ASSESSMENT OF NATURAL RADIATION LEVELS
IN SIWA OASIS, WESTERN DESERT

Submitted By

Lamees Serag El Din Abd El Hay Nasser

B.Sc. of Science (Biochemistry/Chemistry), Faculty of Science,
Ain Shams University, 1999

A Thesis Submitted in Partial Fulfillment
Of
The Requirement for the Master Degree
In
Environmental Sciences

Department of Environmental Basic Sciences
Institute of Environmental Studies and Research
Ain Shams University

2019

APPROVAL SHEET

ASSESSMENT OF NATURAL RADIATION LEVELS IN SIWA OASIS, WESTERN DESERT

Submitted By

Lamees Serag El Din Abd El Hay Nasser

B.Sc. of Science (Biochemistry/Chemistry), Faculty of Science,
Ain Shams University, 1999

A Thesis Submitted in Partial Fulfillment
Of
The Requirement for the Master Degree
In
Environmental Sciences
Department of Environmental Basic Sciences

This thesis Towards a Master Degree in Environmental Sciences
Has been Approved by:

Name	Signature
1-Prof. Dr. Ebrahim El Kattany El Aasy Prof. of Uranium Geology Nuclear Materials Authority	
2-Prof. Dr. Sami Hameed Abd El Nabi Prof. of Geophysics, Geophysics Department Faculty of Science Ain Shams University	
3-Prof. Dr. Mohamed Gharib El Malky Prof. of Environmental Geophysics, Department of Environmental Basic Sciences - Institute of Environmental Studies & Research Ain Shams University	

2019

ASSESSMENT OF NATURAL RADIATION LEVELS
IN SIWA OASIS, WESTERN DESERT

Submitted By
Lamees Serag El Din Abd El Hay Nasser
B.Sc. of Science (Biochemistry/Chemistry), Faculty of Science,
Ain Shams University, 1999

A Thesis Submitted in Partial Fulfillment
Of
The Requirement for the Master Degree
In
Environmental Sciences
Department of Environmental Basic Sciences

Under The Supervision of:

1-Prof. Dr. Mohamed Gharib El Malky
Prof. of Environmental Geophysics, Department of Environmental Basic Sciences - Institute of Environmental Studies & Research
Ain Shams University

2-Dr. Ahmed Gad Abd El Wahed
Lecturer of Environmental Geology, Geology Department
Faculty of Science
Ain Shams University

2019

ACKNOWLEDGEMENT

I am indebted to a great number of individuals who provided moral support, encouragement and scientific expertise throughout the course of this investigation.

First of all, I am extremely indebted to my major professor **Prof. Dr. Mohamed Gharib El Malky,** Professor of Environmental Geophysics, Institute of Environmental Studies and Research, Ain Shams University. The opportunity that he provided was a once in lifetime experience that I will never forget. Without his trust in my abilities I may never have had the chance to accomplish my research. My thanks go out to him for his support and guidance; making my graduated experience truly memorable.

I am very much indebted to thank **Dr. Ahmed Gad Abd El Wahed,** Department of Geology, Faculty of Science, Ain Shams University, for all his help, supervising the fieldwork, encouragement, valuable discussions, constructive criticisms and helpful suggestions concerning this thesis. Also, for being patient and never giving up on me. Many students have benefitted from Dr. Ahmed expertise – especially me.

The acknowledge goes incomplete without mentioning my family who always supported me in every possible way. Without them I would not be here where I am now.

ABSTRACT

A survey was conducted to determine the activity concentrations of ^{226}Ra, ^{232}Th (^{228}Ra) and ^{40}K and related external and internal radiation health hazard indices in water and soil of Siwa Oasis, Western Desert of Egypt. A total of 59 water and 58 soil samples were collected. The presence of natural radionuclides subsequently being assessed by HPGe γ-ray spectrometry. The obtained data were statistically treated by applying regression analysis, Pearson correlation and cluster analysis to investigate the influence of physico-chemical parameters on the distribution of the examined radionuclides in water and soil samples.

It was found that all the Nubian Sandstone Aquifer System (NSAS) water samples have ^{226}Ra and combined ^{226}Ra and ^{228}Ra activity concentrations values higher than the recommended level for drinking water. On the other hand, the activity concentrations of ^{40}K in 67.79 % of the collected samples higher than recommended level for safe drinking water. For cultivated and uncultivated soil types, the activity concentrations of the radionuclide have the order of $^{40}K > ^{226}Ra > ^{232}Th$. The mean values of ^{226}Ra, ^{232}Th and ^{40}K were 27.55 ± 1.79, 16.24 ± 2.49 and 254.22 ± 13.44 Bq kg^{-1}; respectively for the cultivated soils and 15.08 ± 1.03, 10.32 ± 0.70 and 130.20 ± 6.90 Bq kg^{-1}; respectively for the uncultivated soils.

The mean value of total the Annual Effective Dose (AED) for infants (0-1 yr) and toddlers (1-2 yr) significantly exceeded the WHO recommended dose of 0.1 mSv year^{-1}. The mean values of total AED for infant were 0.872, 0.388 and 0.498 mSv yr^{-1} while those for toddlers were 0.390, 0.249 and 0.275 mSv yr^{-1} due to consumption of NSAS, bottled and tap water; respectively. Also, total AED mean values for age groups 2-7 yr, 7-12 yr and 14-17 yr significantly exceeded that recommended dose

due to consumption of NSAS water. All other total AED mean values for different age group were a little higher the WHO recommended dose, except those for age group > 17 year due to consumption of bottled water.

The mean calculated the Radium Equivalent Activity Index (Ra_{eq}), the External Hazard Index (H_{ex}), the Absorbed Dose Rate (D_{ex}) values were far lower than the safe maximum value and so does not pose a radiological hazard to humans. the External Annual Effective Dose (AED_{ex}) mean were higher than the worldwide average for external outdoor exposures for regions of natural radiation background in 62.5 % of the studied cultivated soils samples, and in only one samples (5.5 %) of the uncultivated soils. the Excess Lifetime Cancer Risk (ELCR) mean values were 0.28 x 10^{-3} and 0.16 x $10^{-3}$for the cultivated and uncultivated soils; respectively.

TABLE OF CONTENTS

LIST OF FIGUERS

LIST OF TABLES

Chapter 1
INTRODUCTION