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Analysis of Radio-Isotopes Impact as Radioactive Pollution in Soil Samples of the Ghaggar River Basin

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ABSTRACT

The presence of radio-isotopes in the environment poses significant health and ecological risks. This study aims to analyze the impact of radio-isotopes as sources of radioactive pollution in soil samples from the Ghaggar River basin. Using advanced spectrometric techniques, soil samples were collected and analyzed for radio-isotope concentrations. The findings reveal varying levels of radioactivity across different sites, highlighting the need for continuous monitoring and remediation strategies.

Key Terms: Radio-Isotope, Soil, Gamma Spectrometry

1.0 INTRODUCTION

The Ghaggar River, flowing through northwestern India, is a crucial water source for agriculture and domestic use. However, industrial activities and improper waste disposal practices have raised concerns about radioactive contamination. Radio-isotopes, which are unstable atomic forms, can emanate from natural and anthropogenic sources, leading to soil and water pollution. Jarnail Singh Thakur et al. 2009 focused on environmental influences play an important role in determining health issues. This study observed that heavy metal and pesticide exposure may be potential risk factors for adverse reproductive and people health outcomes. Ramesh R. et al. 2021 proposed the model that Uranium is found in the ground water, which is consumed by human and causes health effects. River basins show the major geological formations of southern India and collected samples analysed for the concentration of major iron and uranium. This study investigates the extent and impact of radio-isotope contamination in the Ghaggar River basin's soil.

1.1 Materials and Methods

1.1.1 Study Area

The Ghaggar River basin spans parts of Haryana and Punjab in India. The study area includes several sampling sites along the river, selected based on proximity to potential pollution sources such as industrial plants and urban settlements.

1.1.2 Sample Collection

Soil samples were collected from 10 different locations along the Ghaggar River. Each sample was taken from a depth of 0-15 cm using a stainless-steel auger to avoid contamination. The samples were then air-dried, homogenized, and sieved to remove debris and stones.

1.1.3 Analytical Techniques

Gamma spectrometry was employed to identify and quantify radio-isotopes in the soil samples. The samples were placed in high-purity germanium detectors, and the spectra were analyzed to detect isotopes such as Uranium-238, Thorium-232, Potassium-40, and Cesium-137. The activity concentration of each isotope was calculated in Bq/kg.

1.2 Results

1.2.1 Radio-isotope Concentrations

The analysis revealed the presence of several radio-isotopes in the soil samples. The activity concentrations varied significantly across different locations:

- Uranium-238: Ranged from 25 to 75 Bq/kg

- Thorium-232: Ranged from 20 to 65 Bq/kg

- Potassium-40: Ranged from 200 to 600 Bq/kg

- Cesium-137: Detected in lower concentrations, ranging from 1 to 10 Bq/kg

1.2.2 Spatial Distribution

The spatial distribution maps indicated higher concentrations of Uranium-238 and Thorium-232 near industrial zones. Potassium-40 was more uniformly distributed, reflecting its natural occurrence in the soil. Cesium-137, a marker of anthropogenic pollution, showed higher levels near urban areas.

1.3 Discussion

The presence of naturally occurring radio-isotopes like Uranium-238 and Thorium-232 suggests geological

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contributions to the soil's radioactivity. However, the detection of Cesium-137 points towards anthropogenic activities, such as fallout from nuclear testing and improper disposal of radioactive waste. The varied concentrations highlight the influence of both natural and human factors on radioactive pollution in the region.

The health implications of these findings are significant. Prolonged exposure to high levels of radioactivity can lead to increased cancer risks and other health issues for the local population. Additionally, radioactive contamination can affect soil quality and agricultural productivity, posing long-term economic challenges.

1.4 Conclusion

This study underscores the importance of monitoring radio-isotope levels in the Ghaggar River basin's soil. The findings highlight areas requiring urgent attention and remediation to mitigate health risks and environmental degradation. Future research should focus on developing effective decontamination strategies and establishing comprehensive monitoring programs.

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