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Full Length Article

Spatial distribution and lifetime cancer risk due to gamma radioactivity in Yelagiri Hills, Tamilnadu, India

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ABSTRACT

The spatial distribution of natural radioactivity due to uranium, thorium and potassium was investigated in soils from the undisturbed areas in Yelagiri Hills, Tamilnadu, India by Isodose map. The radiological hazards due to natural radionuclides content such as representative level index (RLI), activity utilization index (AUI), excess lifetime cancer risk (ELCR) and internal radiation hazards (H_{in}) of the soil samples in this area were calculated. The calculated radiological hazard parameters are compared with different countries of the world. The calculated range of ELCR is 0.326×10^{-3} to 1.067×10^{-3} with an average of 0.700×10^{-3} for soils. This average value of ELCR is more twice than the world average (0.290×10^{-3}). A correlation analysis was made between measured dose rate and individual radionuclides, in order to delineate the contribution of the respective nuclides toward the dose rate. The U/Th concentration ratio in surface soil samples ranged from 0.05 to 1.72 with an average of 0.43 which is more higher (80%) than the world average of 0.26. The application of cluster analysis (CA) and principal component analysis (PCA), coupled with Pearson correlation coefficient analysis, were utilized to analyze the data, identify and clarify between the radiological parameters to know the existing relations. The CA and PCA results showed that the former method yielded three distinctive groups of the soil variables

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whereas the latter one yielded the number of variables into two factors with 94.47% variance explanation.

1. Introduction

The radioactivity level from the natural radionuclides is termed as background radiation which will depend on the amount of the radioactive materials in the environment. The background radiation can be high if the environment is polluted either from man-made or natural activities. Materials from the deposit may be brought to the surface soil through processes such as weathering of rocks and soil formation. They can also leach into the groundwater system, contaminate it, and lead to pollution far away from the source.

Natural radioactivity arises mainly from the primordial radionuclides, such as ^{40}K and the radionuclides from ^{238}U and ^{232}Th series and their decay products, which are present at trace levels in all ground formations [1]. Monitoring the release of gamma radiation from natural radionuclides is important to protect the humans from lung cancer. The main sources of gamma radiations are due to two major radionuclide chains: uranium–radium and thorium. A geological and geographical condition of the study area determine the radioactivity and the associated external exposure due to gamma radiation at different levels in the soils of each region in the world [2–4].

The data will offer useful and necessary information in the monitoring of environmental contamination which will provide appropriate and better protection guidelines to the public.

The distribution of radionuclide concentration reflects migration of uranium and thorium under surface soil condition. The ability of hydrogenous migration falls in the order U > Ra > Th. Uranium is able to remain in soluble state for a long time and gets migrated by flow of streams or river to a long distance. Horizontal transfer of uranium and thorium is dominated by interchange of sorption and desorption [5]. Unfortunately rapid increasing of population and usage of fertilizers for agriculture day by day contaminate the soils. Due to one of the main tourism places in Tamilnadu, point and nonpoint pollution sources are dominated in study area. Hence it is necessary to determine the concentration levels of the ^{238}U and ^{232}Th as well as ^{40}K in the soil from Yelagiri hills, Tamilnadu, India and to analyze the spatial distribution of natural radionuclides by Isodose map with statistical approach.

2. Previous work

In an earlier work, activity concentration of natural radionuclide that in different locations of Yelagiri Hills is reported by Ravisankar et al. [4]. They indicated that average activity concentration of ^{232}Th in that study was 1.19 times higher than world median value while the activity of ^{238}U and ^{40}K was found to be lower and also major gamma radiation exposure to humans in Yelagiri Hills due to enrichment of ^{232}Th content in soils [4]. The present work is a continuation of the previous research work in Yelagiri Hills, Tamilnadu to study the spatial distribution of natural radionuclide and the application of Multivariate statistical method to analyze the data, identify and clarify between the radiological parameters to know the existing relations.

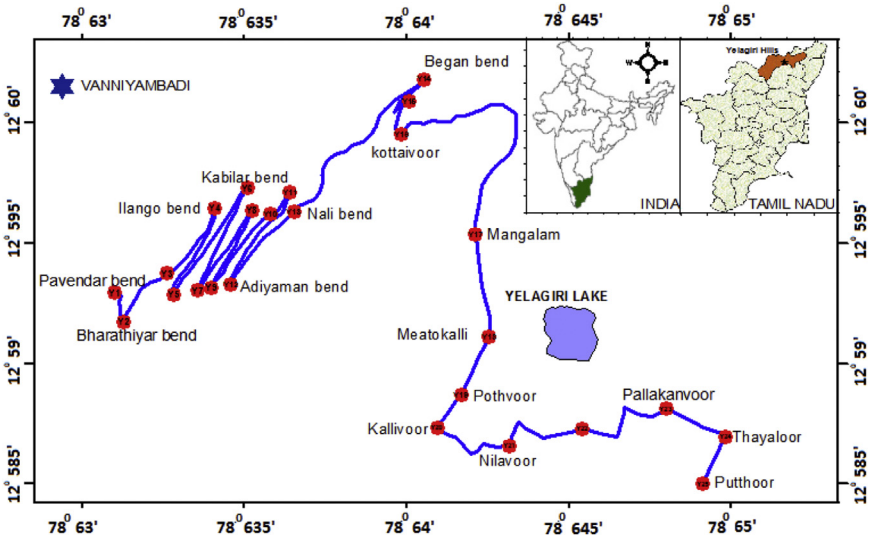

Fig. 1 – Soil samples collected at different sampling points of Yelagiri Hills, Tamilnadu, India.