



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



HANAA ALY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



HANAA ALY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغييرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



HANAA ALY

**ASSESSMNET OF SPECTROSCOPIC AND
MORPHOLOGICAL PROPERTIES OF
SOME FRUIT CROPS UNDER THE
INFLUENCE OF POLLUTION
WITH HEAVY METALS US-
ING REMOTE SENSING
TECHNIQUES**

By

AMANY FAROUK ABDELHAMEED ELWESEMY

B.Sc. Agric. Sc. Fac. Agric., (General Division), Tanta Univ. 2011
M.Sc. Agric I n Desert. (Salt Affected Areas), Fac. Agric., Ain Shams Univ.,
2016

A Thesis Submitted In Partial Fulfillment

Of

The Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in

AGRICULTURE SCIENCES

(Agriculture in Desert and Salt Affected Areas)

Arid Land Agricultural Graduated Studies and Research Institute

Faculty of Agriculture

Ain Shams University

2021

Approval Sheet

ASSESSMNET OF SPECTROSCOPIC AND MORPHOLOGICAL PROPERTIES OF SOME FRUIT CROPS UNDER THE INFLUENCE OF POLLUTION WITH HEAVY METALS US- ING REMOTE SENSING TECHNIQUES

By

AMANY FAROUK ABDELHAMEED ELWESEMY

B.Sc. Agric. Sc. Fac. Agric., (General Division), Tanta Univ. 2011
M.Sc. Agric in Desert. (Salt Affected Areas), Fac. Agric., Ain Shams Univ.,
2016

This the,sis for PhD degree has been approved by:

Dr. Alaa Mohamed Zoheir Hamed Elbably
Prof.. of. Soil and Water, Director of. Soil, Water and Environment
Research Institute, ARC.

Dr. Afaf Mohamed Tolba
Prof.. of. Agronomy, Faculty of. Agriculture, Ain Shams University.

Dr. Ayman Farid Abou-Hadid
Prof.. Emeritus of. Horticulture, Faculty of. Agriculture, Ain Shams
University.

Dr. Nazmy Abdelhamid Abdelghany
Prof.. of. Horticulture, Faculty of. Agriculture, Ain Shams University.

Date of. Examination: / /2021

**ASSESSMNET OF SPECTROSCOPIC AND
MORPHOLOGICAL PROPERTIES OF
SOME FRUIT CROPS UNDER THE
INFLUENCE OF POLLUTION
WITH HEAVY METALS US-
ING REMOTE SENSING
TECHNIQUES**

By

AMANY FAROUK ABDELHAMEED ELWESEMY

B.Sc. Agric. Sc. Fac. Agric., (General Division), Tanta Univ. 2011
M.Sc. Agric in Desert. (Salt Affected Areas), Fac. Agric., Ain Shams Univ.,
2016

Under the, supervision of:

Dr. Nazmy Abdelhamid Abdelghany

Prof.. of. Horticulture, Department of. Horticulture, Faculty of.
Agriculture, Ain Shams University, (Principal Supervisor).

Dr. Ayman Farid Abou-Hadid

Prof. . Emeritus of. Horticulture, Department of. Horticulture, Faculty
of. Agriculture, Ain Shams University.

Dr. Mohamed Amin Aboelghar

Prof.. of. Agricultural Applications, Department, National
Authority for Remote Sensing and Space Science.

ABSTRACT

Amany Farouk Abd-ELhameed ELwesemy: Assessment of. Spectroscopic and Morphological Properties of. some Fruit Crops under the, Influence of. Pollution with Heavy Metals Using Remote Sensing Techniques .PhD. The, sis, Arid Land Agricultural Graduated Studies and Research Institute, Agriculture in Desert and Salt Affected Areas, Faculty of. Agriculture, Ain Shams University, 2021.

The, data of. remote sensing has been used in all the, fields of. natural sciences and became an important tool in many research areas. Using remote sensing for identifying pollutants and polluted objects or materials is a new field of. remote sensing applications.

The, current study aims to assess pollution of. heavy metals for two important fruits for local consumption and exportation as well based on remote sensing technology. Six heavy metals were determined in the, lab and measured in the, field, the, y are nickel, cadmium, chromium, lead, zinc and mercury .The, citrus and mango farms in the, study area are closing to the, industrial area in South Giza governorate. This area is suffering from many sources of. pollution including factories, highways and bad drainage system in some areas.

The, first step of. the, process was to identify the, areas in which citrus and mango are cultivated and to create modified maps of land cover and crop production. The study area was revised using the Food and Agriculture Organization's (FAO) global land cover

classification scheme (FAO-LCCS). Using combined multispectral bands of sentinel-2 data acquired in 2018, land cover classification and crop pattern were performed. spatial resolution of ten metres. Geographic information system (GIS) was used to edit the, classification result in order to reach the, maximum possible accuracy. Based on the,se maps, the, study area was divided into six zones and the, locations of. the, observed sites were identified and covering variations within mango and citrus farms. From each location, spectral reflectances was measured and leave plant samples were collected from the, same trees for laboratory determination of. heavy metals. The, last step of. the, methodology was to statically correlate spectral reflectance characteristics in forms of. spectral vegetation indices and laboratory analysis of. heavy metals to produced models to estimate heavy metals using spectral data with adequate accuracy.

Irrigated herbaceous crops, irrigated tree crops, bare land, water sources, and artificial surfaces make up the total study area of 514425 feddans. GIS was used to provide the area of each land cover as well as geospatial data. Among predicted modelled heavy metals, the models were evaluated using coefficient of determination (R^2) and root mean square (RMSE) error. The findings revealed that, correlation coefficient of. the, generated models, NDVI, Red, IR, Lic_1 , VOG, RVI, SAVI, SIPI, and DWSI for predicting heavy metals in the, leaves of. mango and citrus. The, models could be applied in othe,r study area with similar conditions.

Keywords: Heavy metals, Hyper-spectral Vegetation Indices, Empirical models, Giza governorate.

LIST OF. TABLES

Table	Page
1. Meteorological data of the (study area) (monthly averages in 2014).	32
2. 10 m Spatial Resolution (Bands) and associated Signal to noise ratio (SNR).	37
3. 20-meter Spatial Resolution(Bands) and associated Signal to noise ratio (SNR).	38
4. 60-meter spatial Resolution (Bands) and associated Signal to Noise ratio (SNR).	38
5. The, ASD Field Spec 4 Specifications.	40
6. Date of. Spectroradiometer measurements.	41
7. Dichotomous approach for primary classes in FAO / LCCS.	44
8. Threshold of. heavy metal concentrations (mg kg ⁻¹).	49
9. Spectral Features and Vegetation Indices.	54
10. Land Cover classes in the, study area.	58
11. Crop pattern area (year/2018)/Feddan.	60
12. Static vegetation indices All collected sample.	64
13. Mean of. each element (ppm) within each spatial zone.	78
14. Simple regression models for heavy metals and spectral Vegetation indices (R/IR/NDVI/SAVI) for Mango samples.	89
15. Simple regression models for heavy metals and spectral Vegetation indices (SPI/RVI/VOG/LIC1/DWSI) for Mango samples.	91
16. Coefficient determined by (R ²) and Root Mean (square-error)(RMSE) of. real and expected heavy metals and Mango vegetation indices(R/IR/NDVI/SAVI).	93
17. Coefficient determined by (R ²) and Root Mean (square-error)(RMSE) of. real and expected heavy metals and Mango spectral vegetation indices (SPI/RVI/VOG/ LIC1/DWSI).	94
18. Simple regression models for heavy metals and spectral Vegetation indices (R/IR/NDVI/SAVI) for Citrus samples.	96
19. Simple regression models for heavy metals and spectral	98

- Vegetation indices (SPI/RVI/VOG/LIC1/DWSI) for Citrus samples.
20. Coefficient of. determination (R^2) and Root Mean (square- error)(RMSE) of. actual and predicted heavy metals vegetation indices(R/IR/NDVI/SAVI). 100
 21. Coefficient of. determination (R^2) and Root Mean (square- error)(RMSE) of. actual and vegetation indices (SPI/RVI/VOG /LIC1/DWSI). 101

LIST OF. FIGURES

Figure		Page
1.	Location of. the, (study area).	31
2.	Geologic map of. study area, after CONOCO (1987).	33
3.	Canals and drains in the, study area.	34
4.	SENTINEL-2 10 m spatial resolution bands: B2 (490 nm), B3 (560 nm), B4 (665 nm) and B8 (842 nm).	35
5.	SENTINEL-2 20 m spatial resolution bands: B5 (705 nm), B6 (740 nm), B7 (783 nm), B8a (865 nm), B11 (1610 nm) and B12 (2190 nm).	36
6.	SENTINEL-2 60 m spatial resolution bands: B1 (443 nm), B9 (940 nm) and B10 (1375 nm).	36
7.	ASD Field Spec (Spectroradiometer).	40
8.	Total Sample Location in each zone for Mango and Citrus.	42
9.	The, apparatus of. Global Position System (GPS).	42
10.	Flowchart diagram showing the, steps of. the, research of. the, study project.	43
11.	Ground Truth point (GPS).	48
12.	Network grid system for the, study Area.	52
13.	Land cover map of. the, Giza governorate.	59
14.	crop pattern Giza governorate/ Feddan.	62
15.	crop map of. the, (study area).	63
16.	Spectral reflectance in all Mango crops zone two East Nile.	67
17.	Spectral reflectance in all Mango crops zone two West Nile.	68
18.	Spectral reflectance in all Mango crops zone three West Nile.	69
19.	Spectral reflectance in all Mango crops zone four West Nile.	70
20.	Spectral reflectance in all Mango crops zone five West Nile.	71
21.	Spectral reflectance in all Mango crops zone six West Nile.	72

Nile.

22.	Spectral reflectance in Citrus crops zone four.	73
23.	Spectral reflectance in Citrus crops zone five.	74
24.	Spectral reflectance in Citrus crops zone six.	75
25.	Spectral reflectance in Mango crops all spatial zone.	76
26.	Spectral reflectance in Citrus crops all spatial zone.	77
27.	Levels the, Lead in the, all spatial zone of. the, (study area).	79
28.	Lead distribution in the, all spatial zone of. the, (study area).	79
29.	Chromium distribution in the, all spatial zone of. the, (study area).	80
30.	Levels the, Chromium in the, all spatial zone of. the, (study area).	81
31.	Cadmium distribution in the, all spatial zone of. the, (study area).	82
32.	Levels the, Cadmium in the, all spatial zone of. the, (study area).	82
33.	Zinc distribution in the, all spatial zone of. the, (study area).	83
34.	Levels the, Zinc in the, all spatial zone of. the, (study area).	84
35.	Nickel distribution in the, all spatial zone of. the, (study area).	85
36.	Levels the, Nickel in the, all spatial zone of. the, (study area).	85
37.	Silver distribution in the, all spatial zone of. the, (study area).	86
38.	Levels the, Silver in the, all spatial zone of. the, (study area).	87

LIST OF. ABBREVIATION

ABBREVIATION	Mean
GIS	Geographic Information System
RS	Remote Sensing
Kg	Kilogram
mg	Milligram
μm	micrometer
IR	Infrared
GCP	Ground Control Point system
RMS	Root mean square
NDVI	Normalized Difference Vegetation Index
SPS	Statistical Package for Social Science
LCCS	Land Cover Classification system
Lic1	Lichtenthale Indices
VOG	Vogelman
Red	Ratios around red (ASD)
RVI	Mustard spinach
SAVI	Soil-Adjusted Vegetation Index
DWSI	Disease Water Stress Index
GIS	Geographic Information System

1. INTRODUCTION

As statistics of. 2014, the, total Mango area in Giza governorate is (7730) feddan produces about (23317) tons when the, total Citrus area is (13441) feddan, produces about (96776) tons. Due to the, combination of. agricultural, industrial and urbanization operations, the, governorate of. Giza is one of. the, most complicated regions in Egypt.

One of the most serious global environmental issues is human and ecological exposure to toxic waste from farming, manufacturing, military, and mining activities. Heavy metals, hydrocarbons and other organic chemicals are often included in these wastes. World Health Organization (WHO) identified thirteen (13) heavy metals that have a significant impact on the, environment as well as human health. The, Nickel, cadmium, zinc, lead, chromium, and silver are among these metals. Heavy metal music comes from a variety of places. Human exposure varies, but it is primarily due to mining and industrial operations, such as metal refineries, petrochemical processing, power plants, and electronics manufacturing. Diffuse sources, such as aging metal pipes, food contamination, sewage discharge, and leaching from landfills, can also cause contamination. Spatial variability mapping and spatial analysis is widely used when data is collected at different locations, such as heavy metal samples in order to provide surface continuous information and to obtain estimates for unmeasured positions.

Lead, from air and food is exposed to the, general public in approximately same proportions. Previously, lead in food was extracted from pots used for cooking and storage. Lead emissions