

## Geographic Mapping and Analysis Using GIS of Study Areas in Bahariya Oasis, Egypt

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**Abstract:** Geographic database techniques offer powerful capabilities to manage and integrate vast amounts of environmental data. In this research, ArcView GIS system is used to perform the geographic and physiographic maps. Egypt has directed major efforts to explore the natural resources in the Western Desert Oases. In this accord, the main aim of this study is to produce geomorphologic geometric maps that are expressing the landscape conditions and different landforms available in the selected study areas in Bahariya Oasis. These maps can be used as the basic geo-referenced documentations for the land evaluation decision support system. Concerning the thematic maps, database and climatic data were available. Based on the digitized aerial photo interpretation and field check of the plot study areas, the workable physiographic legend was formulated. In this legend, a geomorphologic approach was applied up to the level of landform features available in the area. Four different landscapes have been recognized in the study area including Hilland, Plateau, Peneplain and Plain that were divided into 6 repeated relief types, each of which were further subdivided based on lithology/origin and finally 27 landforms were distinguished in the area.

**Key word:** Geomorphologic approach . Physiographic maps . GIS . Bahariya oasis

### INTRODUCTION

The Bahariya depression is a natural excavation in the central part of the Egyptian Western Desert, some 130 km west of El-Minia governorate in the Nile valley and about 360km S-W of Cairo. It situated essentially between 27°48' and 28°30'N and 28°29' and 29° 08' E. It comprises an area of approximately 2250 km<sup>2</sup> (Fig. 1) [1].

Bahariya Oasis faces a sever constraint in the availability of good agricultural land. This is further aggravated by the scarcity of irrigation water and suitable soils under the aridic conditions of the area.

It is obvious that land use planning has to be adapted. Storing data files in a digital geographically correlated format is considered of prime importance for the successful management of the natural resources [2]. This study clearly shows that the Geographic Information System (GIS) constitutes an efficient and versatile tool to manipulate and produce physiographic maps of the selected plot areas within Bahariya depression that are needed for decision system.

### MATERIALS AND METHODS

The thematic maps of topographic, geologic and lithologic maps were obtained. Aerial Photographs with



Fig. 1: Location of Bahariya Oasis (IDSC, 2000)

scale (1:10,000) dated in 1998 were used for interpretation. The photographs were studied stereoscopically using the geopedologic approach as detailed by Zinck [3]. The resulted photo-interpretation maps were projected over a recent topographic sheet, scale of 50,000 [4].

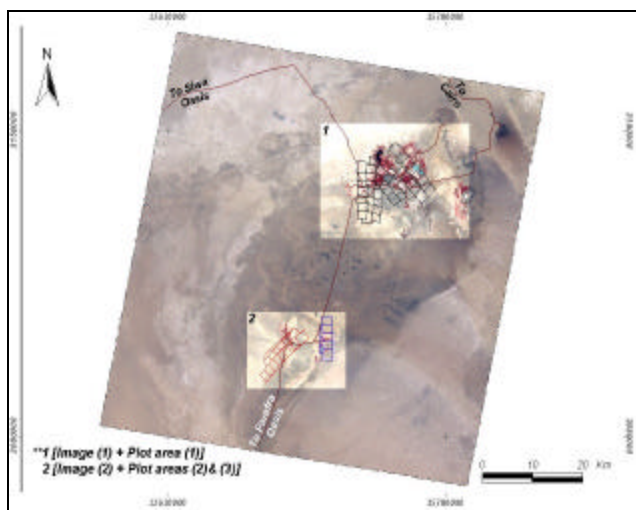


Fig. 2: The satellite image of Bahariya, showing plots 1 and plots 2 and 3 located in North and South Bahariya according to Darwish [5]

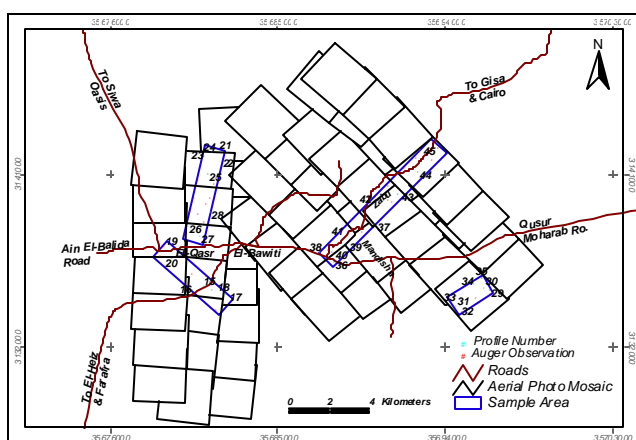


Fig. 3: Photo Index Map (PIM) of Plot area 1 in the Northern part of Bahariya Oasis, with the locations of soil profile and auger observation. (Surface area = 198.03 km<sup>2</sup>) according to Darwish [5]

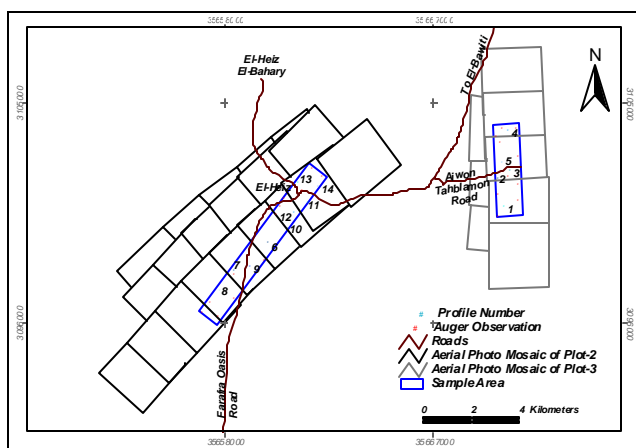


Fig. 4: PIM of Plot areas 2 and 3 in the Southern part. (Surface area of Plots (2) and (3)= 53.62 and 24.17 km<sup>2</sup> respectively) according to Darwish [5]

The geopedologic approach is based on a hierarchical system with six taxonomic levels the following of which have been used in the present study: Landscape; Relief type; Lithology and Level 1-of Landform. A loose mosaic of alternate photos was laid out first and then the major landscapes and topographic features were identified to produce the initial land type maps.

After the interpretation of the aerial photos, selections of the sample area locations were planed (Fig. 2). It was mainly designed in order to cross the majority and check the accuracy of different mapping unit boundaries. Total of six sample areas were selected with a fixed wide of 1km for each (Fig. 3 and 4). The accessibility to these sample areas was also much considered.

The aerial photos available were covering three main unconnected distinguish areas. One in the Northern part of Bahariya, which is covering most of the villages located there, i.e., (El-Bawiti, El-Qasr,

Zabu, Mandisha and El-Ayun). Two others located in the southern part.

## RESULTS AND DISCUSSION

Principally, the area under investigation consists of four main dominant landscapes. These are; flat to almost flat Plain, gently undulating to undulating Peneplain, moderately to highly dissected Plateau and undulating Hilland with isolated conical hills distributed all over the depression of Bahariya (Table 1).

**Hilland:** In this research, as a result of the aerial photo interpretation most of the distinguished hilland landscape area is distributed within the study plot area-1. It is occupying a surface area of 29.07 km<sup>2</sup> (Fig. 5).

It includes two relief types called “undulating” and “steeply dissected” coded as Hi1 and Hi2 respectively. Dominant slopes range from 5 to 30% and altitude ranges from 15 to 150m ASL.

Table 1: Physiographic legend of the selected plot areas in Bahariya Oasis according to Zinck [3] and Darwish [5]

Land-scape	Relief	Lithology/Origin	Landform	Mapping unit	Area (km <sup>2</sup> )	Area (%)
Plain Pa	Flat to Almost Flat Pa 1	Fluviatile Sandstone Pa 1	Relatively Low Sand Flat	Pa111	13.65	4.95
			Relatively High Sand Flat	Pa112	12.52	4.54
		Basalt Pa 2	Sand Sheet	Pa121	12.16	4.41
			Sand Flat	Pa122	15.94	5.78
		Ferruginous Intercalations Pa 3	Alluvium Valley	Pa131	1.29	0.47
			Colluvio-Valley	Pa132	0.78	0.28
			Colluvio-Alluvium Fan	Pa133	0.58	0.21
			Depression	Pa134	0.37	0.13
			Playa	Pa135	24.72	8.96
	Gently Undulating to Undulating Pa 2	Estuarine Sandstone Pa 4	Desert Pavement	Pa241	12.33	4.47
			Sand Bar	Pa242	1.83	0.66
			Sand Dune	Pa243	5.70	2.07
	Undulating to Rolling Pa 3	Aeolian Sandstone Pa 5	Wadi	Pa251	9.78	3.54
			Ridge	Pa351	2.02	0.73
			Isolated Conical Hill	Pa451	1.91	0.69
Pene-plain Pe	Flat to Almost Flat Pe 1	Fluviatile Sandstone overlain by	Sand Sheet or Flat	Pe111	10.20	3.70
	Gently Undulating-to-Undulating Pe 2		Estuarine Sandstone and Shale Pe 1	Rock out crop	Pe211	20.33
	Undulating to Rolling Pe 3		Depression	Pe212	1.54	0.56
			Ridge	Pe311	0.32	0.11
			Rock out crop	Pe312	10.35	3.75
	Rolling Pe 4		Isolated Conical Hill	Pe411	0.30	0.11
	Plateau Pu	Flat to Almost Flat Pu 1	Limestone and Dolomite overlain by Shale and Sandstone Pu 1	Top surface (Trade)	Pu111	7.30
Gently Undulating to		Footslope		Pu211	50.23	18.21
Undulating Pu 2		Colluvium Fan		Pu212	2.57	0.93
Steeply Dissected Pu 3		Escarpment		Pu311	20.59	7.46
Hilland Hi	Undulating Hi 1	Limestone and Dolomite overlain by Shale and Sandstone Hi 1	Summit	Hi111	3.80	1.38
			Footslope	Hi112	20.79	7.53
	Steeply Dissected Hi 2		Escarpment	Hi211	4.48	1.62
Settlement S.T.					6.71	2.43
Water body WB					0.80	0.30
Total area					275.89	100.0%

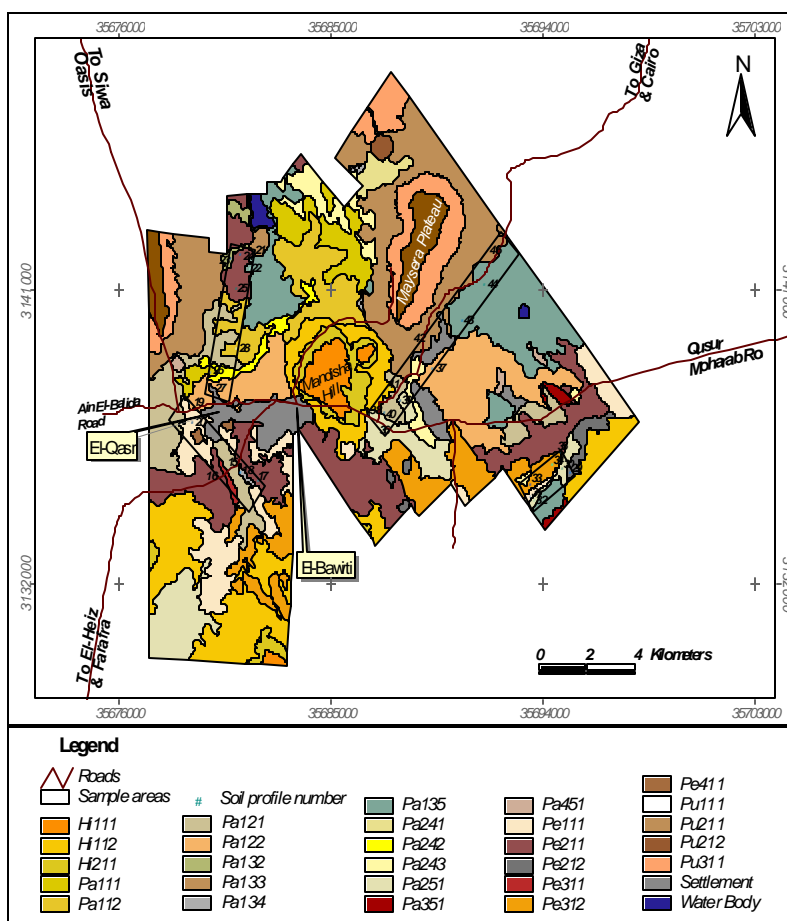


Fig. 5: Physiographic map of plot area-1 in the north of Bahariya according to Darwish [5]

**Plateau:** It is occupying a surface area of 80.7 km<sup>2</sup>. It includes three relief types as; flat to almost flat coded Pu1, which is formulating the plateau trade surface landform. Gently undulating to undulating relief type (Pu2) is distributed into the plateau footslope and colluvium fan landform features.

Steeply dissected (third relief type with a code of Pu3 and geo-formation the steeply dissected escarpment, which is surrounding the entire depression sides (Fig. 1).

Considerable large part of the flat footslope is been used as cultivated lands as well. Dominant slopes are ranged from 2 to 6%, but reach > 30 % in the steeply dissected escarpment.

**Peneplain:** Peneplain is a gently undulating land portion, characterized a pervasive repetition of low hills, rounded or elongated with summits of similar height, separated by a dense, reticular hydro-graphic network. They form either by dissection of a former plain or plateau, or by down-wasting and flattening of an originally rugged land surface [3]. In the case of



Photo 1: The Peneplain landscape portion with its landforms that used for agricultural activities

Bahariya depression, it is believed that this landscape portion was formed of a former plateau [1].

It is occupying about 43.04 km<sup>2</sup> of the interpreted plot areas. It is subdivided into four relief types coded as Pe1, Pe2, Pe3 and Pe4 respectively. In this landscape, the most parts of flat to almost flat relief type that represented by sand sheet and or flat landforms are used for agricultural activities (Photo 1).



type, slope percentage, lithology/origin, landform, drainage conditions and land use. It is found that the plain and penepain landscapes, wherever flat, have good quality soil and are mostly cultivated based on the availability of water. The information needed to carry out a land evaluation for land use planning can mainly be extracted from the physiographic maps to which some information including land use, slope and agro-climatic conditions are added.

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