

**STUDIES THE SOILS OF EL GABAL EL ASFAR  
AREA WHICH IRRIGATED BY SEWAGE  
SLUDGE AND EVALUATED**

**By**

**MAGDY MOHAMED MEKKAWI ODA**

**B. Sc. Agric. Sci. (Technology Reclamation And Desert Soil Cultivation),  
Open Education Center, Fac. Agric., Cairo Univ., Egypt, 2003**

**THESIS**

**Submitted in Partial Fulfillment of the  
Requirements for the Degree of**

**MASTER OF SCIENCE**

**In**

**Agricultural Sciences  
(Soil Sciences)**

**Department of Soil Sciences  
Faculty of Agriculture  
Cairo University  
EGYPT**

**2013**

**APPROVAL SHEET**

**STUDIES THE SOILS OF EL GABAL EL ASFAR  
AREA WHICH IRRIGATED BY SEWAGE  
SLUDGE AND EVALUATED**

**M.Sc. Thesis  
In  
Agric. Sci. (Soil Sciences)**

**By**

**MAGDY MOHAMED MEKKAWI ODA**  
**B. Sc. Agric. Sci. (Technology Reclamation And Desert Soil Cultivation),  
Open Education Center, Fac. Agric., Cairo Univ., Egypt, 2003**

**APPROVAL COMMITTEE**

**Dr. TOLBA SALEH ABD EL-AAL**.....  
**Professor of Soil Sciences, Fac. Agric., El Fayoum University**

**Dr. YAHYA ARFA AHMED**.....  
**Associate Professor of Soil Sciences, Fac. Agric., Cairo University**

**Dr. Wael Ahmed Abd El-Kawi**.....  
**Professor of Soil Sciences, Fac. Agric., Cairo University**

**Dr. Ali Abd El-Hamid Abd El-Hady**.....  
**Professor of Soil Sciences, Fac. Agric., Cairo University**

**Date: / / 2013**

**SUPERVISION SHEET**

**STUDIES THE SOILS OF EL GABAL EL ASFAR  
AREA WHICH IRRIGATED BY SEWAGE  
SLUDGE AND EVALUATED**

**M.Sc. Thesis  
In  
Agric. Sci. (Soil Sciences)**

**By**

**MAGDY MOHAMED MEKKAWI ODA**  
**B. Sc. Agric. Sci. (Technology Reclamation And Desert Soil Cultivation),  
Open Education Center, Fac. Agric., Cairo Univ., Egypt, 2003**

**SUPERVISION COMMITTEE**

**Dr. ALI ABD EL-HAMID ABD EL-HADY**  
**Professor of Soil Sciences, Fac. Agric., Cairo University**

**Dr. WAEL AHMED ABD EL-KAWI**  
**Professor of Soil Sciences, Fac. Agric., Cairo University**

**Dr. RAFAT RMDAN ALI**  
**Assistant Researcher Professor of Soil And Water Use, NRC., Giza, Cairo**

<b>Name of Candidate:</b> Magdy Mohamed Mekkawi Oda	<b>Degree:</b> M.Sc.
<b>Title of Thesis:</b> Studies the Soils of El Gabal El Asfar Area Which Irrigated by Sewage Sludge and Evaluated	
<b>Supervisors:</b> Dr. Ali Abd El-Hamid Abd El-Hady Dr. Wael Ahmed Abdel-Kawy Dr. Rafat Ramdan Ali	
<b>Department:</b> Soil Sciences	<b>Approval:</b> /    /

### ABSTRACT

The investigated area locates to the east of the Nile Delta; it is bounded by latitudes 30° 11' 15" & 30° 14' 10" N and longitudes 31° 22' 05" & 31° 24' 20" E. According to the period of irrigation by sewage effluents, the soils of the area were divided into four grades. These include i) non-irrigated and barren, ii) irrigated for (24 years), iii) irrigated for (49 years) and iv) irrigated for 82 years until 2009 and after this the all area changed to irrigate by ground water.

Fifteen soil profiles were taken to represent the soils of the area. Morphological description and soil sampling were conducted during the field work. The soil properties including texture, depth, organic matter (O.M), EC, CaCO<sub>3</sub>, pH, CEC, and ESP have been determined.

The soils were classified as: Typic Torripsamments and Typic Torrifluvents according to the American soil taxonomy. The soil capability classes ranged between (2) good and (5) very poor. The soil suitability ranged between S<sub>1</sub> and S<sub>3</sub>. The soils of the area are suitable for field crops (Wheat, Barley, Faba bean, Sugar beat, Sun flower, Maize, Soya bean, Peanut, Cotton, Sugar Cane), vegetable (Tomato, Pepper, Watermelon, Alfalfa, Sorghum), and fruit (Citrus, Grape, Olive, Apple, Pear, Figs, Date palm). The soils are in general not suitable for Cabbage, Onion, Rice and Banana.

**Key words:** Soil taxonomy, Soil evaluation, Remote sensing, GIS, El Gabal El Asfar, Egypt

## DEDICATION

*I dedicate this work to whom my heart felt thanks; to my **mother** and my late **father** for their patience and help, as well as to my **brother Dr. Nasser** and his wife **Dr. Dalia**, as well as to my wife, my sons and my daughters.*

## *ACKNOWLEDGEMENT*

*I wish to express my deepest appreciation and sincerest gratitude to Dr. Ali Abd El Hameed Professor of Soil Pedology in Soil Department, Faculty of Agriculture, Cairo University and Dr. Wael Abd El kawy Professor of Soil Pedology in the same department, for their kindness, their continuous guidance and fruitful efforts to supervise this work.*

*Grateful thanks are due to Prof. Dr. Rafat Rmadan Ali Assistant Researcher Professor of Soil in Soils and Water Use Department, National Research Center for his sincere supervision and assistant throughout this work.*

*Grateful thanks are due to Mr. Mohamed Hasanen, brother- in-law and Eng. Nagah Salama, the previous manager of El Gabal El Asfar farm for their assistant throughout this work.*

*A great appreciation is expressed to everyone in Soil Department, Faculty of Agriculture, Cairo University help through out this work.*

*Special deep appreciation is given to my late father, my mother, my wife, my brothers and sisters. Also I feel deeply grateful to my dear country Egypt.*

# CONTENTS

	Page
<b>INTRODUCTION.....</b>	<b>1</b>
<b>REVIEW OF LITERATURE.....</b>	<b>3</b>
<b>1. Location .....</b>	<b>3</b>
<b>2. Climate.....</b>	<b>3</b>
<b>3. Topography.....</b>	<b>6</b>
<b>4. Geological formation of the studied area.....</b>	<b>6</b>
<b>5. Hydrogeological Characteristics.....</b>	<b>8</b>
a. Holocene layer semi-outlet.....	9
b. Pleistocene tank.....	9
<b>6. Land Evaluation.....</b>	<b>10</b>
a. Definitions .....	10
b. Land capability.....	12
c. Land suitability.....	13
<b>7. Remote Sensing.....</b>	<b>15</b>
<b>8. Geographic Information System (GIS).....</b>	<b>18</b>
<b>9. GIS functions.....</b>	<b>21</b>
<b>10. Soils.....</b>	<b>22</b>
<b>MATERIALS AND METHODS.....</b>	<b>26</b>
<b>1. Digital image processing and data extraction.....</b>	<b>26</b>
a. Image classification .....	29
b. Image Visual interpretation .....	29
<b>2. GIS applications.....</b>	<b>29</b>
a. Data input.....	29
b. Digitizing .....	29
<b>3. The Field Studies.....</b>	<b>30</b>
<b>4. Laboratory analysis.....</b>	<b>30</b>
<b>5. Land Capability and Suitability.....</b>	<b>32</b>
<b>RESULTS AND DISCUSSION.....</b>	<b>38</b>
<b>1. Physiographic of the studied area.....</b>	<b>38</b>
a. Low elevated sand sheet.....	40

## **CONTENTS (continued)**

(1) Morphological description.....	40
(2) Particle size distribution.....	45
(3) The Analytical Analysis of Chemical Properties.....	45
(4) Soil classification.....	49
(5) Soil capability.....	49
(6) Soil suitability.....	49
<b>b. Moderately elevated sand sheet.....</b>	<b>51</b>
(1) Morphological description.....	53
(2) Particle size distribution.....	56
(3) The Analytical Analysis of Chemical Properties.....	56
(4) Soil classification.....	59
(5) Soil capability.....	59
(6) Soil suitability.....	59
<b>c. Highly elevated sand sheet.....</b>	<b>61</b>
(1) Morphological description.....	61
(2) Particle size distribution.....	67
(3) The Analytical Analysis of Chemical Properties.....	67
(4) Soil classification.....	70
(5) Soil capability.....	70
(6) Soil suitability.....	70
<b>d. Low elevated alluvial landform.....</b>	<b>72</b>
(1) Morphological description.....	72
(2) Particle size distribution.....	80
(3) The Analytical Analysis of Chemical Properties.....	80
(4) Soil classification.....	83
(5) Soil capability.....	83
(6) Soil suitability.....	83
<b>e. High elevated alluvial landform.....</b>	<b>86</b>
(1) Morphological description.....	86
(2) Particle size distribution.....	92
(3) The Analytical Analysis of Chemical Properties.....	92



## **CONTENTS (continued)**

(4) Soil classification.....	<b>95</b>
(5) Soil capability.....	<b>95</b>
(6) Soil suitability.....	<b>95</b>
<b>2. Thematic Map .....</b>	<b>98</b>
<b>3. Soil Capability.....</b>	<b>106</b>
<b>4. Soil Suitability Class.....</b>	<b>106</b>
<b>SUMMARY.....</b>	<b>110</b>
<b>REFERENCES .....</b>	<b>113</b>
<b>ARABIC SUMMARY .....</b>	

## LIST OF TABLES

No.	Title	Page
1.	Climatological data at El-Khanka the average during the period (1999-2011).....	5
2.	Rating of soil depth .....	35
3.	Capability classes and ratings used by ALES arid-GIS.....	35
4.	Land suitability classes, definition and ranges used by ALES arid-GIS.....	35
5.	Areas of the different Physiographic soil Unit .....	40
6.	Particle size distribution analysis of low elevated sand sheet	47
7.	Some chemical characteristics of low elevated sand sheet..	48
8.	Class of land capability of low elevated sand sheet.....	49
9.	Particle size distribution analysis of moderately elevated sand sheet.....	57
10	Some chemical characteristics of moderately sand sheet.....	58
11	Class of land capability of moderately elevated sand sheet...	59
12	Particle size distribution analysis of highly elevated sand sheet.....	68
13	Some chemical characteristics of highly elevated sand shee.	69
14	Class of land capability of moderately elevated sand sheet....	70
15	Particle size distribution analysis low elevated alluvial soil...	81
16	Some chemical characteristics of low elevated alluvial soil..	82
17	Class of land capability of low elevated alluvial soil.....	83
18	Particle size distribution analysis of high elevated alluvial soil.....	93
19	Chemical analysis of high elevated alluvial soil.....	94
20	Class of land capability of high elevated sand sheet.....	95
21	Areas of the different soil texture class.....	98

**TABLES (continued)**

22 Legend for Suitability map..... 107

## LIST OF FIGURES

No	Title	Page
1.	Location Map of the Studied Area.....	4
2.	Rainfall and ETP of the Studied Area.....	5
3.	Topography Map of the Studied Area .....	7
4.	Geological map of the Studied Area (after RIGW, 1989) ....	8
5.	Hydrogeological Cross Section (after RIGW, 1989) .....	10
6.	Landsat ETM+7 image .....	27
7.	Digital elevation model.....	28
8.	Physiographic units and profiles sites .....	39
9.	Photography image of profile No. (1,2 and 6).....	46
10	Soil suitability for crops profile 1.....	50
11	Soil suitability for crops profile 2.....	50
12	Soil suitability for crops profile 6.....	51
13	Photography image of soil profile No. (10 and 15).....	52
14	Soil suitability for crops profile 10.....	60
15	Soil suitability for crops profile 15.....	60
16	Photography image of soil profile No. (4,9 and 11).....	66
17	Soil suitability for crops profile 4.....	70
18	Soil suitability for crops profile 9.....	71
19	Soil suitability for crops profile 11.....	71
20	Photography image of soil profile No. (3 and 5).....	79
21	Photography image of soil profile No. (7 and 8).....	79
22	Soil suitability for crops profile 3.....	84
23	Soil suitability for crops profile 5.....	84
24	Soil suitability for crops profile 7.....	85
25	Soil suitability for crops profile 8.....	85

## **FIGURES (continued)**

26 Photography image of soil profile No. (12 and 13) .....	91
27 Photography image of soil profile No. (14) .....	91
28 Soil suitability for crops profile 12.....	96
29 Soil suitability for crops profile 13.....	96
30 Soil suitability for crops profile 14.....	97
31 Soil texture Map of the studied area.....	100
32 CEC (meq/100gm. Soil) distribution at the studied area ...	101
33 Map of CaCO <sub>3</sub> content. ....	102
34 O.M% Map. ....	103
35 Salinity Map of the Studied Area.....	104
36 Alkalinity Map of the Studied Area. ....	105
37 Soil Capability Map of the Studied Area. ....	108
38 Soil Suitability Map of the Studied Area .....	107

# INTRODUCTION

Agriculture plays a main role in the growing and stability of the national economy. Egypt's area extends to million km<sup>2</sup>, 94% of this area is classified as a desert while habited area is about 6%. There is a shortage in per capita of the agricultural area.

The Nile River is the main source of water supplying Egypt with 55.5 billion m<sup>3</sup> of water. Egypt is classified as an arid area characterized by rain shortage and high temperature which is considered a hinder of development and expansion in agriculture area.

Since 1900, Egypt began to apply the use of sewage water in farming as unconventional source of water to reduce the water shortage and achieve the block of the food gap between the product and the overpopulation. Sewage water contains useful nutrients for soil fertility and plants nutrition. The benefits of these nutrients depend on the concentrations of the nutrients in wastewater, the quantities of wastewater applied, the times of application, the type and the target yield of the crop grown, and the fertility of the soil. (Janssen et al. 2005). On the other hand it contains high percentage of heavy metals which cause toxicity of plant and a harmful effect on humans.

El Gabal El Asfar farm is one of these areas which has started to use sewage water in irrigation since 1911. It is located in the Eastern desert in the southeastern edge of Al Qaliobia governorate.

Soil evaluation is one of the methods which can be inferred from the productive capacity of the land and its ability for different uses.

Geographic information system (GIS) and remote sensing (RS) techniques were used in order to implement this study. Remote sensing (RS) and geographic information system (GIS) techniques proved to be effective in management, detection, prediction and planning studies. Remote Sensing is the science of acquiring, processing and interoperating images that record the interaction between electromagnetic energy and matter. GIS is considered as organized collection of computer hardware, software, spatial and non-spatial data that can help users for the efficient capture, storage, update, manipulation, analysis and management of all geographically referenced information. The present study aims to achieve the following objectives:

1. Physiographic map of the studied area.
2. Soil map of the studied area.
3. Land capability map of the studied area.
4. Land suitability map of the studied area.