Land-Use Evolution and Consequences in the Mediterranean Coastal Region of Egypt

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ABSTRACT

The increasing human pressure concurrent with recent socioeconomic changes in the Mediterranean coastal zone of Egypt effectuated fast development of land-use practices. Clearing of natural vegetation for use as fuel wood and for agricultural purposes (cultivation of fruit trees and cereal crops) is conflicting with the mobility necessary for the rational traditional system of grazing, beside other land-use practices and activities of better income for inhabitants. The analysis and comparison of the present (1979) land-use patterns with those of thirty years ago, based on aerial photographs and field mapping provide evidence of the consistent specialization of various sectors of land for particular land-use practices. Such specialization may be attributed largely to certain socioeconomic changes and to the unsuccessful spontaneous extension of agriculture to certain sites. This specialization does not halt the ongoing processes of environmental degradation.

The assessments of the sensitivity of soil and vegetation, and the suitability of different ecosystems to different land-use practices, provide a means for the analysis of actual and potential sensitivities of ecosystems to degradation factors and to the risks and transformations that the ecosystems can withstand.

INTRODUCTION

The main aim of this paper is to provide a broad data base about the management of land resources in the rural areas of the western Mediterranean coastal region of Egypt. To achieve this aim, we had to meet the following objectives:

a. analysis of the process of change in agricultural practices in the region, through the activities of the local populations; and
b. assessment of the various effects of the evolution of such process.

Location and Brief Description of the Test-Area

El Omayed, the selected test-area, (about 5,000 hectares), may be considered representative of a more extended territory in the Western Coastal Desert of Egypt which covers about 1,000,000 hectares from Alexandria to Sollum (Figure 1).

As elsewhere in this region, El Omayed test-area has an arid Mediterranean climate. Rainfall is low (about 150 millimeters per year), strictly seasonal (mainly during winter) and uneven in distribution. The harsh conditions resulting from lack of rainfall and high radiation are tempered, however, by the maritime influence of air temperature and humidity. The Mediterranean coastal region of Egypt lies in Meig's warm coastal deserts (1) and belongs to the dry climatic zone (Bwh) of Koppen's 1931 classification system [as quoted in (2)], the meso-thermal province of Thornthwaite (3) and the Mediterranean arid bioclimatic zone of Emberger (4).

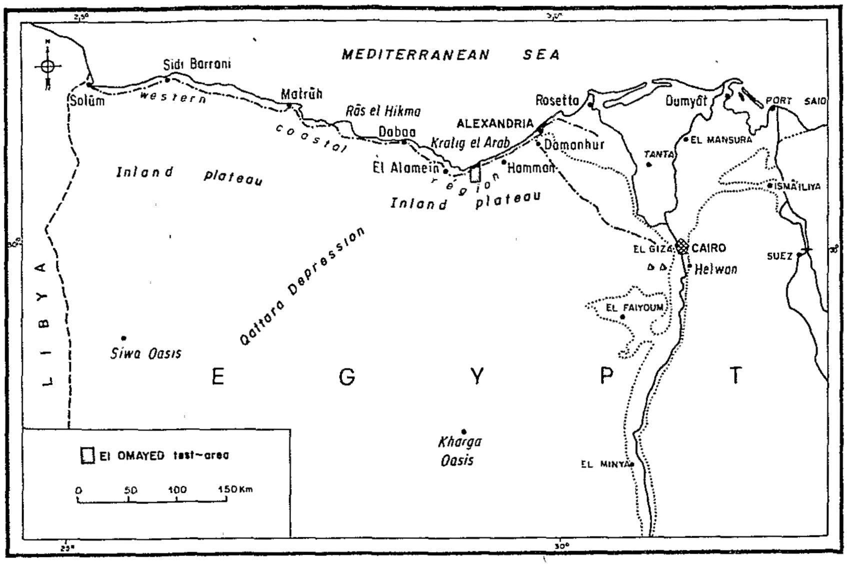

Figure 1. Location of El Omayed test-area in the western coastal region of Egypt.

As elsewhere in the coastal desert of Egypt, the population of El Omayed test-area is organized in tribes. Every tribe is divided into subtribes. Land is divided between these population groupings according to tradition, size of grouping and its influence, and the conflicts between tribes and subtribes.

Vegetation in the region is mainly steppic and the main types are related to the physiographic, hydrologic, edaphologic and land-use conditions (5).

In the extended territory represented by the test-area, the topography becomes higher from the coast inland in an irregular fashion (Figure 2). The relief is characterized by successive undulations running more or less parallel to the coast. These undulations are calcareous rocky ridges (ancient dunes) alternating with depressions. Several ridges start near Lake Mariut and become gradually less obvious toward the West.

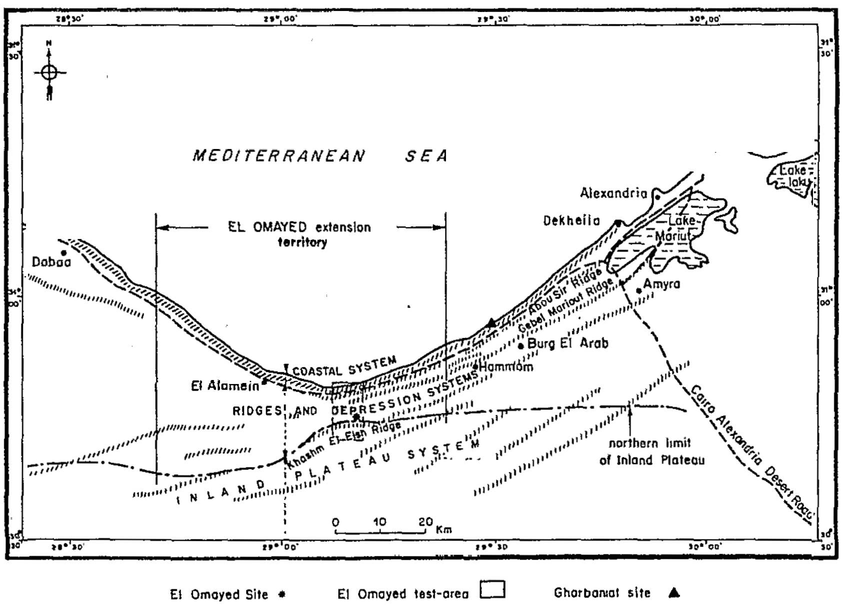

Figure 2. Location map of El Omayed test-area and extension territory.

The main features of the various physiographic units (Figure 3 and Table 1) lead to the distinction of three major systems:

a. **coastal system**, which covers a small part of the territory, including the beach and the coastal sand;
b. **ridges-depressions system**, which constitutes the main part of the territory including ridges, their gentle slopes, and the more or less large depressions; and
c. **inland plateau system**, which is close to the inland desert.

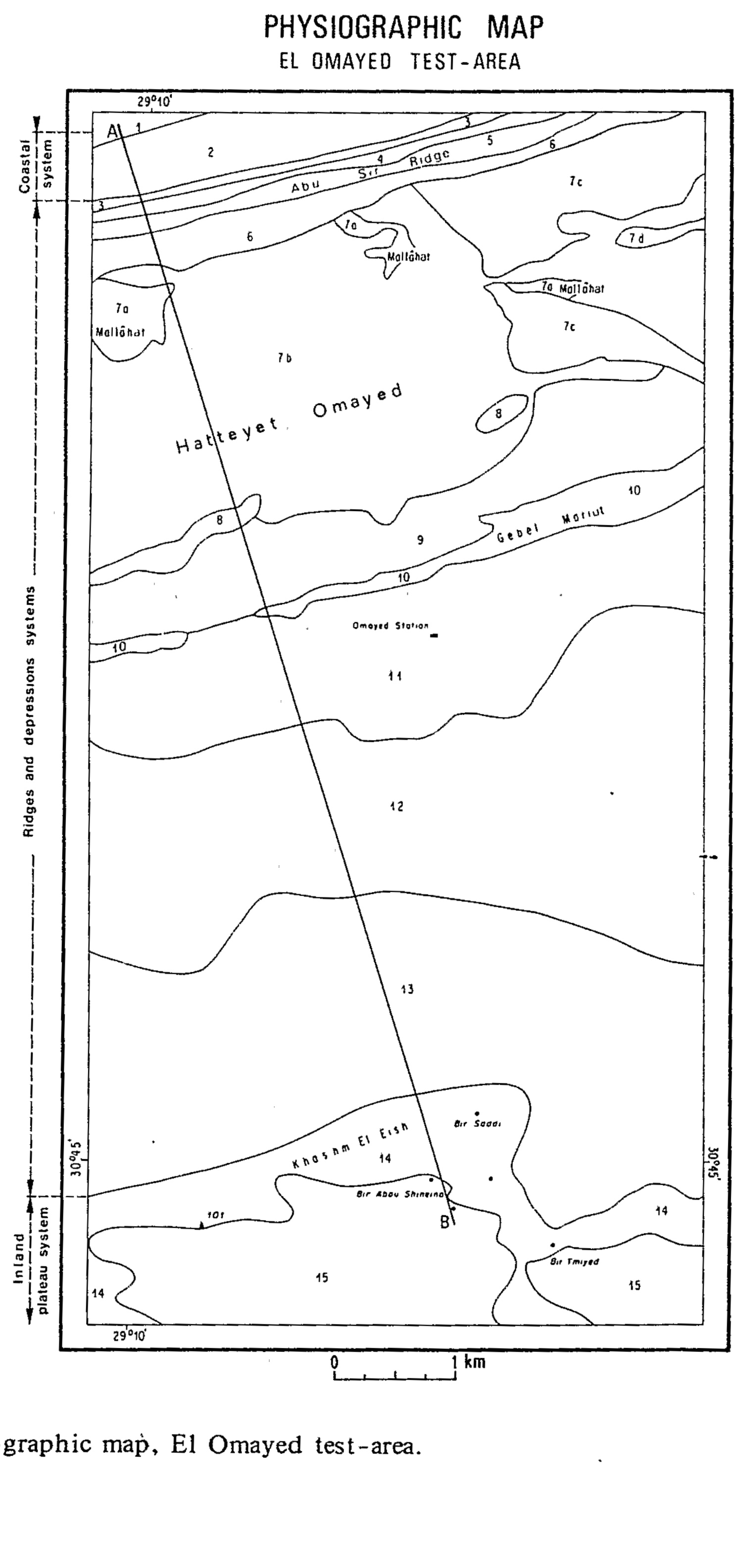

Figure 3. Physiographic map, El Omayed test-area.

Table 1. Summarized legend of the physiographic map (Figure 3).

	No. of unit on the map		Designation of the unit	Main geological and geomorphological features
Coastal system	1		Beach	---
	2		Coastal sand dunes	Present active dune on consolidated material
Ridges and depressions systems	3		First depression	Flat and stretched depression (sand deposits)
	4		Northern slope of first rocky ridge	Hillside (sandy colluviums)
	5		First rocky ridge	Summit of stretched hill (oolithic limestone, ancient consolidated dune)
	6		Southern slope of first rocky ridge	Hillside (sandy colluviums)
	7		Saline depression	
		a	Salt-marsh	Waterlogged depression (loamy and clayey sand)
		b	Hummocky depression	Flat area, locally waterlogged, with numerous sandy hummocks
		c	Sandy meso-deposit	Gentle and irregular sloping sandy hill
		d	Sandy indurated convexity	Low and stretched convexities (indurated sand)
	8		Second rocky ridge	Summit of stretched hill (oolitic limestone, ancient consolidated dune)
	9		Interridge sandy slope	Gentle sloping surface overlain by drifted sand
	10		Third rocky ridge	Summit of stretched hill (oolitic limestone, ancient consolidated dune)
	11		Southern sandy slope of third rocky ridge	Gentle sloping surface overlain by drifted sand with some small convex strongly indurated surface
	12		Nonsaline flat depression	Plain more or less drifted
	13		Sandy glacis with gullies	Sandy glacis dissected with gullies in the upper part
Inland plateau system	14		Cliff and outcrop of inland plateau system	Cliff with outcrop of calcareous sandstone and stretched and gentle sloping inland plateau
	15		Undulating sandy surface	Slighty undulated surface with drifted sand

Figure 4 shows the relative locations of these three major systems, and the distribution of the physiographic units on a topographic transect from the seashore, in the North, to Khashm El Eish ridge in the South.

METHODS

An ecological diagnosis of vegetation and land use and the relevant thematic mapping were carried out. This survey was conducted in order to determine

- the spatial organization of the physiographic units and their reciprocal relationships according to the pattern of variability of their characteristic features and parameters;
- the spatial and temporal variability in landscape systems by analyzing the past (1954, 1962) and present (1979) land-use patterns on aerial photographic imageries; and
- the location and intensity of current environmental deterioration processes, to provide a base for analysis of the present and potential sensitivity of the environment.

RESULTS AND DISCUSSION

Recorded data indicate a severe progressive evolution of ecological conditions due to changes in human pressure. Such evolution is expressed in the modification of the type of habitat (Table 2). It is obvious that there is almost a complete loss of mobility of human population. Sedentariness furnishes the possibility for inhabitants to develop other agricultural activities, and to disengage labor forces for nonagricultural activities (such as trade and quarries).

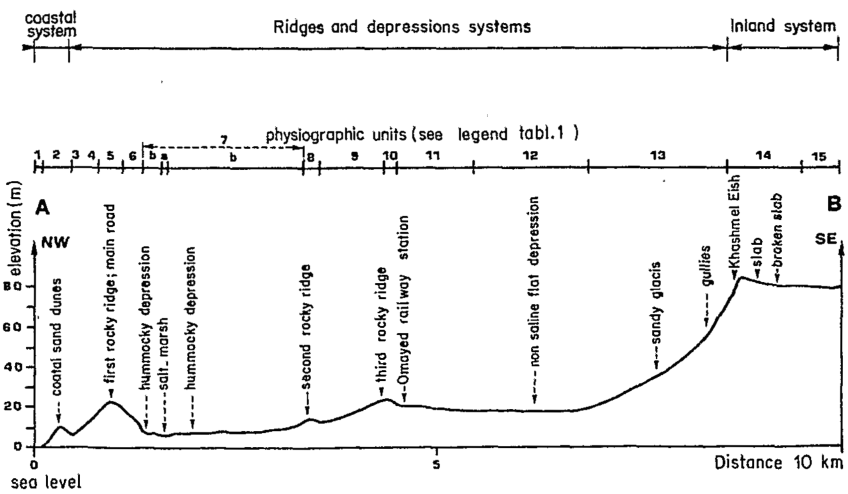

Figure 4. Location of physiographic units along a topographic transect from the sea to Khasm el Eish (El Omayed test-area).

The agricultural activities in the area are: pastoralism in rangelands, rain-fed cereal cropping and fruit tree plantation (mainly figs, but also olives).

Table 3 indicates a present competition for space; although rangeland still constitutes the predominant type of land use, it is evident that cultivation of fruit trees is increasing rapidly.

Table 2. Evolution of the number of tents and houses in El Omayed test-area from 1954 to 1979.

Habitat types (number)	1954	1962	1979
Tents	55	30	2
Houses	4	12	50

Table 3. Evolution of land use (in ha) in El Omayed test-area from 1954 to 1979.

Land-use types	1954	1962	1979
Rangelands	4,625	4,344	4,168
Cropping lands	244	356	273
Orchards	104	275	531

Such facts have to be analyzed in more detail. Table 4 includes data on the evolution of land use as related to the physiographic units, which may provide good information about such evolution in the past and in the future.

It seems that the inhabitants who have been changing their living conditions from pastoralism to agricultural practices, such as cropping and planting trees, must have done their empirical "experimentation" or acquired appropriate knowledge about their "new lands."

We may also note that there has been specialization of land utilization of various units:

- all units (except rocky ones) have been once cropped with or without failure;
- in situations where crops have acceptable yields, other practices (for example, fig plantation) were sometimes tested and, if relevant, they were often extended. This view is supported by the fact of the recent but fast trend of fig plantation already described. Economic and sociological advantages are higher for fig income than for barley income, which is progressively abandoned or is only used for testing of ecological possibilities of different areas;
- some locations may be suitable for cropping, which, for instance due to the high level of water table, may be inadequate for tree plantation; and
- under some conditions, when crop farming was unsuccessful, it was abandoned and not followed by fruit tree plantation.

Table 4. Evolution of land use (1954, 1962, 1979) in percentage of the area of each physiographic unit (in El Omayed test-area: 5,000 ha).

Physiographic units (see Table 1)	Area (ha)	% of each physiographic unit under different types of land use								
		Rangelands			Cropping lands			Orchards		
		1954	1962	1979	1954	1962	1979	1954	1962	1979
1	17	0	0	0	0	0	0	0	0	0
2	126	73	73	73	0	0	0	27	27	27
3	27	50	0	0	50	46	46	0	54	54
4	34	82	82	48	18	82	46	0	0	6
5	62	100	100	100	0	0	0	0	0	0
6	102	92	46	61	5	26	11	3	28	28
7a	60	100	100	100	0	0	0	0	0	0
7b	844	88	88	81	11	8	14	1	4	5
7c	219	64	32	0	21	42	0	15	26	100
7d	9	100	100	100	0	0	0	0	0	0
8	27	100	100	100	0	0	0	0	0	0
9	316	90	60	40	9	22	22	1	18	38
10	98	100	100	100	0	0	0	0	0	0
11	504	96	91	90	2	6	5	2	3	5
12	927	100	99	99	0	1	0	0	0	1
13	934	97	92	94	2	5	3	1	3	3
14	276	100	100	100	0	0	0	0	0	0
15	408	95	100	100	5	0	0	0	0	0

The increase in area of crop farming and tree plantation is certainly linked with the requirements of the population and with the ecological possibilities of every physiographic unit. Transformation reflects the ecological potentialities of every unit. For instance:

- orchards are abundant in deep sandy soils, close to the main road;
- orchards (and houses also) exist in unit 6, thanks to the windscreen offered by the first rocky ridge;
- in unit 13, orchards and crops settled in the lower portion where they may benefit from run-off water supply; and
- there are no orchards or crop plantations in unit 12 due to the presence of a calcareous crust (locally salt affected) close to the surface.

Therefore each unit could be characterized by constraints and/or advantages. Changes in land use take this into account along with other variables of the economic structure (such as labor force) on which the system of production is based.

This evolution described for the past few decades would influence the evolution during the following decades. Thus, even if the location of each type of land use is apparently optimal for the requirements of the local population, this may induce a high level of human pressure which results in the degradation of some biotic and abiotic resources.

It is well known that environmental deterioration may be anticipated in terms of current processes: impoverishment of the natural plant cover, increase of aeolian deposits, and alteration of soil surface by deflation and water erosion on foothills and glacis, etc.

The main factors of environmental deterioration in the test-area are the following:

- overgrazing and extensive wood cutting (eradication of woody species for fuel consumption);
- spreading of cultivation to previously uncultivated areas (mostly rangelands), and frequent plowing every year for cropping as often as required to get rid of weeds in orchards; and
- misuse of land around human settlements (such as houses, tents, stabling of livestock).

These processes are not exhibited everywhere with the same intensity, and it appears that different types of ecosystems are not equally sensitive or susceptible to the factors of environmental deterioration. Sensitivity depends in fact on two combined criteria. The first criterion is the vulnerability of land to degradation. The degree of vulnerability depends mainly on the method and magnitude of exploitation of resources; but it can also be related to the following features:

- natural vegetation--physiognomy (dominant plant forms), plant cover, capacity of regeneration, etc; and
- soils--topographic position, soil depth, soil structure, etc.

The second criterion is the attractivity of site for land use. Some areas are more or less attractive for various human activities. This leads to differences in the intensity of exploitation. The level of attractivity may be linked to several features, such as

- type of land tenure and type of system of production;
- vicinity of watering points, road and human settlements; and
- the possibility of mechanizing agricultural practices (such as plowing).

These two concepts "vulnerability" and "attractivity" may be combined to provide an assessment of the "present sensitivity" taking into account the environmental risks of the current practices in land development. It appears clearly that, even under conditions of the present practices and the present level of human pressure, about 80 percent of the study area is at least highly sensitive, and that environmental deterioration may be generalized to the total area. Therefore, it is urgent to plan for a drastic change in the trend of the present land-use and systems of production.

Considering on the one hand a multicriterion approach (present sensitivity, land resources, carrying capacity), and on the other hand, labor force and population requirements, it is possible to provide a comprehensive ecological assessment of renewable resources, which could be used by decision makers in the potential development of land.

CONCLUSIONS

The current evolution of various features and parameters proposed for a comprehensive assessment of evolution of land use in the study area indicates that the present level of human pressure is leading to significant deterioration of the environment. The study of the effects of human practices and their impacts may provide very useful information for land managers and decision makers concerned with optimal allocation of resources and rural agricultural production. Through appropriate incitements, as introduction of irrigation water to suitable soils, land development may, in fact, contribute to the improvement of agricultural practices, and to the evolution of ecosystems to better ecological conditions. The consequences of these incitements may be analyzed through

- impacts on main ecological features;
- effects on the future of resources; and
- results concerning the socioeconomic situation of land users.

Without such an approach the continuation of present practices, along with the maintenance of the present land use system--which places economic concerns before population requirements--means the extension of cereal and fig cultivation in addition to overgrazing and severe uprooting of plants, thereby promoting the degradation processes.

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