Trans. Inst.Indian Geographers
Vol. 16 No.2, July 1994

SPATIAL ANALYSIS OF THE DISTRIBUTION OF RADIOACTIVITY IN THE HIGH NATURAL BACKGROUND RADIATION AREAS OF KERALA, INDIA

MURALI KRISHNA.M, NANDAKUMAR.D, PADMANABHAN.V.T., Kerala

ABSTRACT - High Natural background radiation areas have been identified as a valid field of investigation for the assessment of the effects induced by low-level exposure. In the present study a datailed dosimetric survey was done with a portable gamma counter. It was found that the radiation intensities decrease from south to north and from west to east of the study area. The average dose recorded was 621 mR/year with a maximum reading of 3200 mR/year. In the subsequent survey the presence of radon concentration was found normal. The material sheilding effect was found to be highest in concrete houses.

INTRODUCTION

Ionising radiation can manifest impairment of physical growth and mental development on exposed individuals or genetic effects in subsequent generation. Though it is widely accepted the linear hypothesis of dose response curve at higher dose, scientific community yet cannot fix the lower threshold of radiation levels.Studies reveal that even low-level ionisation radiation received through generation can manifest genetic anomalies in their offsprings (Padmanabhan, 1987).

The main source of natural background radiation is from the concentration of rare earth minerals. The beach sands of Ganjam (Orissa), Manavalakurichi (Tamilnadu) and Kollam (Kerala) containts these thorium-uranium bearing monazite minerals which are radioactive. The thorium content of monazite in Kerala region ranges from 8.0 to 10.5% and is highest in the world. The monazite belt present elsewhere in the world are China, Brazil and Ninu Island of South Pacific.

Geologists are of the opinion that these rare earth concentration in Kerala region came from the Archaean gneisses which occupy much of the Western Ghats, the parallel rock ridge of coastal Kerala. Due to the weathering action the sediments are brought to Arabian sea through the fast flowing rivers. On the beaches, wave action has concentrated these heavy mineral sands into rich placers. The coastal villages of Kerala are densely populated (1200 person/sq km) living here for generations.

STUDIES SO FAR:

The pilot dosimetric study in the monazite sands of South India was done by Bharatwal and Vaze (1957) using Milliroentgen Metre with a Geiger Muller Counter. The study area extend from Needakara in Kollam district to Manavalakurichi in Kanyakumari. A dosimetry survey in 50 houses at 27 locations and at various points on the beach was carried out in 1956. The result showed natural backg[illegible]nd

radiation level varying from 3 to 50 times. In the second survey in 1957 using a ionisation chamber milliroentgen metre the same team surveyed 200 houses in a total area of 23 sq km.

Dosimetric study was conducted using thermoluminiscent dosimeters by Ayengar et.al. (1971) with 15% sampling. 12,000 dosimeters were distributed among individuals and dwelling units in the study area. According to the study 3.4% of the study population is exposed ton 5 to 10 times high the normal background radiation. The highest annual exposure value encountered for a dwelling unit was 3480 mR/ year for an individual.

Raju et. al. (1986) carried out radiometric survey in whole of Trivandrum district, Kerala and identified several localities having high natural background radiation.

THE PRESENT STUDY

A detailed micro level dosimetric survey has been conducted in these monazite villages of Kerala. The area bounds within 8^0 45' to 9°15' N latitude and 76° 34' to 76° 51' E longitude. With an average of half km width the land strip is sandwiched between Arabian sea in the west and backwaters in the east. The study area includes Neendakara, Chavara, Panmana and Alapped Panchayats, the coastal villages of Kollam district of Kerala. The majority of the population in the area are Hindus who are traditional fisherfolk Christians and Muslims also live here with the later in marginal number. Majority of the people are engaged in fishing and related activities.

MATERIALS AND METHODS

The spatial diversity in the concentration of mineral and intensities of natural background radiation needs the micro level field dosimetry survey The levels of gamma radiation is measured by a portable gamma counter. The counter was calibrated at the Regulation Biology Laboratory of Saitma University, Japan and at nuclear Physics Laboratory, Calicut University, Kerala at periodic intervals. The study area was divided into rectangular grids of 500 × 250 mts. and house numbers in each rectangular grides were recorded for the systematic recording of the exposure levels. About 2070 measurments were taken randomly, in the study area from 694 points at a height of 1000 cm and 10 cm above the ground. Measurments were also taken at the corners of the rectangular grids to check the variation. Panchayat wise and ward wise mean dose were computed. With the 2070 measurments and simultaneously taken prismatic compass measurements, map on levels of dose dostribution and mean ward wise dose distribution was prepared (see fig no. 1)

The details of gamma exposure in different panchayats/villages at 1000 cm and above ground is given in the table no. 1

Table No.1.
Panchayat wise gamma exposure in the study area.

Panchayats	Mean dose in/mR/year 1000 cm	10 cm
Alappad	460	528
Chavara	501	602
Neendakara	973	1140
Panmana	428	466

In the study area the dose rate ranges from near 100 mR/year to 3200 mR/year with a mean of 621 mR/year (1000 cm above ground).

It is observed that in the study area 29% of the population receives an ammual dose of 201-500 mR, 44% of the population resides in 501-750 mR region and the rest of population, 25%, receives an exposure above 750 mR. The detalis of population and the

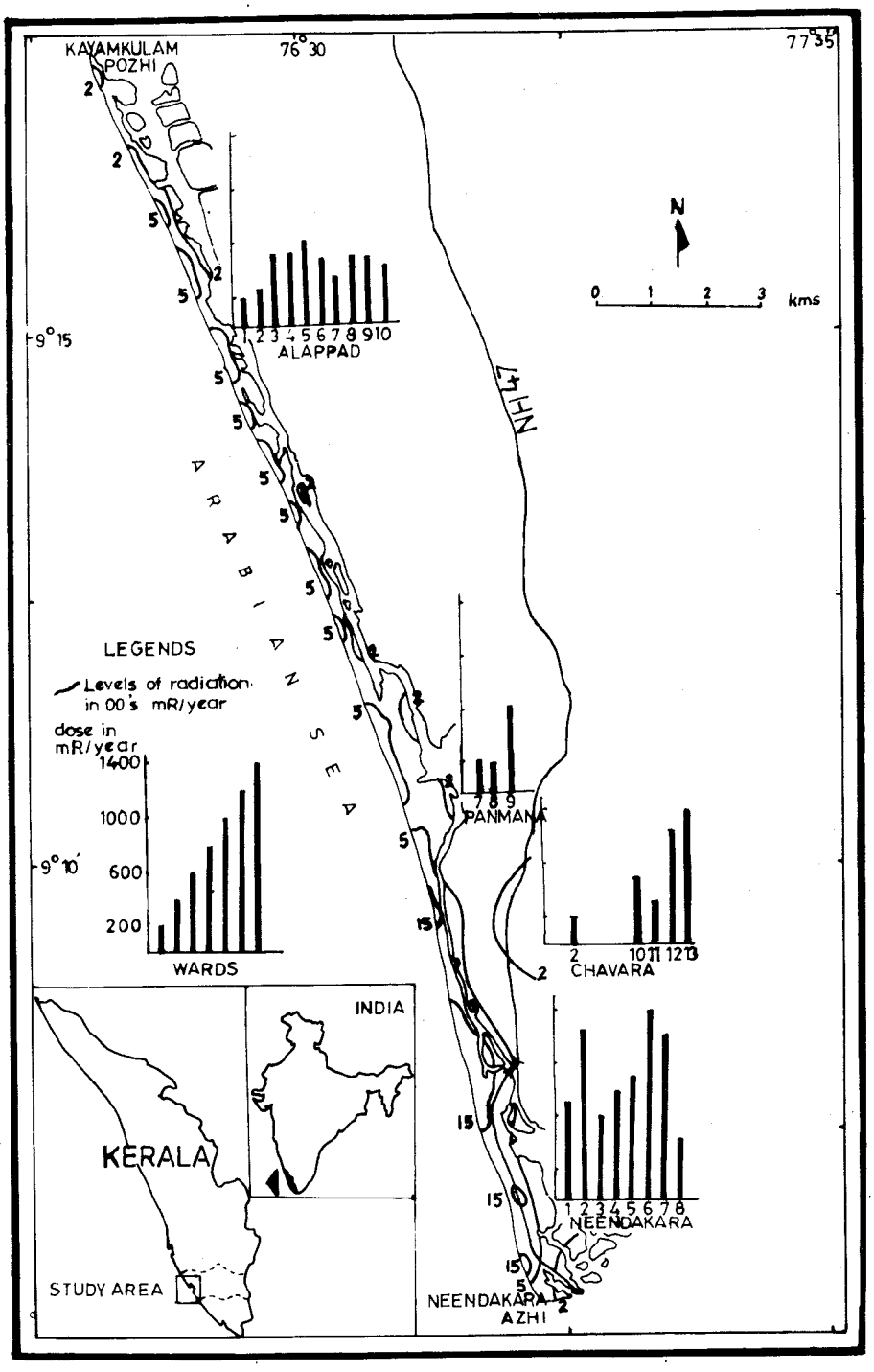

Fig.No.1 Map showing levels of Natural Background Radiation and ward wise distribution of dose on Neendakara Chavara region, Kollam, Kerala.

house type at various exposure above 750 mR. The details of population amd the house type at various exposure levels are given in the table no. 2.

Table No. 2.

Details of population distribution in different dose contours.

Dose in mR/year	Population	%	House type in % A*	B*	C***
201-500	11272	29.11	30.8	28.2	28.0
501-750	17160	44.32	44.5	41.7	44.6
750 +	10278	26.55	24.6	29.9	27.3

A* - Huts with thatched walls and roof. Usually such houses are found in the beach area. The floor materials are mostly cowdung mixed with the local sand.

B** - Houses with mud walls, thatched roof and cemented floor.

C*** - Concrete houses.

Higher intensities of radiation concentration is seen along the coastal region than the inland. The frequency distribution of dose measurment shows that recurrence of readings ranges between 201-500 mR is high in whole though the higher recurrence is seen along the eastern portion that is along the backwaters. Higher measurment was observed along the coastal region than the inland. The frequency distribution of dose measurment shows that recurrence is seen along the eastern portion that is along the backwaters. Higher measurement was observed along the coastal region especially on the southern portion of the study area.

The frequency distribution of the different dose groups is shown in the table no. 3.

Table No. 3.

Frequency of measurements at various dose group

Dose group in mR/year	No. of measurements at 1000 above the ground	%	10 cm above the ground	%
Upto 200	110	16.56	88	12.77
201-500	314	47.28	304	44.12
501-750	86	12.94	77	11.17
750 +	184	27.71	220	31.93

From the recorded data an attempt is made to calculate the rate of shielding effect of air. A factor ranging from 0.05 to 0.11 is obtained.

To assess the material shielding effect of different building materials measurments have been taken at various positions of different house types. Measurments were taken at the entrance varandhas and inside the living room. For this, a sample of 100 houses were selected which includes A, B and C type houses. Three measurments were taken at each position and the mean is used for computing the shielding factor. The shielding factor ranges from 0.45 t0 0.25 of C-type house to A-type houses in the room and 0.42 to 0.27 in varandha. Details is given in the table no. 4.

Estimation of radon levels

Indoor radon and thoron concentration in air was assessed by radon survey using cellulose nitrate radon sampler.

Radon (220 and 222) concentrations were measured in 10 dwellings using cellulose nitrate radon samplers. The devices were placed on walls, 2 meters above ground for 90 days and were analysed as not found. According to Karl z. Morgan this is due to the short half life period of thorium progency of randon 220, the level would not be higher than the normal.

Table No. 4.

Shielding effect of building materials

House type	Measurments taken at Room		Varandha	
	No. of house	Dose factor	No. of house	Dose factor
A	39	0.25	41	0.27
B	21	0.38	21	0.38
C	37	0.45	38	0.42

CONCLUSION AND SUGGESTION

The background radiation is relatively higher in the southern region of the study area. Due to the non homogenety of the monazite deposit there exits a significant variation in the dose distribution. Considering the shielding factors of concrete materials constrution of concrete building with raised basements can reduce the level of exposure to a certain extent. Awareness among the inhabitants also helps avoiding the ingestion of radio nucliodes by their offsprings.

ACKNOWLEDGENT

Our sincere thanks to Dr. Rosalie Bertel, Dr. Alice Stewart, Dr.Micheal Fernex, Dr. Karl Morgan and Dr.Sadap Ichikawa for their guidence and suggestion in the finallisation of the work. Financial assistance from the world Council of Churches (WCC) Geneva is also greatefully acknowledged

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ADDRESS OF THE AUTHORS:

1. Muralikishna M, Padmanabhan V.T.,
CISEC, Kottamukku,
Kollam - 13, Kerala.

2. Nandakumar D,
Senior Lecturer,
Dept. of Geography,
University College,
Trivandrum, Kerala.