CONTENTS

1. INTRODUCTION	1
2. REVIEW OF LITERATURE	3
2.1 DESCRIPTION OF THE STUDY AREA	3
2.1.1 Location	3
2.1.2 Climate	3
2.1.3 Geology	8
2.1.4 Geomorphology	10
2.2 Remote Sensing (RS) & Geographic Information System (GIS)	13
2.2.1. Remote Sensing	13
2.2.1.1. Concept of Remote Sensing	13
2.2.1.2. Electromagnetic Waves	14
2.2.1.3. Type of Remote Sensing	14
2.2.1.4. Remote sensing Satellites	15
2.2.1.5. Interpretation Techniques	20
2.2.2 Geographic Information System (GIS)	22
2.2.2.1 Concept of GIS	22
2.2.3. Remote Sensing in Relation to GIS:	22
2.3. Land Degradation and Desertification	23
2.3.1. Concept of Degradation and Desertification	23
2.3.2. Degradation by salinization	24
2.3.2.1. Concept of Saline Soil	24
2.3.2.2. Sources of Salts	25
2.3.2.3. Reflectance of Saline Soils	27

2.3.3. Degradation by urban Encroachmcnt 28
2.4. Change Detection 29
2.4.1. Concept of changc Detection 29
2.4.2. Change Detection Techniques 30
2.4.2.1 Principal Components Analysis Technique 30
2.4.2.2 Image Classification Techniques 31
2.4.2.3 Data Fusion Technique 34
2.4.2.4 Subtractcd Technique 35
2.4.3. Applicatiou of changc Detection Technique 35
2.4.3.1. Change Detection of Saline Soils 35
2.4.3.2.Change Detection of Urban Encroachment 38
3. MATERIAL AND METHODS 40
3.1. Location of the study area 40
3.2. Data Sources 40
3.2.1. Maps 40
3.2.2. Images 40
3.3. Field Work 46
3.4. Laboratory Analysis 46
3.4.1. Physical Analysis 46
3.4.2. Chemical Analysis 49
3.5. Data Atomization 50
3.5.1. Data Input 50
3.5.2. Digital Data Processing 50
3.5.2.1. Image Rectification and Restoration 53
3.5.2.2. Mosaics 55
3.5.2.3. Image Classification 55

3.5.2.4. Delineations Process 61
3.5.3. Data Output 62
3.6. Software and Hardware 62
3.6.1. Software 62
3.6.2. Hardware 62
4. RESULTS AND DISCUSSION 64
4.1 Assessment of the Present Condition of Soil According to Current Investigation 63
4.1.1 Physical Properties 63
4.1.1.1 Particle Size Distribution 63
4.1.1.2 Soil Moisture Retention 67
4.1.2 Chemical Properties 70
4.1.2.1 $CaCO_3$ 70
4.1.2.2 Gypsum 70
4.1.2.3 Organic Matter Content 74
4.1.2.4 Soil Reaction (pH) 74
4.1.2.5 Soluble Salts 80
4.1.2.6 Distribution of Soluble Cations 80
4.1.2.7 Distribution of Soluble Anions 80
4.2. Detection and Monitoring Soil Salinity in Fayoum Governorate Using Remote Sensing Technique 81
4.2.1. Image Classification 81
4.2.1.1. Signature Collection 81
4.2.1.2. Bands Selection 83
4.2.1.3. Supervised Classification Process 84
4.2.1.4. Feature Space Image 86

4.2.1.5. Accuracy Assessment 90
4.2.1.6. Fayoum Salinity Map in 2002 94
4.3. Detection and Monitoring Soil Salinity in Fayoum Governorate Districts in 1960 and 2002. 96
4.3.1. Itsa District 96
4.3.2. Fayoum District 102
4.3.3. Tamia District 108
4.3.4. Sinnuris District 113
4.3.5. Ibshawai District 118
4.4. Detection and Monitoring Urban Encroachment in Fayoum Governorate Districts in 1952, 1991, 2000 and 2002 Using Remote Sensing Technique 124
4.4.1 Urban Encroachment in Itsa Town 126
4.4.2 Urban Encroachment in Fayoum Town 129
4.4.3 Urban Encroachment in Tamia Town 132
4.4.4 Urban Encroachment in Sinnuris Town 135
4.4.5 Urban Encroachment in Ibshawai Town 138
5. CONCLUSIONS 142
6. RECOMMENDATIONS 143
7. SUMMARY 144
8. REFERENCES 149
APPENDIX 163
ARABIC SUMMARY

6- RECOMMENDATIONS

1. Multitcmporal satellite remote sensing is a viable approach for identifying and monitoring the state of agricultural lands such as: soil salinity, soil productivity, soil formation, soil suitability etc.....
2. A very high-resolution satcllite data is very important for identifying, detecting the growth of urban and following up the urban encroachment on agricultural Lands.
3. Establishment Geographic Information Systems using database of soil salinity status and characteristics integratcd with satellite imageries in governorates facing salinity problem.
4. Remote sensing techniques, including low and high-resolution satellite data, can be used mainly to assess tbe effectiveness of irrigation distribution and to detect surface water content.
5. Using remote sensing and Geographic Information Systems techniques to assess the localization of malfunctioning subsurface drainage networks.
6. Soil salinity management by soil database initiation that aided by field data acquisition guidcd by satellite data processing and the GIS database analysis for aim of deeision maker sup port.

7. SUMMARY

The current investigation represents a trial to undertake two major problems of soil salinity and urban eneroaehment in Tamia, Sinnuris, Ibshawai, Fayoum, and Itsa (Fayoum Governorate). It lies between latitudes 29° 02¯ and 29° 35¯ N and longitudes 30° 20¯ and 31° 06¯ E.

Modern techniques of Remote Sensing (RS) and Geographic Information System (GIS) were used in this study. Data used in this investigation were twenty topographic maps at scale 1:25000 (first edition 1952) produced and published by (EGSA), salinity maps were produced in 1960 through reports of (SWRI), two panchromatic SPOT-3 scenes acquired in 1991, two panchromatic LANDSAT-7 "ETM" scenes acquired in 2000 and 2002 and two LANDSAT-7 multispectral scenes acquired in 2002.

An image mosaic of rectified images of multispectral LANDSAT-7 path/row 176/40, and 177/40 acquired on 28 July 2002, and 19 July 2002 was prepared to be used in supervised classification process. The representative image mosaic of Fayoum governorate was used to generate supervised signatures using the Area of Interest AOI tools by delineate training areas. In this investigation, it has been found that bands 2, 3, and 4 were the best to be used from signature curve to process Maximum Likelihood supervised classification. Results of supervised classification were 7 classes as follow: None - slightly saline soils, Moderately saline soils, Highly saline soils, Extremely

saline soils, Urban, Desert, and Water equal to 170068, 46487, 63433, 66436, 36308, 629381 and 78888 feds., respeetively. Data showed that the area of None-Slightly and Moderately saline are 216555 fed. While the area of Highly and Extremely saline are 129869 fed. These results indieate that progress in soil reelamation proeess in Fayoum governorate.

In this study, ten random reference chcck sites were seleeted in Fayoum governorate using Global Positioning System (GPS) instrument, samples were eollected from theses sites and chemically analyzcd to define their salinity classes. Results of this work showed that 9 chick sites were in their correct salinity class while only one chick site was in incorrect salinity class.

Data of salinity classes in Itsa district showed that there were decrease (2175, 12070 and 7823 fed.) of the areas of non-slightly, moderately and extremely saline soils, respectivcly in the period (1960 – 2002). Depending on results of 1960 there were decrease equal to about 22068 fed. in non-slightly, moderately and extremcly saline soils comparing to results of 2002. this decreasc may be duc to changc to bear soils under reclamation and urban encroachment as shown in rcsults of 2002.

Data of salinity classcs in Fayoum district showed that there were decreasc (4779 and 819 fcd.) of the arcas of non-slightly and moderatcly salinc soils, rcspectively in the period (1960 – 2002) refer to a degradation process. Whilc there was a dccrease (3668 fed.) of the area of extremely salinc soils in the same period refers to an

improvement process. It notieed too that there was an increase (1226 fed.) of the areas of highly saline soils in the same period refers to a degradation process. In Tamia district that there was an inerease (2026 fed.) of the area of non-slightly saline soils in the period (1960 – 2002) refers to an improvement process. While therc were increase (741and 250 fed.) of the areas of highly and extremely saline soils, respectively in thc samc period refer to a degradation process. It noticed that there was a decrease (9704 fed.) of the areas for the area of moderately saline soils in the same period, which indicates to a degradation process due to some of the decrcased area of this class changed to highly and extremely saline soils. Also this decrease refers to an improvement process because some of the decreased area of this moderately saline soils changed to non-slightly saline soils.

Results of salinity classes in Sinnuris district showed that there were increase (25384 and 7707 fed.) of the areas of nonc-slightly, moderately saline soils, respectively in the period (1960 – 2002) indicate to an improvemcnt process. While there were increase (7163 fed.) of the area of extremely saline soils in the same period refers to a degradation process. It is noticed too that there werc decrease (49033 fcd.) of the area of highly saline soils in the same period refers to an improvement process.

Data of salimity classes in Ibshawai district showed that there wcre decrease (24952 and 2517 fed.) of the area of non-slightly, moderatcly saline soils, respectively in the period (1960 – 2002) indicate to a degradation process. While there were decrease (4109

fed.) of the area of highly saline soils in the same period refers to also degradation process, due to the decreased area of this class changed to extremely saline soils. It is noticed too that there was an increase (7898 fed.) of the area of extremely saline soils in the same period refer to a degradation process.

The majority of Fayoum districts soils have insufficient field drainage as well as insufficient irrigation water for the irrigated soils due to a shortage in management process. Also the variation of soil elevation ranges (+20 m to -45 m) which leads to infiltration from high to low land. This help to lose a large quantity of irrigation water. Also, some soils of fayoum districts devoid of drains specially which are adjacent to Qaroun Lake and label to be flooded by the Lake.

Delineation process was used in this investigation in order to delineate the boundaries of Itsa, Fayoum,Tamia, Sinnuris, and Ibshawai twons by using topogrphic maps 1952, SPOT-3 Image 1991, and LANDSAT-7 Image 2000 , 2002 mosaies. In this process vector layers (urban coverages) were produced by using veetor module of the used software. Overlay of urban coverage was done for each town in detecting dates. After delineation process urban area in feddan for each town in dctecting dates were calculated from urban vector coverages. Expansion urban area in feddan, and percent of increase to the area "relative to 1952 area" for each twon in 1952, 1991, 2000, and were calculated.

Results of urban cneroachment on the fertile land of Itsa town showed tbat tbere was an inerease of urban area in the period (1952 –