

# Chapter one

## Introduction

### 1.1 General background:

In 1896, Henri Becquerel discovered that penetrating radiation was given off in the radioactive decay of uranium [1] and thus opened a new field of study of radioactive substances and the radiation they emit. Since that time, the studies on radioactivity have been an interest of scientific world . The use of radioactive materials has made significant impact in various areas and lead to changes in human practices [2, 3]. In fact, no one can escape from being exposed to ionising radiation. However, the amount of exposure differs depending on human practices and surroundings [4]. For example, staffs in the nuclear industry or patients irradiated with neutron for treatment of tumours receive a different dose compared with members of the public [5].

According to the International Atomic Energy Agency (IAEA) , the main sources of radiation exposure to general public includes natural radiation of terrestrial and cosmogenic origins, internal radioisotopes, medical radiation, technologically enhanced natural radiation and consumer products.

The applications of radiations have become part and parcel in human life. We receive radiation emitted from the floor, walls of our homes, food we eat and drink and the air we breathe. Due to its effects, radiation can be categorized into ionising or nonionising.

Ionising radiation includes x-rays, gamma rays, cosmic rays, and radiation from other radioactive materials, whereas ultraviolet light, microwaves,

radio waves and radiant heat are members of non-ionising radiation [2]. Cosmogenic radionuclides are continually being generated from outer space due to nuclear interactions of cosmic rays with stable atoms such as  $^{22}\text{Na}$ ,  $^{14}\text{C}$  and  $^7\text{Be}$ .

Another contributor of background radiation is the Naturally Occurring Radioactive Materials (NORM). This is because NORM of terrestrial origin is associated with the formation of the earth's crust, and releases radiation everywhere in our surroundings [6]. In addition to cosmogenic and terrestrial sources of radiation exposures, primordial radionuclides have been mentioned as a major contributor of radiation exposure.

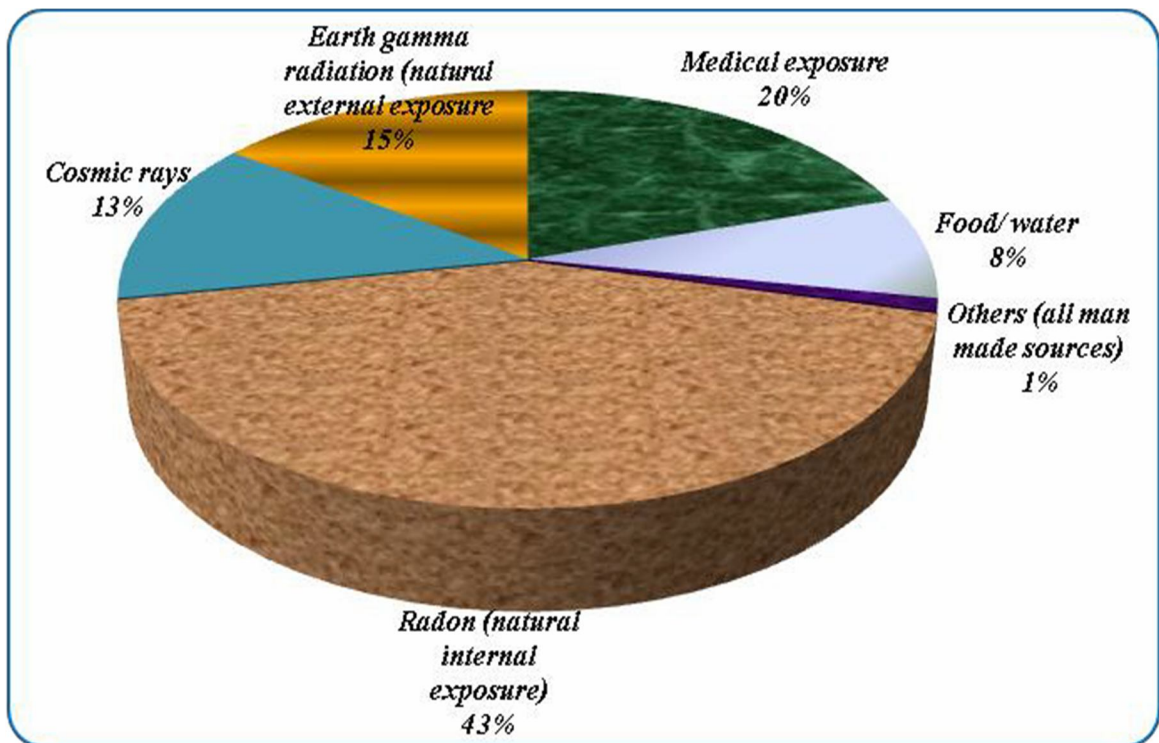


Figure 1.1: Sources of radiation exposure [7]

Apart from natural radioactivity, human activities such as the use of fertilizers contribute to our natural radiation environment [8].

According to the National Council on Radiation Protection (NCRP) report No.95, the raw phosphate materials incorporated into fertilizer contain radionuclide's from uranium and thorium series [9]. Furthermore the human exposure to radiation is a result of anthropogenic nuclides released in the environment through, for example, nuclear weapons testing (e.g.  $^{137}\text{Cs}$ ), radioactive disposal from nuclear sites, (e.g.  $^{241}\text{Am}$ ), radio isotope manufacturing industry (e.g.  $^{90}\text{Sr}$  and  $^{131}\text{In}$ ) or from a nuclear reactor accident (e.g. Chernobyl) [10].

## **1.2 Research problem:**

Contaminations of environment by radioactive materials and heavy elements have direct impact on human health.

This is because it causes some killing diseases like cancer and kidney failure. This needs surveying all areas in Sudan to determine the degree of contamination.

## **1.3 Overview:**

The world interest in the study of Naturally Occurring Radioactive Materials (NORM) has led to the performance of extensive surveys in many countries. Ebaid et al. (2000) studied the distribution of NORM in the northern area of the river Nile [11].

El-Keemsey et al.(2008) surveyed the distribution of natural radioactivity in the northwest Tripoli [12] while Slvasekarapandian et al. (2000) studied the distribution of radioactivity in Indian soils [13]. Malain et al. (2010) reported on the background radiation level of Thailand beach sand [14]. In the preliminary study of the radioactivity level of River Chao Phraya, Santa wamaitre et al.(2010) reported on the possibility of contamination

of River soil due to agricultural activities[15]. Mehra, R.(2010), Veiga, R. et al. (2006) and Matiullah et al. (2004) determined the radiation level of soil in India, Brazil and Bangladesh respectively [16,17,18].

The findings from all studies showed that radionuclide's from  $^{235}\text{U}$ ,  $^{238}\text{U}$  and  $^{232}\text{Th}$  series, and  $^{40}\text{K}$  are dominant radionuclide's in soil samples with varying concentrations from one location to another. These investigations are important for the environmental monitoring, assessment of the public radiation exposure and performance of epidemiological studies, in order to ascertain possible changes due to human and industrial activities [19].

#### **1.4 Objectives of the study:**

This study aims to determine the level of natural radioactivity in highly populated area where people use various activities which contaminate the surface soil and to evaluate the soil pollution with heavy metals for surface and subsurface soil samples (0–5 cm in depth) from various locations to cover the area study. Also aims to establish the data baseline of trace elements from study area that has not been investigated before. [20].

There are different methods used in the measurements of activity concentrations in soil samples. These include laboratory-based measurements using X-ray fluorescence's techniques and  $\gamma$ -ray methods of analysis and in-situ type of measurements [21].

The focus in this study is on X-ray fluorescence's in the laboratory.

#### **1.5 Importance of the study:**

The main highlighted reasons for the importance of Radioactive decay and

half life study is in Health and Medical that it is used in the sterilization of food, medical supplies etc., sterilization of male pest insects to reduce breeding, radiation therapy to kill cancer cells, diagnosis of brain tumours, blocked arteries etc., research into the workings of the brain etc. and in Radio dating and analysis is that used in dating of rocks, deep ice, ocean movements, archaeological facts and remains, chemical mechanisms, equilibrium constants and dynamic exchange, analysis of trace materials and art forgeries. Radiotherapy is widely used for the treatment of some kinds of cancer. In radiotherapy the high energy of gamma radiation is used to kill cancer cells and prevent the malignant tumour from developing. Although this may be successful, there are often unpleasant side effects such as nausea and hair loss. Patients are usually treated in the supine position (lying on their backs). A beam of radiation is shone through the body part to be irradiated. The precise anatomical location is first drawn out on the skin by use of a special marking pen. Alternatively.

### **1.6 Work plan:**

The tasks performed in the undertaking of this research are summarized in the following work plan:

- A. Soil samples were collect from different areas of study.
- B. The sample s prepared and store d in Marinelli beaker s for about 40 days, to allow for the radon radionuclide's to come to equilibrium with its progeny.
- C. X-ray fluorescence (XRF) technique was used to evaluate the soil pollution with heavy metals for 40 surface and subsurface soil samples (0–5 cm in depth) from various locations
- D. The activity concentrations in the soil are determined [5].

- E. The thesis consist five chapters presented as follows:
- I. Chapter one and two concerned with introduction and nuclear radiation.
  - II. Chapter three and four are deals with literature review and experimental works.
  - III. Results, discussion and a conclusion of the work carried out together with the recommendations for future work is given finally.