

**UNIVERSITI TEKNOLOGI MARA**

**ACCUMULATION OF  
NUTRIENTS AND RADIONUCLIDES  
FROM PLANTATION AREAS  
INTO LAKE SEDIMENT**

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Thesis submitted in fulfillment  
of the requirements for the degree of  
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## AUTHOR'S DECLARATION

I declare that the work in this thesis/dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as reference work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree of qualification.

I, hereby, acknowledge that I have been supplied with Academic Rules and Regulation for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

A nutrient is the important component for plant growth. Fertilizer is added into the soil to supply more nutrients for the plants. The excessive usage of fertilizer at plantation areas will lead to the nutrients loss through leaching and into catchment area carried by water from runoff. Cameron Highlands as study areas was chosen because of the excessive agriculture activity and the present of Lake of Sultan Abu Bakar Dam as catchment area. Soil samples were taken from two tea plantation (Bharat Tea Plantation and Boh Tea Plantation) and sediment was taken at Lake of Sultan Abu Bakar Dam. Nutrients and radionuclides content in soil and sediment were measured to determine the concentration, radiation hazard index and accumulation occur at tea plantation areas and Lake of Sultan Abu Bakar Dam. The measurements include the profile distribution in soil and sediment. Measurement of nutrients and radionuclides was carried out using CHNS analyzer, EDXRF and Gamma spectrometer. The nutrients (N, P and K) and radionuclides ( $^{226}\text{Ra}$ ,  $^{228}\text{Ra}$ ,  $^{40}\text{K}$ , U and Th) at plantation B (Boh Tea Plantation) is higher than plantation A (Bharat Tea Plantation). N and P shows decreasing trends through the depth whereas K shows no observable trends in soil. In sediment, P and K show monotonic trends through the depth and N was not detected in sediment. Radionuclide does not show any observable trends through the depth in soil and sediment. The concentration range of N at tea plantation areas is not detected – 3490 mg/kg for Plantation A and 400 – 9760 mg/kg for Plantation B. Concentration of P range from 596 - 2712 mg/kg for Plantation A and 591 - 7956 mg/kg for Plantation B. The concentration of K in soil is range from 922 – 10597 mg/kg for Plantation A and 3759 - 15846 mg/kg for Plantation B. In sediment P range from 1144 mg/kg - 1745 mg/kg and K is 10018 mg/kg - 17759 mg/kg. The concentration of N in sediment was not detected due to the low concentration. The activity concentration of radionuclides was measured using gamma spectrometer in soil and sediment. The range activity concentration for  $^{226}\text{Ra}$  is 44.76 - 86.31 Bq/kg for Plantation A and 70.20 - 142.89 Bq/kg for Plantation B.  $^{228}\text{Ra}$  is range from 77.04 - 195.53 Bq/kg for Plantation A and 157.12 - 280.11 Bq/kg for Plantation B.  $^{40}\text{K}$  range from 78.67 - 491.43 Bq/kg for Plantation A and for Plantation B is range from 192.08 - 628.84 Bq/kg respectively. The external hazard index ( $H_{\text{ex}}$ ) at plantation B is higher than one whereas plantation A below one but annual effective dose still in range proposed by UNSCEAR 2008 0.3-1.0 mSv/y. The accumulation of nutrients and radionuclides in sediment was calculated by estimation of sedimentation rate except for N that was not detected in sediment. The cluster analysis for nutrients and radionuclides for both plantation show different cluster group of elements. This may be due to the different of soil texture, pH, topography and origin of the elements.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 BACKGROUND OF THE RESEARCH

Cameron Highlands is well known as agriculture areas that supply vegetables, fruits and industrial crop. To maintain the product of the crops, fertilizer is used to supply of nutrient to the plant. The native nutrient in soil generally is not enough to support growth of mass production of the plant. Therefore fertilizer is one of the important nutrients sources for agriculture production. Fertilizers are organic or chemical substance that added to soil to enrich it with nutrient for growth of the plant. Fertilizer is broadly used in agriculture activities which used large amount of fertilizers in one time of application. The excessive usage of fertilizer application could cause a long term effect. Fertilizers that were not been absorbed by the plant will accumulated in the soil. The fertilizers that was applied to the soil either sweep by the runoff or leaching into the soil. The activities of fertilizing will directly and indirectly affect the environmental ecosystem. Pollution such as water pollution could occur at the water bodies that could cause eutrophication. The major component of elements that accumulate in the soil causes by the fertilizer is nitrogen, phosphorous and potassium. The migration of the fertilizers will lead to soil contamination with these elements. Besides major component of nutrients (N, P and K), other compound present with fertilizer is low level radionuclides in it and emit low radiation from it. When the nutrients and radionuclides starting to accumulate, the low level of radiations increase (Tufail, 2009).

This study investigates the distribution of nutrients and radionuclides elements in soil and sediment to determine the extent of migration and accumulation. The movement of nutrient and radionuclides from soil into lake through soil erosion and runoff increase during rainy season. This study involves investigation on vertical (depth profiling) distribution on soil surface land and lake sediment. Therefore the level of these elements (N, P, and K) and radionuclides were measured. Nuclear method and other conventional method were used in this study. The instruments that were used are CHNS Analyzer, Energy Dispersive X-rays Fluorescence spectrometer