

## Dedication

To my.....,

Father soul.

Mother soul .

To my family.....,

Who gave me self confident, knowledge, education, happiness and future. To my husband and children with love.

To those.....,

Who guided, supported, encouraged, taught and helped me to achieve this goal. To my university, teachers and colleagues

I dedicate this work

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## Abstract

The subject of this work is a radiological study of environmental radionuclides along the River Nile branch in northern Sudan. Measurements of natural and some artificial (man-made) radionuclides in sediments, water were performed. Twenty eight samples have been collected along the River Nile from Khartoum , Aljaily , Shandi , Atbra , Dongola ,Wawa , Janas and Halfa using the standard sampling procedures. The radioactivity concentrations were measured in  $\text{Bq kg}^{-1}$  ,  $\text{Bq L}^{-1}$  for natural  $^{226}\text{Ra}$  ( $^{238}\text{U}$ ) series,  $^{232}\text{Th}$  series and  $^{40}\text{K}$  and artificial  $^{137}\text{Cs}$  radionuclides . The technique for the measurements of radionuclide concentrations applied is gamma ray spectrometers based on hyper pure germanium ( HPGe ) detectors .

The data obtained for samples were fed and displayed through a computer program and plotted for the activity distribution. The doses received by population along the River Nile have been estimated from the represented results.

This study leads to the following concluded points

- The average activity concentrations of  $^{226}\text{Ra}$  ( $^{238}\text{U}$ ) series,  $^{232}\text{Th}$  series and  $^{40}\text{K}$  in sediment samples measured by gamma spectrometry were 22.31, 25.24 and 372.98  $\text{Bq/kg}$  (dry weight) respectively.
- The activity concentration of  $^{137}\text{Cs}$  in (sediments and water) samples is less than deduction limit (<DL) .
- The activity concentration of radionuclides  $^{226}\text{Ra}$  ( $^{238}\text{U}$ ) series and  $^{232}\text{Th}$  series in some water samples were within the low limit of detection.
- K-40 was detected in water samples with an average concentration of  $110.38 \text{ Bq L}^{-1}$ .

- Higher concentration of  $^{232}\text{Th}$  compared to that of  $^{238}\text{U}$ .
- The Absorbed Dose Rate in Air, Effective dose rate in Air and Radium Equivalent Activity from External Gamma Radiation emitted by (sediments and water) samples selected along the River Nile bank in northern Sudan was calculated from the activity concentrations of  $^{226}\text{Ra}$ ( $^{238}\text{U}$ ) series,  $^{232}\text{Th}$  series and  $^{40}\text{K}$ . All results were found to be less than world maximum values.

These results obtained show that the natural and artificial radioactivity levels of  $^{226}\text{Ra}$ ( $^{238}\text{U}$ ) series,  $^{232}\text{Th}$  series,  $^{40}\text{K}$  and  $^{137}\text{Cs}$  for the selected samples from River Nile bank in northern Sudan are within the normal values of naturally occurring levels, and have been found to be in good agreement with the standard values cited in the literature. Also these data are considered as baseline data for drawing a radiological map of the River Nile in northern Sudan and as reference values that can be used in emergency radiation actions.

## مستخلص

اهتمت هذه الدراسة ببيئة الانوية المشعة على ضفاف نهر النيل بشمال السودان ،حيث تم قياس مستوى تركيز النشاط الاشعاعي الطبيعي والصناعي بعينات رسوبيات ومياه ،جمعت ثمانية وعشرين عينة من الضفاف على طول نهر النيل بداية من الخرطوم ومرورا بالجيلي وشندي وعطبرة ودنفلا وواوا وجنس وحلفا باستخدام طرق التجميع العيارية،تم قياس التركيز الاشعاعي بوحدات Bq/kg,Bq/L للنويدات المشعة الطبيعية لسلاسل ( $^{40}\text{K}$ ، $^{232}\text{Th}$ ، $^{226}\text{R}$ ) والصناعية( $^{137}\text{C}$ ) تم استخدام تقنية مطياف جاما بكاشف جرمانيوم عالي النقاوة وعرضت نتائج العينات خلال نظام كمبيوتر وحسبت الجرعات الاشعاعية الممتصة بواسطة السكان على ضفاف النيل من النتائج المتحصلة.خلصت هذه الدراسة للنتائج التالية:

- متوسط النشاط الاشعاعي الطبيعي في عينات الرسوبيات لنويدات الراديوم-226(سلسلة اليورانسيوم)،الثوريوم-232 ونظير البوتاسيوم-40 المقاس بمطياف جاما هو 22.31، 25.24، 372.98 بيكرل/الكيلوجرام علي التوالي.
- متوسط النشاط الاشعاعي الصناعي ( $^{137}\text{C}$ ) في عينات الرسوبيات والمياه كان اقل من حدود الكاشف الاشعاعي بمطياف جاما.
- متوسط النشاط الاشعاعي الطبيعي في عينات الرسوبيات لنويدات الراديوم-226(سلسلة اليورانسيوم)،الثوريوم-232 ونظير البوتاسيوم-40 في بعض عينات المياه كان اقل من حدود الكاشف الاشعاعي بمطياف جاما.
- نظير البوتاسيوم-40 في عينات المياه له متوسط تركيز اشعاعي 110.38 بيكرل/اللتر.
- هنالك تركيز عالي لنويدات الثوريوم-232 مقارنة مع اليورانسيوم-238.

- معدل الجرعة الممتصة، معدل الجرعة المؤثره والنشاط الاشعاعي المكافئ للراديووم من اشعة جاما المنبعثة من عينات الرسوبيات والمياه المختاره علي طول ضفاف نهر النيل بشمال السودان حسبت رياضيا باستخدام التراكيز الاشعاعية للراديووم-226(سلسلة ليورانيوم)، الثوريوم-232 ونظير البوتاسيوم-40. وجد ان جميع النتائج المحسوبة اقل من القيم العليا العالمية المسموح بها.

توضح النتائج التي تم الحصول عليها ، أن مستوى النشاط الإشعاعي الطبيعي والصناعي للعينات المختارة من نهر النيل بشمال السودان، يقع في حدود المستويات العالمية المسموح بها ، ومتوافق مع القيم العيارية الموضوعه سابقا. كما تعتبر هذه النتائج بمثابة قيم مرجعية لرسم خريطة إشعاعية لبيئة نهر النيل بشمال السودان، وكذلك يمكن الرجوع إليها في حالات الطوارئ

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## Appendix

<i>Symbol</i>	<i>Definition</i>
Becquerel ( Bq )	<b>Unit of radioactivity</b> 1 Bq = $2.7 \times 10^{-11}$ Curie
Gray ( Gy )	<b>Unit of Absorbed radiation dose</b> 1 Gy = 1J / kg = 100 rad
Sievert ( Sv )	<b>Unit of Effective dose</b> 1 Sv = 1 Gy x Q ( quality factor ) = 100 rem
( KeV )	<b>Kilo electron volt ( unit of energy )</b> 1 eV =