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RESEARCH ARTICLE

ASSESSMENT OF AMBIENT GAMMA RADIATION LEVEL IN THE TOBACCO CULTIVATED AREAS OF DINDIGUL AND ERODE DISTRICTS OF TAMILNADU

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ABSTRACT

Natural radioactivity is widespread in the earth environment and it exists in various geological formations such as earth crust, rocks, soils, plants, water and air. The natural radiation exposure level around the globe usually varies by different factors. The natural ambient gamma survey in tobacco cultivated field soil samples along Dindigul and Erode districts of Tamilnadu, India, has been carried out using a The ECIL, Scintillometer, type SM 141E. The total average concentration of ambient gamma is found as 8.54 (μRh^{-1}). The total average absorbed dose rate in the study areas is found to be 74.03 ($nGyh^{-1}$), where as the annual effective dose rate has an average value of 0.085 ($mSvy^{-1}$). The difference in the results may due to variation in the altitudes of region and unequal distribution of gamma radiation in these locations. The overall results depict that even lesser amount of radiation exposure is producing more problems to human beings.

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INTRODUCTION

The radioactive elements and their radiations are indispensable part of the nature. Human beings are always exposed to background radiation that stems both from natural and man-made sources. Natural radioactivity is widespread in the earth environment and it exists in various geological formations such as earth crust, rocks, soils, plants, water and air. Natural radioactive concentration mainly depends on geological and geographical condition and appears at different level in soils of each different geological region (UNSCEAR, 2000). The ^{238}U, ^{232}Th and along with daughter products and the singly occurring radioisotopes ^{40}K in soil and rocks are the major source of gamma radiation in the environment.

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They emit gamma ray of sufficient intensity either directly or from the daughter products and contribute significantly to the gamma absorbed dose of the population (Iyer *et al*., 1994). The three major way of radiation exposure are the entire body irradiation in the background gamma field, inhalation of air borne radioactivity especially the short lived radon – Thorn-decay products, and ingestion of radioactive elements via food and water. The gamma ray emitted from the ground are absorbed and scattered in the air. This external gamma dose rate varies widely from place to place, but for any given area, it remains reasonably constant. Environmental radioactivity measurements are necessary for determining the background radiation level due to natural radioactive sources of terrestrial and cosmic origins (Shashikumar *et al*., 2011). Around the world the elevated levels of background radiation are found in the countries such as Brazil, China, India and Iran (Roser and Cullen, 1964; Nambi, 1994).

Radionuclide activity concentration in soil is one of the main determinants of the natural background radiation (Taskin *et al*., 2009). The present study is focused to survey the ambient gamma radiation and their effects, evaluation of transfer of radiation to tobacco soil and tobacco plant and population of Dindigul and Erode Districts.

MATERIALS AND METHODS

Study Area

The study area selected is Tobacco cultivated fields soil which covers the areas of Dindigul (11°30.870'N, 077°57.722'E) and Erode (10°32.256'N, 077°57.039'E) (longitude and latitude) districts, Tamilnadu (India). 42 location sites (Figure 1; and Table 1) from these two districts were used for the survey from the December-2012 to April -2013. Locations are recorded in terms of degree minute second (Latitude and Longitudinal position) using hand held Global Positioning System (GPS) (Model: GARMIN GPS-12) unite and the distance between each site is 3-6 km.

Scintillometer

The ECIL, Scintillometer, type SM 141D is used to measure terrestrial gamma radiation levels. It is a rugged, light weight and portable scintillometer designed for radiometric, geophysical and environmental reconnaissance survey. The microcontroller based design employs accurate measurement of radiation level and the large crystal volume employs reliable statistic, the radiation levels are displayed on the 2×16 LCD module having antiglare and back light facilities, which facilities better visibility under direct sun light and even in low light conditions.

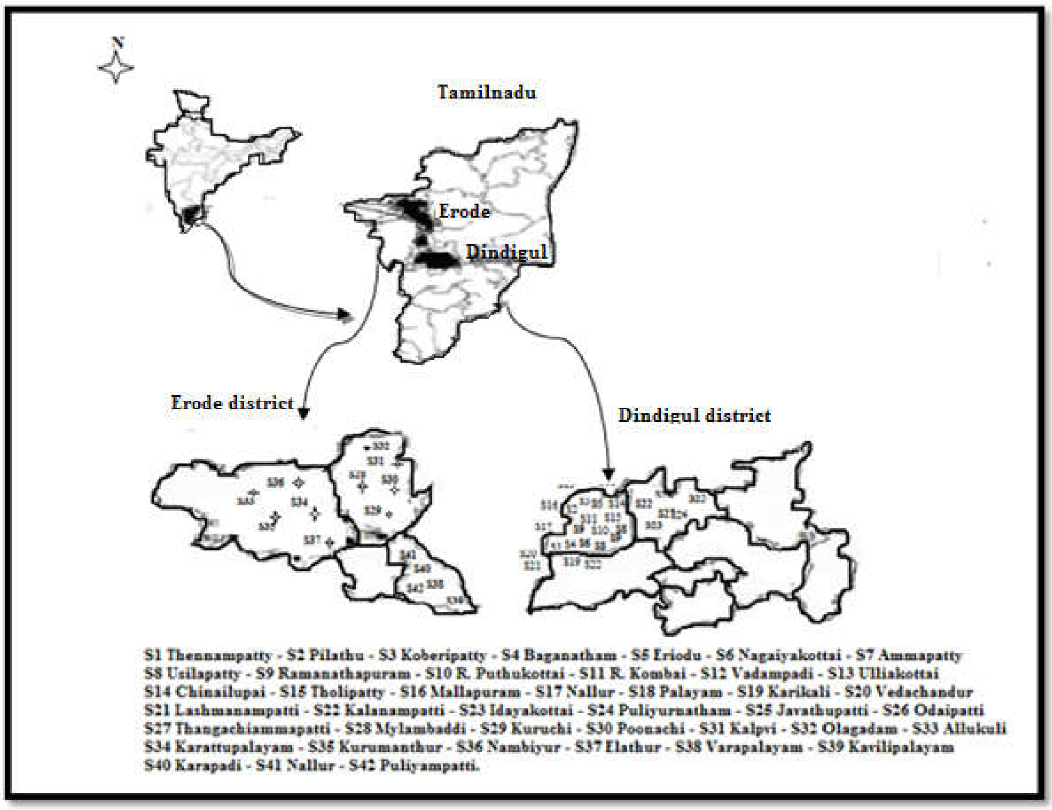

Figure 1. The sampling locations in of Dindigul and Erode Districts are shown in the map

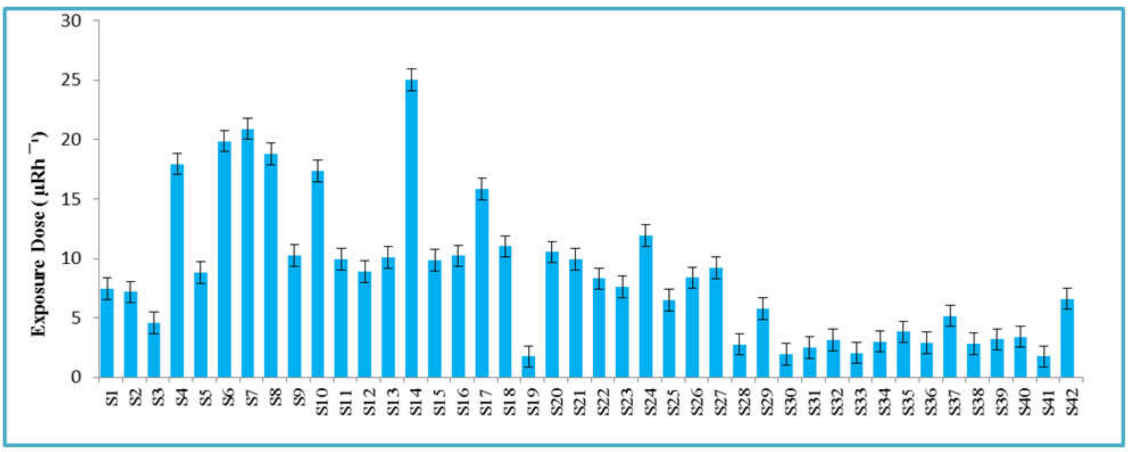

Figure 2. Exposure dose rate from sampling stations

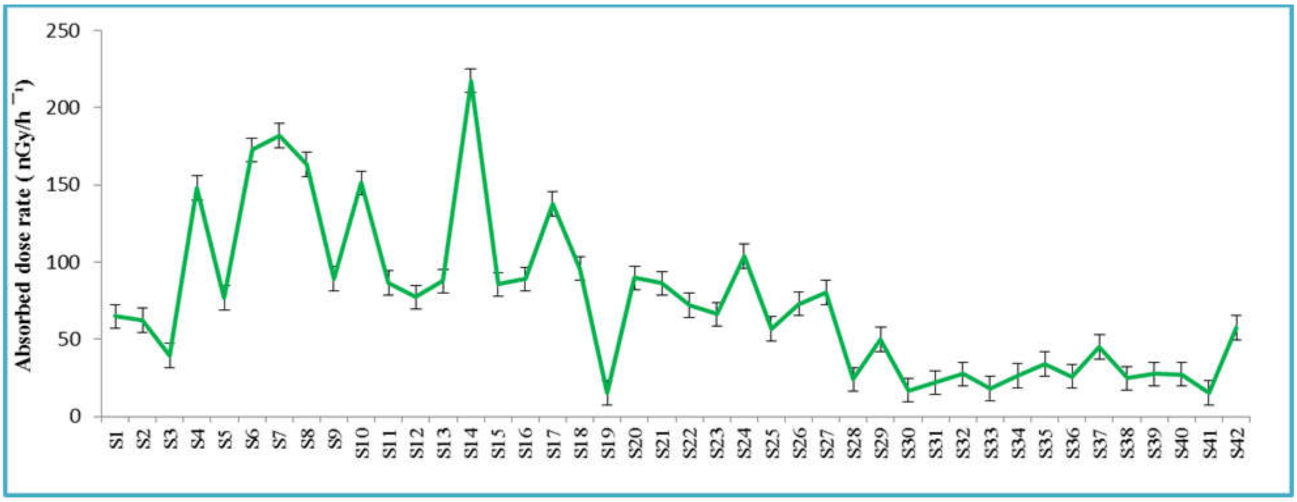

Figure 3. Absorbed dose rate from sampling stations

Table 1. Different location sites and their GPS position

Site No	Name of the Site	GPS Position	
		Latitude	Longitude
S1	Thennampatty	78°05.840'E	10°28.580' N
S2	Pilathu	78°06.557'E	10°28.845' N
S3	Komberipatty	78°07.456'E	10°30.822' N
S4	Baganatham	78°05.599'E	10°30.492' N
S5	Eriodu	78°03.856'E	10°31.509' N
S6	Nagaiyakottai	78°03.778'E	10°33.323' N
S7	Ammapatty	78°01.212'E	10°32.740' N
S8	Usilapatty	78°01.993'E	10°34.400' N
S9	Ramanathapuram	78°01.993'E	10°35.737' N
S10	R. Puthukottai	78°03.016'E	10°36.544' N
S11	R. Kombai	78°06.549'E	10°36.574' N
S12	Vadagampadi	78°05.604'E	10°37.603' N
S13	Ulliakottai	78°04.390'E	10°40.105' N
S14	Chinnailupai	78°05.669'E	10°39.917' N
S15	Tholipatty	78°04.042'E	10°39.351' N
S16	Mallapuram	78°02.688'E	10°30.828' N
S17	Nallur	78°03.498'E	10°41.117' N
S18	Palayam	78°06.498'E	10°41.941' N
S19	Karikali	78°06.498'E	10°41.941'N
S20	Vedachandur	77°57.039'E	10°32.256' N
S21	Lashmanampatti	77 ° 57.582'E	10°32.740' N
S22	Kalanampatti	77 ° 57.988'E	10°32.730' N
S23	Idayakottai	77°53.523' E	10°31.436,N
S24	Puliyurnathan	77°50.025'E	10°32.002'N
S25	Javathupatti	77° 51.053'E	10°31.350'N
S26	Odaipatti	77°47.095'E	10°35.232' N
S27	Thangachiammapattti	77°42.025'E	10°29.232' N
S28	Mylambaddi	77°40.722'E	11°30.870'N
S29	Kuruchi	77°41.564'E	11°34.031'N
S30	Poonachi	77°39.397'E	11°36.294'N
S31	Kalpavi	77°41.633'E	11°33.740'N
S32	Olagadam	77°38.471'E	11°34.151'N
S33	Allukuli	77°21.379'E	11°26.751'N
S34	Karattupalayam	77°21.353'E	11°26.906'N
S35	Kurumanthur	77°20.874'E	11°24.815'N
S36	Nambiur	77°19.313'E	11°21.679'N
S37	Elathur	77°18.430'E	11°23.293'N
S38	Varapalayam	77°13.958'E	11°22.344'N
S39	Kavillibalayam	77°13.885'E	11°23.186'N
S40	Karapaddi	77°12.057'E	11°22.741'N
S41	Nallur	77°08.377'E	11°30.870'N
S42	Puliyampatti	77°10.490'E	11°34.031'N

The use of the scintillation detectors renders the SM 141E highly sensitive as compared to the survey meters featuring GM detectors.

To investigate the extent of background gamma radiations levels in the tobacco cultivating area of Dindigul and Erode districts, detailed radiation survey over an extended tobacco plant cultivating area using scintilomentric surveys were carried out. The ambient gamma is known as terrestrial gamma. The exposure dose of gamma radiation on soil, absorption rate on tobacco plant and their effective dose rate for tobacco users were calculated to assess the impact of radiation (UNSCEAR 2000).

RESULTS AND DISCUSSION

The 42 locations of tobacco cultivations are recorded in terms of degree minute second (Latitude and Longitudinal position) using hand held Global Positioning System (GPS) in December-2012 to April-2013 which is the season for tobacco cultivation (Figure 1; and Table 1).

Table 2. Terrestrial Gamma radiation levels in Tobacco cultivated field soil for different study sites

Sampling site	Exposure Dose (μRh^{-1})	Absorbed Dose (nGyh^{-1})	Effective Dose (mSvy^{-1})
S1	7.45	64.8	0.07
S2	7.18	62.4	0.07
S3	4.55	39.5	0.04
S4	17.95	147.9	0.18
S5	8.83	76.8	0.09
S6	19.86	172.7	0.21
S7	20.91	181.9	0.22
S8	18.77	163.2	0.20
S9	10.27	89.3	0.10
S10	17.38	151.2	0.18
S11	9.92	86.3	0.10
S12	8.88	77.2	0.09
S13	10.07	87.6	0.10
S14	25	217.5	0.26
S15	9.83	85.5	0.10
S16	10.22	88.9	0.10
S17	15.85	137.8	0.16
S18	11.01	95.7	0.11
S19	1.75	15.2	0.01
S20	10.53	89.6	0.10
S21	9.91	86.2	0.10
S22	8.3	72.1	0.08
S23	7.61	66.2	0.08
S24	11.93	103.7	0.12
S25	6.51	56.6	0.06
S26	8.38	72.9	0.08
S27	9.23	80.3	0.09
S28	2.77	24.0	0.02
S29	5.75	50.0	0.06
S30	1.95	16.9	0.02
S31	2.51	21.8	0.02
S32	3.16	27.4	0.03
S33	2.05	17.8	0.02
S34	3.01	26.1	0.03
S35	3.82	33.7	0.04
S36	2.92	25.9	0.03
S37	5.16	44.8	0.05
S38	2.83	24.6	0.03
S39	3.19	27.4	0.03
S40	3.41	27.3	0.03
S41	1.75	15.2	0.01
S42	6.61	57.5	0.07
Mean	8.54	74.03	0.085
Range	1.75 – 25	15.2 – 217.5	0.01 - 0.26
SD	5.86	50.69	0.062

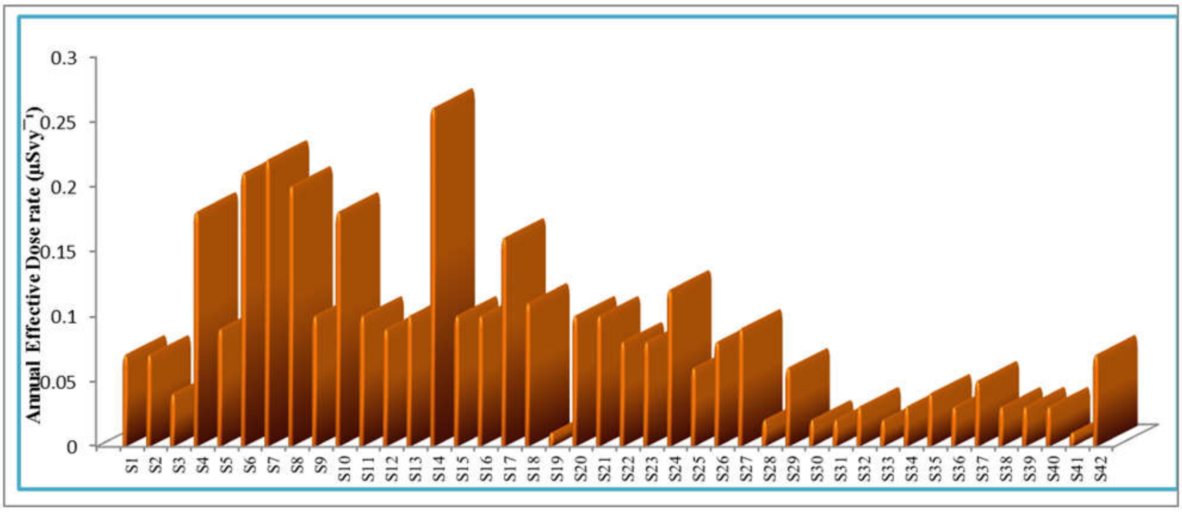

Figure 4. Annual effective dose rate from sampling stations

The terrestrial Gamma radiation levels in the study area of Tobacco cultivated field soil are given in Table 2. The Gamma radiation level ranges from 1.75 to 25μRhr^{-1}. The result reveals the non-uniform distribution of Gamma radiation among the study area. The minimum level of 1.75μRh^{-1} in Nallur of Erode district (S42) and a maximum level of 25 μRh^{-1} (S14) Chinnailupai of Dindigul district were recorded in the Tobacco cultivated soil of Dindigul and Erode districts. During the survey period an irregular distribution of radiation profile was observed (Table 2 and Figure 2). The results show that the gamma radiation is very low in these locations comparing to world range (28 - 120 μRhr^{-1}) which is analyzed by Raju and Sing (2001). The mean value of gamma radiation levels in the study area of Tobacco cultivated soil of Dindigul and Erode districts are lower (8.57μRhr^{-1}) when compared to mean value (74 μRhr^{-1}) of coastal area of Karnataka (Narayana *et al*., 1995) and the results of Mishra and Sadasivan (1971) also reveals the same trend for different regions of India with high value of gamma radiation (80.7 μRhr^{-1}) and the works of Ravikumar (2001) also show high gamma radiation (10 – 450 μRhr^{-1}) in the areas of coastal Gulf of Mannar and in Kerala, the gamma radiation is more high (100- 3000 μRhr^{-1}) in coastal area (Pilla and Kamath, 1966). In the coastal region of Kanyakumari district of Tamilnadu reported a gamma level ranging from 200 to 1600 μRhr^{-1}. The absorbed dose rate of gamma radiation by the tobacco plants were measured in the selected villages in Erode and Dindigul districts. The results showed that the plants in the S14 has highest absorption rate (217.5 nGyh^{-1}) where as S41 has lowest absorption rate (15.2 nGyh^{-1}). The overall results show that the tobacco plants of the survey region have a mean gamma radiation of 50.69 nGyh^{-1}. It is evident that the plants have high absorption of gamma radiation than gamma radiation exposure to the tobacco cultivating soil (Table 2 and Figure 3). The natural radiation exposure level around the globe usually varies by factor of about 3 (Zerquera *et al*., 2001), but in some locations, however, typical levels of natural radiation exposure exceed the average levels by factor of 10 and sometimes even by factor of 100 (Bouzarjomehri and Ehrampoush, 2005). The annual effective doses of the tobacco cultivated field soil were calculated from equivalent dose rates multiplied to time and the occupancy factors of 0.02 for environment. The results of annual effective dose show that the tobacco grown in S14 has high effective dose compared to other villages of the survey region (Table 2 and Figure 4). The difference in the results may due to variation in the altitudes of region and unequal distribution of gamma radiation in these locations. According to Bouzarjomehri and Ehrampoush (2005) the cities in different altitudes have different exposure rate of gamma radiation.

Conclusion

This study is focused on the ambient gamma survey of tobacco cultivated field soil samples and the resulting radiation dose from ambient gamma radionuclides. In addition to that, the estimation of the absorbed gamma dose rate, and the annual effective dose rate were also studied .The data presented in this study will serve as a base line survey for primordial radionuclides concentration and radiation exposure in the tobacco cultivated areas. Further investigation is still needed to measure the ^{210} Po and ^{210} Pb from tobacco plant including root, shoot and Leaf.

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