UNIVERSITI TEKNOLOGI MARA

INDEXING LOW-LEVEL RADIOISOTOPES IN FELDA JENGKA CULTIVATED LAND

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ABSTRACT

Naturally occurring radionuclides such as ^{40}K, ^{226}Ra and ^{228}Ra which emit gamma radiation through their decay process could reach the human in vicinity. The amount of radioactivity concentration of these radionuclides is the important factor in assessing whether it harmful or vice versa. In this study, the oil palm plantation in Jengka 15, Maran District, Pahang Darul Makmur was chosen as a study area, since geographically it has various sections such as slope, flat land and catchments area. The samples were collected using hand auger at specific locations determined by using global positioning system. The surface dose measurement were done *in-situ* using dose rate meter, and the radioactivity concentration levels were done by counting the soil samples using gamma spectrometer with HPGe detector in the laboratory. The concentrations of uranium, thorium and potassium were determined using neutron activation analysis technique. It is found that the mean radioactivity concentrations for ^{40}K are 70.7 ± 12.4 Bq/kg and 55.5 ± 10.9 Bq/kg, 50.5 ± 11.2 Bq/kg and 61.9 ± 12.8 Bq/kg, and 243.0 ± 29 Bq/kg for flats 1 and 2, slopes 1 and 2 and catchments area respectively. The mean radioactivity concentrations for ^{226}Ra are 16.6 ± 0.8 Bq/kg and 17.9 ± 0.8 Bq/kg, 20.1 ± 1.4 Bq/kg and 18.8 ± 1.7 Bq/kg and 22.1 ± 1.1 Bq/kg for flats 1 and 2, slopes 1 and 2 and catchments area respectively. The mean radioactivity concentrations for ^{228}Ra are 22.4 ± 2.5 Bq/kg and 26.9 ± 2.6 Bq/kg, 27.1 ± 3.5 Bq/kg and 24.5 ± 3.1 Bq/kg, and 36.6 ± 13.2 Bg/kg for flats 1 and 2, slopes 1 and 2 and catchments respectively. The mean concentrations of uranium are 3.0 ± 0.2 µg/g and 2.0 ± 0.2 µg/g for flats area, 2.0 ± 0.2 µg/g for slopes area and 3.1 ± 0.2 µg/g for catchments area. The mean concentrations of thorium are 7.7 ± 3 µg/g and 6.9 ± 2 µg/g for flats area, 3.9 ± 1µg/g and 4.3 ± 2 µg/g for slopes area, and 11.4 ± 4 µg/g for catchments area. The mean concentrations of potassium are 1763 ± 14 µg/g and 2148 ± 13 µg/g for flats area, 1484 ± 13 µg/g and 1657 ± 15 µg/g for slopes area, and 6200 ± 13 µg/g for catchments area. The surface radiation dose measured are in the range of 0.057 – 0.200 µSv/h for the whole area. Air absorbed dose, annual effective dose, radium equivalent activity (Ra_{eq}) and radiation hazard index (H_{ex}) are in

CHAPTER 1

INTRODUCTION

1.1 Radioactivity in Nature

Our world is radioactive ever since it was created. Over 60 radionuclides (radioactive elements) can be found in nature, and they can be placed in three general categories i.e. Primordial - formed before the creation of the Earth, Cosmogenic - formed as a result of cosmic ray interactions, and Human Produced - enhanced or formed due to human actions (minor amounts compared to natural). Radionuclides are found naturally in air, water and soil. They are even found in us, being that we are products of our environment. Every day, we ingest and inhale radionuclides in our air, food and the water. Natural radioactivity is common in the rocks and soil that makes up our planet, in water and oceans, and in our building materials and homes. There is nowhere on Earth that we can not find natural radioactivity [1].

Uranium, radium, and thorium occur in three natural decay series, headed by ^{238}U, ^{232}Th and ^{235}U. In nature, the radionuclides in these three series are approximately in a state of a secular equilibrium, in which the activities of all radionuclides within each series are nearly equal [2]. By emitting particles, the original (or parent) element alters its composition to another element known as the daughter element. If the daughter element is also radioactive, then it will emit a particle and decay into yet another daughter element. The decay process continues until the final daughter product is no longer radioactive [3].

Radium, one of the daughter product in the uranium and thorium decay series, is a common naturally occurring radionuclides in soils. The most radiotoxic of the natural radionuclides is ^{226}Ra, since it is an alpha emitter with a relatively long half-life and with dynamics similar to calcium, an element essential to living beings and with which it