	2.9	82.7	86.3	9.4
Southeast	0.1	0.7	2.0	2.8	0.3
(Percent)	(1.7)	(42.3)	(56.0)	(100.0)	--
Industry, subtotal	70.7	429.8	255.3	755.8[b]	100.0
Northwest	5.6	32.3	67.8	105.7	13.9
Northeast	43.6	134.4	148.9	326.9	43.3
Uplands	0.5	61.0	3.2	64.7	8.6
Southwest	21.0	196.2	25.1	242.3	32.1
Southeast	--	5.9	10.3	16.2	2.1
(Percent)	(9.3)	(56.9)	(33.8)	(100.0)	--
Tourism, subtotal	27.5	108.3	205.5	341.3[b]	100.0
Northwest	12.5	36.3	50.3	99.1	29.0
Northeast	7.0	25.5	62.0	94.5	27.7
Uplands	--	2.5	13.4	15.9	4.7
Southwest	4.2	14.0	13.0	31.2	9.1
Southeast	3.8	30.0	66.8	100.6	29.5
(Percent)	(8.1)	(31.7)	(60.2)	(100.0)	--
All leading sectors	113.8	904.3	955.6	1,973.8[b]	100.0
Northwest	30.9	182.3	226.4	439.6	22.3
Northeast	52.5	329.1	293.8	675.4	34.2
Uplands	0.6	143.2	225.5	369.3	18.7
Southwest	25.9	213.1	130.8	369.8	18.7
Southeast	3.9	36.6	79.1	119.6	6.1
(Percent)	(5.8)	(45.8)	(48.4)	(100.0)	--

[a] Excludes heavy industries like petrochemical complex which are in the national system.

[b] Sector totals were rounded slightly for inclusion in the Investment Plan.

SOURCE: Estimates by Dames & Moore based on sector analyses.

Nile Water Conveyance System (Pipelines and Canals)
Areas to be Irrigated and Estimated Capital Costs, by Phase

Route (number)	Number of Pipelines a/	Sub-region/ Zone	Feddans to be Irrigated (000)b/	Conveyance Capital Costs (LE million) Primary	Secondary	Per Feddan (LE)
Through Phase II (1991/92), Subtotal	8		65	568	124	10,646
Ismailia-El Shatt (1)	1	NW/S	6	62	9	11,833
Suez Canal-Baloza (2a)c/	1	NW/N	6	17	12	4,812d/
Suez Canal-El Mazar (3)	2	NE/W	20	141	37	8,900
Suez Canal-Rafah (4)	2	NE/E	15	208	26	15,600
Ismailia-Gifgafa (9a)	1	UP/W	8	105	15	14,938d/
Suez Canal-El Tina (11a)c/	1	NW/N	10	35	25	6,000d/
Phase III (1992/93-2000), Subtotal	12		94	1,591	187	18,915
Suez Canal-Baloza (2b)c/	2	NW/N	10	28	20	4,812d/
Suez Canal-El Arish (5)	2	NE/E	17	282	30	18,353
Suez Canal-El Sirr (6)	1	UP/E	10	193	18	21,100
Ismailia-Abu Rudeis (7)	1	SW/N	6	198	11	34,833
Ismailia-W. Feiran Delta (8)	1	SW/N	8	273	16	36,125
Ismailia-Gifgafa (9b)	1	UP/W	8	105	14	14,938d/
Ismailia-Bir El Thamada (10)	3	UP/W	25	477	53	21,200
Suez Canal-El Tina (11b)c/	1	NW/N	10	35	25	6,000d/
Totals through Phase III	20		159e/	2,159f/	311	15,535

a/ As a general rule one pipeline of two meters diameter provides sufficient irrigation water for 10,000 feddans, though this could vary from 8,000 to 12,000 feddans depending on the cropping pattern, rate of evapotranspiration and other factors. Figure 6.1 in Volume III provides a schematic diagram of these pipeline systems.

b/ Fields actually under irrigation in any year; project area, land distributed to farmers, and area cropped would be significantly larger because of area required for roads and public services, housing and other non-crop uses, and multiple-cropping practices.

c/ A canal may be both feasible and cheaper to build.

d/ Average cost for Phase II and Phase III combined.

e/ Reclamation of an additional 30,000 feddans has already been initiated east of Bitter Lake.

f/ Total cost of primary conveyance in the overall Sinai investment program includes an additional LE 76 million, the estimated cost of water conveyances to serve the proposed petrochemical and heavy industrial complex north of Ras Sudr.

Source: Dames & Moore calculations, for which basic data are in Volume V, Water Supplies and Costs, in the discussion of alternative strategies.

Land Preparation Costs for Nile Water Reclamation Areas, by Phase

Reclamation Area (number)	Sub-region/ Zone	Feddans to be reclaimed	Land Preparation and Equipment cost: Per feddan[a]	Land Preparation and Equipment cost: Total	Total cost including conveyances[b]
		(000)	(LE)	(LE million)	(LE per feddan)
Through Phase II (1991/92) Subtotal		65	3,149	204.7	13,795
El Shatt (1)	NW/S[c]	6	2,900	17.4	14,733
Qantara-Baloza (2a)[d]	NW/N	6	3,917	23.5	8,729
North Coast (3)	NE/W	20	2,965	59.3	11,865
Rafah Strip (4)	NE/E	15	2,720	40.8	18,320
Gifgafa (9a)[d]	UP/W	8	2,963	23.7	17,901
El Tina (11a)[d]	NW/N	10	4,000	40.0	10,000
Phase III (1992/93-2000) Subtotal		94	2,977	279.8	21,892
Qantara-Baloza (2b)	NW/N	10	2,340	23.4	7,152
Lower Wadi El Arish (5)	NE/E	17	2,794	47.5	21,147
El Sirr (6)	UP/E	10	3,000	30.0	24,100
Abu Rudeis (7)	SW/N	6	2,900	17.4	37,733
Wadi Feiran Delta (8)	SW/N	8	3,000	24.0	39,125
Gifgafa (9b)	UP/W	8	2,963	23.7	17,901
Bir El Thamada (10)	UP/W	25	2,952	73.8	24,152
El Tina (11b)	NW/N	10	4,000	40.0	10,000
Totals		159	3,047	484.5	18,582

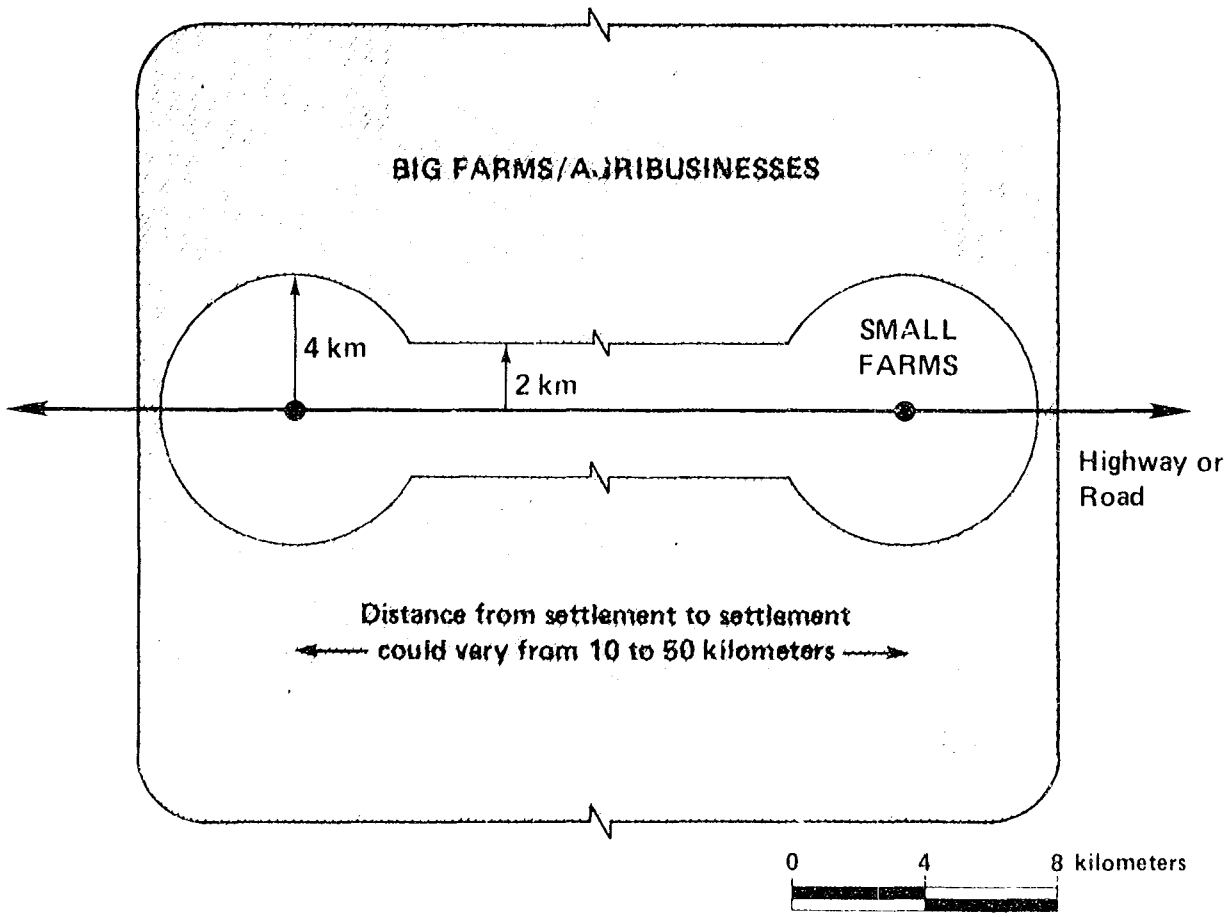
a/ Per-feddan cost varies not only with terrain, type of irrigation, and tenure arrangements, but also with the mix of intensive and less intensive techniques of cultivation chosen for each project area. These planning estimates require verification on the basis of project-by-project feasibility studies.

b/ Primary and secondary conveyance costs from Table 6-2 Volume III; also RS-S$-4 on preceding page of this volume.

c/ One thousand feddans of this project area are in the very northern end of the Southwest Subregion.

d/ First phase of a project which will be completed after 1992/93. Per-feddan costs represent average for both phases.

SOURCE: Calculations by Dames & Moore after review of land preparation and irrigation equipment costs of other recent projects in Egypt and comparable situations.



LEGEND

- ● TOWN OR SETTLEMENT
- ▭ AREA GENERALLY ALLOCATED IN LARGE TRACTS TO BIG AGRIBUSINESS OPERATIONS
- ▭ AREA GENERALLY ALLOCATED IN SMALL PLOTS (5-10 feddans each) TO INDIVIDUAL FAMILIES

NOTES

Big farms, agribusinesses in tracts up to 5,000 feddans allocated to corporations and other large investors. These tracts would be located more than two kilometers from a highway and more than four kilometers from the center of a town or settlement.

Small farms in plots of five to ten feddans each to be allocated to individual farmers. These plots would be within two kilometers of a highway or within four kilometers of the center of a town or settlement.

Distances between settlements would vary from 10 to 50 kilometers according to resource availability and other conditions.

DIAGRAMMATIC SKETCH OF
GUIDELINES FOR LOCATING FARMS

Dames & Moore

Summary of Projected Regional Industrial Investments, by Subregion, Zone and Phase

(LE million)

Subregion and Zone	Industry	Phase I	Phase II	Phase III	1983-2000
Northwest, subtotal		5.6	32.3	67.8	105.7
Northern	Food processing	0	0.4	1.6	2.0
Central	Food processing	1.6	12.8	14.4	28.8
	Light industry	4.0	14.1	31.0	49.1
Southern	Food processing	0	3.2	8.0	11.2
	Light industry	0	1.8	12.8	14.6
Northeast, subtotal		43.6	134.4	148.9	326.9
Eastern	Food processing	25.6	51.1	73.6	150.3
	Light industry	16.0	22.0	30.0	68.0
Western	Salt	0	10.3	10.3	20.6
	Food processing	0	48.0	32.0	80.0
	Light industry	2.0	3.0	3.0	8.0
Uplands, subtotal		0.5	61.0	3.2	64.7
	Coal	0	60.0	0	60.0
	Food processing	0	0	3.2	3.2
	Light industry	0.5	1.0	0	1.5
Southwest, subtotal		21.0	196.2	25.1	242.3
Northern	Food processing	0	1.6	12.8	14.4
	Light industry	0.6	5.5	5.3	11.4
	Minerals, Abu Rudeis, Abu Zenima, Ras Malaab, Umm Bugma	19.4	182.0	2.0	203.4
Southern	Food processing	0	4.3	0	4.3
	Light industry	1.0	2.8	5.0	8.8
Southeast, subtotal		0	5.9	10.3	16.2
Southern	Food processing	0	2.1	2.1	4.2
	Light industry	0	2.0	4.0	6.0
Northern	Food processing	0	0.8	3.2	4.0
	Light industry	0	1.0	1.0	2.0
Grand Total		70.7	429.8	255.3	755.8*

* Rounded to LE 750 million for presentation in the Investment Plan.

SOURCE: Calculations by Dames & Moore, based on industry-by-industry analysis in Working Paper No. 36, Industry, April 1982.

Recommended Mineral Mining and Processing Prospects

Industry / Location	Annual Capacity (000 tons)	Startup Phase*[a]	Employees	Power (KW)	Water (m^3/day)	Investment (LE 000) Foreign	Investment (LE 000) Local
Manganese-iron mine							
Umm Bugma	70	II	100	--	8	3,000	2,000
Ferromanganese Smelter							
Abu Zenima	50	II	900	20,000	1,700	10,000	6,000
Glass sand mine							
Southwest	60	I	30	70	50	500	3,000
Northwest	12	II	60	140	100	1,000	6,000
Flat glass							
Abu Rudeis[b]	100	II	900	4,000	700	70,000	42,000
Gypsum mine							
Ras Malaab	300	I	120	--	5	900	900
Ras Malaab[c]	300	II	120	--	5	900	900
Calcined gypsum							
Ras Malaab	210	I	280	5,000	17	5,000	3,800
Ras Malaab[c]	210	II	280	5,000	17	5,000	3,800
Kaolin mines, Southwest							
No. 1	50	I	50	700	250	4,000	1,000
No. 2	50	I	50	700	250	4,000	1,000
No. 3	50	II	50	700	250	4,000	1,000
No. 4	50	III	50	700	250	4,000	1,000
Refractories							
Abu Rudeis[d]	54	II	200	600	15	2,000	1,500
Salt							
Lake Bardawil	2,000	I	240	1,000	12	3,300	17,300
Coal mine							
Gebel El Maghara, Uplands	600	II*	1,000	4,300	800	60,000	34,000
TOTAL			4,430	42,910	4,429	177,600	125,200

[a] Phase I - 1983 through June 1987; Phase II - 1987/88 - 91/92; Phase III - 1992/93 through December 2000.

[b] LE 4.5 million allocated in the 1982/83 - 86/87 Plan.

[c] Gypsum and calcinated gypsum investment costs excluded the cost of a power plant.

[d] As in Five-Year Plan.

SOURCE: Estimates by Dames & Moore.

Summary of Projected Tourism Investments, by Subregion/Zone and Phase

(LE million)

Subregion and Zone	Type	Phase I	Phase II	Phase III	Total
Northwest, subtotal		12.5	36.25	50.35	99.1
Northern	Hotel	--	1.25	2.5	
	Villa	2.5	5.0	4.0	
	Bungalow	--	1.25	1.25	
Central	Hotel	--	2.5	5.0	
	Villa	2.0	5.0	4.1	
	Bungalow	1.5	1.25	5.0	
Southern	Hotel	--	5.0	5.0	
	Villa	3.0	10.0	14.5	
	Bungalow	3.5	5.0	9.0	
Northeast, subtotal		7.0	25.5	62.0	94.5
Eastern	Hotel	2.5	15.0	50.0	
	Vacation Village	4.5	10.5	12.0	
Uplands	Hotel	--	2.5	13.4	15.9
Southwest, subtotal		4.2	14.0	13.0	31.2
Northern	Hotel	--	2.5	5.0	
	Villa	--	4.0	--	
	Bungalow	1.5	1.0	--	
Southern	Hotel	2.7	5.0	5.0	
	Vacation Village	--	1.5	3.0	
Southeast, subtotal		3.8	30.0	66.8	100.6
Northern	Hotel	--	7.5	7.5	
	Vacation Village	--	4.5	3.0	
Southern	Hotel	2.8	11.25	46.9	
	Vacation Village	1.0	6.75	9.4	
Grand Total		27.5	108.25	205.55	341.3*

*Rounded to LE 350 million for presentation in the Investment Plan.

SOURCE: Calculations by Dames & Moore, based on revised tourism plans after review of land capability considerations in the early months of 1983.

Proposed Sinai Industries That Could Use Natural Gas

Location	Activity	Projected Gas Requirement mmcfd*
Northeast Subregion		
	Clay brick	0.6
	Salt	3.0
Southwest Subregion		
	Fertilizer complex, subtotal	75.1
	. gas feedstock	39.0
	. fuel	32.0
	. electric power	4.1
	Caustic/chlorine, subtotal	16.0
	. fuel	1.0
	. electric power	15.0
	Soda ash, subtotal	5.5
	. fuel	4.7
	. electric power	0.8
	Cement, subtotal	31.7
	. fuel	28.0
	. electric power	3.7
	Clay brick, fuel	0.5
	Refractories	0.6
	Flat glass	4.5
	Ferromanganese smelter	3.5
	Calcined gypsum, subtotal	3.6
	. fuel	2.2
	. electric power	1.4
		144.6 mmcfd

*million cubic feet per day.

SOURCE: Volume III, Chapter 5 and Working Paper No. 36, Industry, in SDS-I project files.

SUMMARY OF ECONOMIC CHARACTERISTICS OF ALTERNATIVE STRATEGIES

	Three Alternatives (considered early 1983)			
	Frontier	All Coasts	Dispersed	Recommended Strategy
1. Total projected population (000)				
1992	338.0	422.0	362.0	521.2
2000	944.0	1,058.0	1,100.0	973.1
2. Projected employment (000), by sector				
1992, total	90.0	118.0	98.0	146.0
Agriculture	37.0	38.0	40.0	56.6
Industry	7.0	16.0	3.0	21.6
Tourism	1.0	5.0	6.0	4.3
Other	45.0	59.0	49.0	63.5
2000, total	293.4	330.0	374.6	313.0
Agriculture	122.7	80.0	160.3	121.3
Industry	17.0	65.0	9.0	47.3
Tourism	7.0	20.0	18.0	11.2
Other	146.7	165.0	187.3	133.2
3. Subregional Distribution of year 2000 population (percent)				
NW	27.9	25.0	36.0	17.2
NE	59.1	44.5	38.4	46.6
UP	a/	a/	a/	17.5
SW	8.2	22.6	15.7	14.1
SE	4.8	7.9	9.9	4.6

a/ Included in Northeast Subregion

4. Phasing by Subregion:	Spread from Canal NW to NE. SE also benefits from trade.	Continued emphasis along coasts to the limit of resources there.	Early emphasis NE, SW; later in NW.	Develop activities in each subregion; then integrate into peninsular economy.
5. Special economic emphasis	Agriculture the dominant employer, spreading from the East Bank of the Canal to the Wadi El Arish area.	Balanced employment with industry not far short of agriculture.	Agricultural employment, same percentage of total employment as Egyptian economy as a whole.	Major promotion of industrial activities and intensive irrigation; promote tourism, especially along beaches, to limit of market, balancing local and overseas clientele.
6. Infrastructure	High quality networks for Nile water, roads and power.	Heavy infrastructure lines along coasts; connecting lines E-W and N-S in interior.	Most "distributed" system; very high investment in Nile water to the interior; conscious effort, regardless of cost, to have population spread to all areas of peninsula.	Represents synthesis and refinement of major elements in previously considered strategies; aims at balanced achievement of several complex, sometimes competing, national goals.

Source: Projections prepared by the Consultant.

Leading Sector Employment Under Alternative Strategies, by Subregion

Subregion	STRATEGY Recommended	All Coasts	Frontier	Dispersed
Northwest	36,945	41,400	40,941	66,186
Northeast[a]	107,950[b]	73,000	86,524	72,072
Southwest	26,620	37,100	7,100	30,938
Southeast	8,210	13,500	12,150	18,097
TOTAL	179,725[c]	165,000	146,715	187,293

[a] Includes Uplands.

[b] Of which Uplands 33,550 and Northeast (coastal) 74,400.

[c] In addition to this employment in the three "leading sectors" (agriculture, industry/mining, and tourism), approximately 133,830 jobs are projected in other sectors (for example, construction, transport, trade, government, and repair services), making total estimated employment 313,555, which is generally rounded to about 313,000 jobs in the text of this report.

Source: Calculations by Consultant, 1983.

Sinai Water Demands and Proposed Allocations of Nile Water, in the Year 2000, by Subregion, for the Recommended Strategy and Three Alternatives
(million cubic meters per year)

Subregion and Use	RS	FR	DI	AC
	Nile Water			
Northwest, subtotal	550.7	263.2	291.3	193.1
Irrigation	544.8	255.4	282.3	188.0
Public Supply	4.3	7.1	6.3	4.5
Industry and Tourism	1.6	0.7	2.7	0.6
Northeast/Uplands[a], subtotal	808.1	1,184.5	1,477.0	294.9
Irrigation	784.1	1,165.9	1,457.6	278.7
of which Uplands	(411.3)	(827.4)	(1,084.8)	(57.5)
Public Supply	17.4	17.4	18.5	14.9
Industry and Tourism	6.6	1.2	0.9	1.3
Southwest, subtotal	250.5	6.2	548.0	108.5
Irrigation	170.6	b/	542.6	103.4
Public Supply	3.5	1.5	1.3	3.3
Industry and Tourism	76.4	4.7	4.1	1.8
Southeast, subtotal	b/	b/	b/	b/
Nile Water, subtotal	1,609.3[c]	1,453.9	2,316.3	596.5
	Groundwater[d]			
Northwest, subtotal	e/	e/	e/	e/
Northeast/Uplands[a], subtotal	38.1	23.2	38.0	23.7
Irrigation	35.2	20.7	35.2	20.7
of which Uplands	(15.2)	(0.7)	(15.2)	--
Public supply	2.8	2.4	2.8	3.0
Industry and Tourism	0.1	0.1	--	--
Southwest, subtotal	47.9	46.1	50.7	7.3
Irrigation	44.2	45.4	46.0	1.8
Public Supply	1.8	0.6	2.8	2.5
Industry and Tourism	1.9	0.1	1.9	3.0
Southeast, subtotal	12.8	6.2	6.7	8.5
Irrigation	11.1	3.9	4.6	5.3
Public Supply	1.2	1.6[f]	1.6[f]	1.6[f]
Industry and Tourism	0.5	0.7	0.5	1.6[f]
Groundwater, subtotal	98.8	75.5	95.4	39.5
Total Water Demand	1,708.1	1,529.4	2,411.7	636.0

(Footnotes are on the following page.)

FR, DI, and AC represent Frontier, Dispersed and All Coasts alternative strategies considered at an early stage in the 1983 analysis. RS is the Recommended Strategy proposed by the Consultant after discussions with the Steering Committee and further analysis. The Recommended Strategy is summarized in Volume I of this Report.

a/ Uplands not originally considered a separate subregion. Prior to formulation of the Recommended Strategy, Uplands requirements were included with those of the Northeast subregion.

b/ Groundwater only.

c/ Total Nile water requirement for irrigation is 1,499.5 million cubic meters per year; the estimated requirement for all other uses is 109.8 million cubic meters.

d/ Including desalinized groundwater.

e/ No significant quantity of groundwater yet proven in this subregion.

f/ Between 800,000 and 1.4 million cubic meters per year desalinized groundwater included. No other figure includes more than 600,000 cubic meters per year of desalinized groundwater.

SOURCE: Calculations by the Consultant. See also Tables A-6 to A-8 in the Appendix to Volume V.

Irrigated Feddans Under Alternative Strategies, by Subregion (Year 2000)

Subregion	Recommended Strategy	Alternative Strategies		
		All Coasts	Frontier	Dispersed
Northwest	71,000	30,000	62,000	47,000
Northeast*	109,900**	45,000	119,800	195,000
Southwest	17,300	12,000	1,000	55,000
Southeast	1,700	750	4,500	8,000
TOTAL	199,900	87,750	187,300	305,000

* Includes Uplands.
**Of which Uplands accounts for 51,900 feddans (excluding 2,000 feddans of managed runoff).

Summary of Projected Water Requirements in the Year 2000, by Subregion, for Four Strategies
(million cubic meters per year)

Subregion	Irrigated Agriculture	Domestic Water	Industry and Mining	Tourism	Total
(a) Recommended Strategy					
Total	1,590.0	31.0	86.7	0.4	1,708.1
Northwest	544.8	4.3	1.6	*	550.7
Northeast	392.8	18.1	6.1	0.2	417.2
Uplands	426.5	2.1	0.4	*	429.0
Southwest	214.8	5.3	78.3	*	298.4
Southeast	11.1	1.2	0.3	0.2	12.8
(b) Frontier Strategy					
Total	1,491.3	30.6	7.2	0.3	1,529.4
Northwest	255.4	7.1	0.6	0.1	263.2
Northeast[a]	1,186.6	19.8	1.3	*	1,207.7
of which Uplands	(828.1)	n.a.	n.a.	n.a.	n.a.
Southwest	45.4	2.1	4.7	0.1	52.3
Southeast	3.9	1.6	0.6	0.1	6.2
(b) Dispersed Strategy					
Total	2,368.3	33.3	9.1	1.0	2,411.7
Northwest	282.3	6.3	2.5	0.2	291.3
Northeast[a]	1,492.8	21.3	.6	0.3	1,515.0
of which Uplands	(1,100.0)	n.a.	n.a.	n.a.	n.a.
Southwest	588.6	4.1	5.9	0.1	598.7
Southeast	4.6	1.6	0.1	0.4	6.7
(c) All Coasts Strategy					
Total	597.9	29.8	8.0	0.3	636.0
Northwest	188.0	4.5	0.5	0.1	193.1
Northeast[a]	299.4	17.9	1.3	*	318.6
of which Uplands	(57.5)	n.a.	n.a.	n.a.	n.a.
Southwest	105.2	5.8	4.7	0.1	115.8
Southeast	5.3	1.6	1.5	0.1	8.5

n.a. Not available.
* Less than 0.05
a/ Includes Uplands.

Source: Calculations by the Consultant.

Development Priorities by Phase

	Priority Sectors	Construction Emphasis	Management Priority	Planning Emphasis
PHASE I 1982/83- 1986/87	-Rural development -Tourist marketing -Agricultural research	-Ferry crossings -Highway network -Telecommunications -Wells, small dams, cisterns -Resorts for domestic tourists	-Regional Agency -Information, monitoring systems -Agricultural, industrial credit -Industrial promotion policies	-Reserve key touristic, agricultural, industrial sites -5 subregional plans -Groundwater research -Water master plan -El Arish detailed plan -Abu Rudeis new town
PHASE II 1987/88- 1991/92	-Irrigated agriculture -Industrial promotion -Manpower and immigration	-Water conveyances -Industries -New towns -Tourist hotels	-Water systems -5 economies -Job creation -Locational patterns -Build local enterprises	-Settlement plans -Irrigated agriculture -Export programs -Watersheds -Social development
PHASE III 1992/93- 2000	-Agricultural processing -Petrochemicals -International tourism -High-tech industry	-Agricultural projects -Energy systems -Heavy industry -Water, sewerage systems -100,000 housing units -Harbors	-One economy -Exports -Maintenance systems -Revenue generation -Preserving high quality of tourism	-Energy after petroleum -Health and education -Sectoral policies -Regional economy -Infrastructure for population beyond one million
PHASE IV After 2000	-Specialized agriculture -Infrastructure -Higher education and research	-Recycle, reuse water -Recreation, conservation -Canal tunnel or bridge -Improved housing	-Style of life -Participation in decisions -Environmental enhancement -Reassign interim Regional Agency to permanent institutions	-Urbanization -Transport and communications -Maintaining economic growth -Aging population -Review subplans and opportunities

Source: Summary of recommendations by the Consultants.

RS-EC-6

New Employment in Leading Sectors, By Phase, Subregion and Zone

Subregion/zone/sector	Total	Through 1991/92	1992/93-2000
NORTHWEST Subregion, subtotal	36,955	19,375	17,580
Northern zone (Port Said), subtotal	8,885	2,385	6,500
Agriculture: El Tina - extensive	5,700	1,400	4,300
(feddans)	(20,000)	(5,000)	(15,000)
Fisheries	2,900	900	2,000
Industry: Food processing	135	35	100
Tourism	150	50	100
(rooms)	(75)	(25)	(50)
Central zone (Ismailia), subtotal	22,110	13,010	9,100
Agriculture*: Area 1 - intensive	3,800	1,400	2,400
(feddans)	(1,900)	(700)	(1,200)
Area 1 - extensive	4,000	1,500	2,500
(feddans)	(14,100)	(5,300)	(8,800)
Area 2 - intensive	3,200	3,200	--
(feddans)	(1,600)	(1,600)	--
Area 2 -extensive	4,100	4,100	--
(feddans)	(14,900)	(14,900)	--
Industry: Qantara food processing	1,400	700	700
Qantara light manufacturing	4,760	1,760	3,000
New Mit Abul Kom food processing	400	200	200
Firdan light manufacturing	150	50	100
Tourism**: Bitter Lakes	300	100	200
(rooms)	(150)	(50)	(100)
Southern zone (Suez), subtotal	5,960	3,980	1,980
Agriculture: Area 3 - intensive	2,000	2,000	--
(feddans)	(1,000)	(1,000)	--
Area 3 - extensive	1,400	1,400	--
(feddans)	(5,000)	(5,000)	--
Industry: Food processing	700	200	500
Light industry	1,460	180	1,280
Tourism***: Ayun Musa	400	200	200
(rooms)	(200)	(100)	(100)

* Not including about 11,000 feddans already under irrigated cultivation in 1983.

** Not including domestic tourist plots--at least 500 through 1991/92 and another 1,500 by the year 2000.

*** Not including domestic tourist plots--at least 1,500 by 1991/92 and another 3,000 by the year 2000.

RS-EC-6 (continued)

Subregion/zone/sector	Total	Through 1991/92	1992/93-2000
NORTHEAST Subregion, subtotal	74,400	44,700	29,700
Eastern zone, subtotal	57,700	31,500	26,200
Agriculture*: Rafah strip - intensive	14,000	14,000	--
(feddans)	(7,000)	(7,000)	--
Rafah strip - extensive	2,200	2,200	--
(feddans)	(8,000)	(8,000)	--
Lower Wadi El Arish - intensive	11,600	--	11,600
(feddans)	(5,800)	--	(5,800)
Lower Wadi El Arish - extensive	3,200	--	3,200
(feddans)	(11,200)	--	(11,200)
Groundwater	5,800	5,000	800
(feddans)	(2,900	(2,500	(400)
Industry: El Arish food processing	2,400	1,200	1,200
El Arish light industry	5,000	2,800	2,200
Sheikh Zuwayid/Rafah			
Food processing	7,000	3,600	3,400
Light industry	2,000	1,000	1,000
Tourism: El Arish/Rafah	4,500	1,700	2,800
(rooms)	(2,250)	(850)	(1,400)
Western zone, subtotal	16,700	13,200	3,500
Agriculture: Intensive	4,000	4,000	--
(feddans)	(2,000)	(2,000)	--
Extensive	5,100	5,100	--
(feddans)	(18,000)	(18,000)	--
Fisheries	1,500	300	1,200
Industry: Salt	300	300	--
Food processing	5,000	3,000	2,000
Light industry	800	500	300
Tourism**			

* Not including about 9,000 feddans already under irrigated cultivation in 1983.

** Not including domestic tourist plots--at least 1,000 through 1991/92 and another 2,500 by the year 2000. Employment to service domestic tourist plots and other beach developments (for instance, at Romana) counted under "derived" employment.

*** Not including domestic tourist plots--at least 1,500 by 1991/92 and another 3,000 by the year 2000.

RS-EC-6 (continued)

Subregion/zone/sector	Total	Through 1991/92	1992/93-2000
UPLANDS Subregion, subtotal	33,550	7,650	25,900
Agriculture: El Sirr - extensive	2,900	--	2,900
(feddans)	(10,000)	--	(10,000)
Gifgafa - intensive	2,000	1,000	1,000
(feddans)	(1,000)	(500)	(500)
Gifgafa - extensive	4,200	2,100	2,100
(feddans)	(15,000)	(7,500)	(7,500)
Wadi El Bruck - intensive	4,000	--	4,000
(feddans)	(2,000)	--	(2,000)
Wadi El Bruck - extensive	6,600	--	6,600
(feddans)	(23,000)	--	23,000
Groundwater (dispersed locations)	12,400	3,300	9,100
(feddans)	(6,200)	(1,650)	(4,550)
Industry: Maghara coal	1,000	1,000	--
Food processing	200	--	200
Other industries	150	150	--
Tourism: Maghara/Quseima/other	100	100	--
(Rooms)	(50)	(50)	--

RS-EC-6 (continued)

Subregion/zone/sector	Total	Through 1991/92	1992/93-2000
SOUTHWEST Subregion, subtotal	26,620	8,050	18,570
Northern zone, subtotal	19,850	4,680	15,170
Agriculture: Abu Rudeis - intensive	2,000	--	2,000
(feddans)	(1,000	--	(1,000)
Abu Rudeis - extensive	1,400	--	1,400
(feddans)	(5,000)	--	(5,000)
Wadi Feiran - extensive	2,300	--	2,300
(feddans)	(8,000)	--	(8,000)
Groundwater	1,900	800	1,100
(feddans)	(950)	(400)	(550)
Industry: Abu Rudeis-Food processing	800	--	800
Light manufacturing	480	180	300
Mineral processing	1,100	1,100	--
Ras Sudr - Food processing	100	100	--
Light manufacturing	560	330	230
Petrochemical/fertiliser complex*	6,790	--	6,790
Mining	2,120	2,070	50
Tourism**: Hamman Faraun, Sarabit El Khadim, etc.	300	100	200
(rooms)	(150)	(50)	(100)
Southern zone, subtotal	6,770	3,370	3,400
Agriculture: groundwater	4,700	2,200	2,500
(feddans)	(2,350)	(1,100)	(1,250)
Industry: food processing	270	270	--
Light manufacturing	880	380	500
Tourism: St. Catherine/Wadi Feiran	220	220	--
(rooms)	(110)	(110)	--
Coast	700	300	400
(rooms)	(350)	(150)	(200)

* Although construction of this complex is projected to start in the late 1980's, all employment is here attributed to Phase III; it may be more realistic to plan for the first 2,000 of more of those jobs before 1991/92.

** Not including domestic tourist plots--at least 1,500 by 1986/87 and another 4,000 by 1991/92.

RS-EC-6 (continued)

Subregion/zone/sector	Total	Through 1991/92	1992/93-2000
SOUTHEAST Subregion, subtotal	8,210	2,680	5,530
Southern zone, subtotal	6,460	1,730	4,730
Agriculture: Groundwater	2,200	500	1,700
(feddans)	(1,100)	(250)	(850)
Industry: Food processing	260	130	130
Light manufacturing	600	200	400
Tourism	3,400	900	2,500
(rooms)	(1,700)	(450)	(1,250)
Northern zone, subtotal	1,750	950	800
Agriculture: Groundwater	200	200	--
(feddans)	(100)	(100)	--
Industry: Food processing	250	50	200
Light manufacturing	200	100	100
Tourism	1,100	600	500
(rooms)	(550)	(300)	(250)

SOURCE: Projections by the Consultants

APPENDIX

LISTS OF REPORTS, MAPS AND FIGURES

RS-32

A. LIST OF REPORTS, WORKING PAPERS AND OTHER WRITTEN SUBMITTALS

LIST A

REPORTS, WORKING PAPERS AND OTHER WRITTEN SUBMITTALS

The Sinai Development Study - Phase I called for the Consultant to deliver certain memoranda, reports and working papers to the Ministry of Development. The following list begins with various reports or papers, many of which were deliverables specifically mentioned in the Contract; the list continues with Working Papers, most of which were optional under the Contract. Included as Working Papers 32-47 are reports submitted as part of the original Draft Final Report of April, 1982, which were later filed as "working papers" when it was decided to recast and rewrite the DFR in 1983, incorporating additional analyses of land capability and spatial alternatiaves while providing a substantially revised synthesis of information in the earlier reports. The last items listed below were submitted to the Steering Committee for review and comment mostly during the period February-May, 1983, while preparing the second Draft Final Report.

Reports and papers

Data List, Planning Information Needs, Draft Data Matrix (January 1981)

Economic Criteria Memorandum (January 31, 1981)

Preliminary Drilling Program for Hydrogeological Investigations (January 31, 1981)

First Project Summaries Report (February 28, 1981)

First Status Report (March 15, 1981)

Early Action Tourism Recommendations (March 31, 1981)

Data List, Planning Information Needs, Draft Data Matrix - Revised (March 31, 1981)

Base Maps and Mapping Standards (Land Capability Analysis) (April 4, 1981)

Tourism Study of North Sinai Coast/Early Tourism Report and Proposal for North Sinai Tourism (January 15, 1981 and May 4, 1981)

Second Project List Report (May 10, 1981)

Well Drilling Program (May 23, 1981)

Meteorology Network Project Discussion (May 24, 1981)

Mapping and Data Collection - Definition of Standards (January 1981 and May 1981)

Map Progress Report (July 7, 1981)

Final Project List Report (October 31, 1981)

Sinai Information System User's Manual, four volumes (April 30, 1982)

Working papers

No. 1 - Sinai Bibliography (December 23, 1980)

No. 2 - Bibliography on Geology and Other Earth Sciences (March 1981)

No. 3 - Bibliography on Nuclear Materials (March 23, 1981)

No. 4 - Sinai Mineral Resource Exploration & Development Plan (April 15, 1981)

No. 5 - Environmental Working Paper (April 28, 1981)

No. 6 - Initial Environmental Examinations Working Paper (April 28, 1981)

No. 7 - Preliminary Summary of Findings on Population in Sinai (June 22, 1981)

No. 8 - Preliminary Summary of Alternative Development Strategies for Sinai (May 14, 1981)

No. 9 - Initial Energy Resources Assessment (May 15, 1981)

No. 10 - Preliminary Tourism Strategy for Sinai and Recommendations for Future Action (June 10, 1981)

No. 11 - Livestock Production in Sinai - A Preliminary Assessment (June 22, 1981)

No. 12 - Agricultural Support Infrastructure in North Sinai (not submitted)

No. 13 - Preliminary Evaluation and Recommendations Regarding Groundwater Conditions at El Arish (June 30, 1981)

No. 14 - Settlement Survey of Social and Economic Activity in Sinai (August 12, 1981)

No. 15 - Energy Resource Assessment and Energy Requirement Evaluation (August 31, 1981)

No. 16 - Recommended Physical Planning Standards for Development of Major Sinai Settlements (September 26, 1981)

No. 17 - Draft Monograph (August 19, 1981)

No. 18 - Crop Production in Sinai (September 26, 1981)

No. 19 - Controlled Environment Agriculture in Sinai (October 1, 1981)

No. 20 - Status Report on Alternative Development Strategies for Sinai (September 30, 1981)

No. 21 - Desalinization Possibilities in Sinai (not submitted)

No. 22 - Shifting Sands in Sinai (not submitted)

No. 23 - Agriculture Potential and Prospects in Sinai (October 11, 1981)

No. 24 - Review of Existing Sinai Transport Systems (October 29, 1981)

No. 25 - Sinai Cloud Seeding Potential (November 21, 1981)

No. 26 - Aspects of Land Settlements in Sinai (November 19, 1981)

No. 27 - A Summary Statement on the Industrial Sector (November 16, 1981)

No. 28 - Inventory of Tourism Places of Interest in Sinai (December 21, 1981)

No. 29 - Land Classification and Capability in Sinai (December 31, 1981)

No. 30 - The Public Administration of Development in Sinai: Current Practice (December 31, 1981)

No. 31 - Review of Migration Movements in Egypt with Policy Implications for Sinai Development (February 1, 1982)

No. 32 - Draft Report on a Development Strategy for Sinai (April 1982)

No. 33 - Water Resources (April 1982)

No. 34 - Hydrogeological Information Cards (April 1982)

No. 35 - Agriculture and Fisheries (April 1982)

No. 36 - Industry (April 1982)

No. 37 - Minerals (April 1982)

No. 38 - Energy (April 1982)

No. 39 - Tourism (April 1982)

No. 40 - Population Issues (April 1982)

No. 41 - Environment (April 1982)

No. 42 - Fourth Project List and Studies (April 1982)

No. 43 - Index to Map Standards and Glossary (April 1982)

No. 44 - Information Management (April 1982)

No. 45 - Preliminary Map Portfolio (April 1982)

No. 46 - Public Administration (April 1982)

No. 47 - Community and Regional Infrastructure (as observed in Mid-1981) (April 1982)

Papers submitted for review and comment in 1983

Revised Map Standards (February 6)

Initial Data Book (February 16)

Land Capability Findings, including a Technical Annex with 22 colored Maps (February 26)

Outside Factors that Influence Sinai Development (February 27)

Draft Statement of Goals and Objectives (March 7)

Alternative Strategies for the Development of the Sinai Peninsula until the Year 2000, with two Technical Annexes (March 7)

Trade-Offs Among Development Objectives (March 16)

Second Status Report, including an Annotated Outline of the Second Draft Final Report (March 17)

Preferred Strategic Path to Development (March 28)

Spatial Strategy Maps and Physical Plans (March 10 and 30)

A Short List of Goals for Sinai's Development until the year 2000, following evaluation of responses to a March 16 questionnaire on the Relative Importance of Regional Objectives (March 30)

Agriculture and Tourism Issues (April 10)

Land Capability Worksheets for El Arish, Great Bitter Lake, Ayun Musa, Ras Taba, Abu Rudeis and Nuweiba (April 19)

Tourism Land Capability Analysis (April 20)

Tourism "Desk Top" Studies (April 30)

Goals Evaluation of the Recommended and the Alternative Sinai Development Strategies (April 30)

Note on the Preferred Strategy, containing preliminary projections regarding land use, employment, population and investment costs as well as illustrative maps (May 24)

Comments on Port Said Governorate Projects in Sinai (November 17)

Note on Investment Requirements and Financing for the Strategy Recommended to Settle Sinai (December 8)

B. Lists of Maps and Figures

B-1 Figures Included in the Final Report (March 1985)

B-1-1 A Strategy for the Settlement of Sinai (Volume I) AP-6

B-1-2 Managing Sinai's Development AP-7

B-1-3 An Economic Development and Investment Plan, 1983 to 2000 (Volume III) AP-8

B-1-4 The Land and the Environment (Volume IV) AP-9

B-1-5 Water Supplies and Costs (Volume V) AP-10

B-1-6 Settlement and Social Development (Volume VI) AP-12

B-2 Plates Included in the Preliminary Map Portfolio, (Working Paper No. 45, April 1982) AP-13

B-1-1 List of Figures in Volume I:
A Strategy for the Settlement of Sinai

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