

Land Planning for Sustainable Development of Mersa Shaa'b Area, Southeastern Desert of Egypt

An Integrated RS and LIS Approach¹

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1. Abstract

The Halieb -Shalatien district represents one of the selected areas for sustainable development in south Egypt. It covers about 35000 km². The reconnaissance soil survey of this region reveals that the most suitable areas for agricultural development are located in the coastal zone (Sahl El Wadaa). It consists of a number of deltas, plains and wadi formations. Mersa Shaa'b area is selected for detailed studies using different remote sensing techniques. Interpretation of Landsat TM image produces a geomorphological map at a scale of 1:100000. Field investigations and laboratory analysis enable to produce a soil map of the area that shows the characteristics and distribution of different soil types. The soils were classified according to the U.S. Soil Taxonomy (1996). Supervised image classification enhanced the mapping of the existing soil units. Then, a parametric land capability classification model is applied to evaluate the different mapping units and determine their suitability for sustainable agricultural development. Recommendations for protecting the natural resources of the coastal region are outlined.

Key words: Remote sensing, land resources, soils, Mersa Shaa'b, Egypt.

2. Introduction

The Delta of Mersa Shaa'b in the southeastern desert of Egypt represents one of the promising areas for sustainable development in the coastal area of the Red Sea. The study area covers about 3000 km², and is located between Latitudes 22 30-23 00 N, and Longitudes 35 30- 36 00 E. The climatic condition is arid with winter thunder storms on the adjacent mountainous area that reach about 30 mm/day, causing severe flash floods. The mean temperature is about 31 C in summer, and 20 C in winter. Human activities are mainly grassing and fishing. No agricultural activities were noticed in the area,(NARSS 1996). Few studies have been published about this area, mainly focused on the geology and mineral resources (Ramadan et. Al., 1996 ; El Rakiby et.al,1996; and Basta and Saleib 1971). However, Zaghloul (1996) and Hammad (1994) explored the water resources of the area through geological and hydrological investigations and concluded that:

- groundwater resources can be present in four types of rocks, namely ; fractured basement, Nubian cretaceous sandstone, Miocene limestone, and Wadi deposits.
- the ground water of the fractured basement rock would have the best water quality of the four types.

¹ This work has been carried out in cooperation with NARSS.

- the groundwater of the Delta and Wadi regions are highly saline (5000-17000 ppm) due to sea water intrusion and the presence of old saline sediments and evaporates.
- the discharge is limited and depends on the precipitation in the mountainous region.
- water produced by the desalinization plants is slightly saline.
- some wadis have a high potentiality of run off water, which must be controlled by construction of dams and dykes.

Generally, more studies are required including establishment of a meteorological station for climate monitoring and the digging of some test wells. The utilization of remote sensing and GIS technologies for the assessment of natural resources in Egypt has been addressed by many authors, (Abdel Rahman and Sadek, 1991; Abdel Rahman et al, 1995; Abdel Rahman and Onsi, 1996). The aim of this paper is to present the capabilities of Remote Sensing technology and information systems for mapping and evaluating the land resources of Marsa shaa'b area.

3. Environmental Setting

Geomorphology: The landforms of this area can be divided into three groups: the bahada plain, faulted mountains and hills, and Coastal forms. The bahada plain is formed by the alluvial fans of the wadis Meisa, Adib, Shaa'b, Sifeira and some other smaller wadis. Drainage lines dissect this plain. Faulted mountains and hills project from the bahada surface specially in the western part, of which Gebel Homra Dom (390 m) is the largest and highest. G. Homra Dom is a part of a larger block to the east; there is another low hilly block (150 m) crossed by wadi Meisa. In the northern part, several volcanic hills extend along a line trending NNW. These hills are the southern group of hills of the same origin and appear on the two plates of Wadi Hodean and Shalatein.

Lagoons, spits, hooks, coral reefs and sabkhas developed along the Red Sea coast. The largest lagoon is that one lying between Marsa Shaa'b and Marsa Adu Suma (10 Km long). In this locality, several smaller lagoons developed within the complex of spits and hooks that separate the large lagoon from the sea. Other lagoons with irregular shape formed to the North of Marsa Abu Suma and to the South of Marsa Shaa'b. Coral reefs (bluish tone) occur along the marine margins of the coastline. Inland, coastal sabkhas occupy a narrow strip except for the area lying to the South of Marsa Shaa'b where the sabkha width is about three kilometers.

Geology: Quaternary deposits include the fluvial sediments of the bahada and the coastal sediments of the barriers and sabkha. Faulted mountains and hills are formed of basement and volcanic rocks. Pink "younger" granite in the block of Gebel Homra Dom, while metamorphic and grey "granite" dominate the area west of the Homra block. Tertiary volcanic rocks occur in the hills in the NW part. In addition to secondary fractures and faults, a major fault striking NNW is bounding the eastern side of the volcanic hills and G. Homra Dom. Basement rock may contain mineral ores such as Titanium that has been found in G. Homra Dom.

Soils, water and vegetation: Soils are either of fluvial or sabkha origin. The fluvial soils are those of the bahada and are coarse textured. The sabkha soil is composed of fine material and is always damp with a high salt content. Underground water is scarce in the area. Bir El-Hasa and Bir El-Khor are the only wells. Salt-tolerant vegetation grows along the coastal strip, around the sabkha margins and wadi mouths.

4. Materials and Methods

- Satellite imagery: Landsat-5 Thematic Mapper data cover of the study area was used. The data were collected in 6/7/1993 and the scene center was; Path (172), Row (44/45).
- Digital Image Processing: The distributing technique was used to improve the quality of raw data, which are received from the ground stations. Geometric correction using control points on the available topographic maps of the area. Mosaiking and radiometric balance and high pass filter methods were used to improve the final products of the false color composites FCC bands 2, 4 and 7 used for visual interpretation. Non supervised and supervised classification techniques were used to discriminate between the different soil types within the mapped units.
- Field studies and sampling: Field investigation for ground truth, using ground-positioning system GPS, was carried out for selection of the training sites. About 25 sites were visited, where soils and water samples were collected for analysis and characterization of minerals, soils, and water resources.
- Land Evaluation: A parametric Land Classification System (NARSS 1995) was applied to evaluate the existing land resources for agricultural use. Then, a land suitability model (Abdel Rahman et al 1989) was applied to select the suitable cropping system for the area.

5. Results and discussion

5.1 Assessment and Mapping of Land Resources :

The interpretation of Landuse Thematic Mapper data, FCC 2,4,7, was found to be very useful for producing thematic a map showing the main landform units, soil types and drainage pattern of Marsa shaa'b. A soil map at scale 1:100, 000 was produced based on a topographic map of the same scale.

Visual interpretation of remote sensing data reveals the presence of the following landform units: beach, marine terraces, back swamps, delta plains, wet sabkhas, dry sabkhas, wadis, alluvial plains and sand dunes.

Field investigations including terrain analysis and sampling of soils for laboratory analysis were carried out for each of the aforementioned land units. The main soil characteristics of some potential land units in the study area are discussed and the soils were classified according to Soil Taxonomy (1996). The soils of the Wadi deposits were classified as *typic Torri-fluvents.*, The soils of the alluvial plain and Delta plain were classified as *Typic Torriorthents.* The soils of sabkhas were classified as *Typic Salids.*

5.2 Image classification:

Delta Shaa'b, the most suitable area for sustainable development in the El-Wadaa plain, was subjected to detailed studies using different image processing techniques. Non-supervised classification of remote sensing data classified the selected area into 25 classes. However the use of GPYS, and the application of supervised classification methods using a number of training sites reduces the number of classes to 12 in Marsa shaa'b. The differentiation between sandy plain and wind blown sand was very clear in the classified image. Also salt affected soils and areas covered with a thin silty crust were very distinct.

5.3 Land Evaluation:

The primary evaluation of the mapped land units, using a parametric land capability classification model, reveals that Marsa shaa'b delta plain is suitable for sustainable agriculture development projects. The lands of Marsa shaa'b are classified as capability classes 2 and 3. Soils of the Wadis, deltas, alluvial plains were suitable for agricultural production under proper management of flash floods, which represent the main water resources in this region. The main limitations for development in this region were the severe climatic conditions and erosion hazard.

The soils were found to be suitable for producing wheat, maize, olives, watermelon, groundnuts and tomatoes. Attention must be paid to protect valuable fauna and flora, and marine natural resources (i.e. fishes, coral reef).

6. Conclusion

The interpretation of Landsat Thematic Mapper images provides valuable information for assessment and mapping of the existing natural resources in the southeastern desert of Egypt. Landform, geology, hydrogeology, and soil maps at scale of (1:100,000) of the study area were produced. Detailed study using different image processing techniques (i.e. non-supervised, supervised classification analysis), and field truth using GPS were performed to provide detailed information about land units. Land evaluation using two mathematical models was applied. The available data about Marsa shaa'b district were used to build a regional database. A land use map at a scale of 1: 50,000 showing the location of agriculture extensions areas, has been produced. Recommendations for sustainable development of the study area were presented.

7. References

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