DOCTORAL (PHD) DISSERTATION

Survey of Naturally Occurring Radionuclides in Soils, Water, and Rice from Artisanal and Small-Scale Gold Mining Affected Areas in Ghana

Written by
Lordford Tettey-Larbi
Chemical Engineering and Material Sciences Doctoral School

Supervisor:
Dr. Edit Tóth-Bodrogi (PhD)
Associate Professor

University of Pannonia
Faculty of Engineering
Research Centre for Biochemical, Environmental and Chemical Engineering
Department of Radiochemistry and Radioecology

Veszprém

2026

INTRODUCTION

Ghana's mining sector contributes approximately 6–8% to the country's GDP; accounting for about 40% of total export earnings, with gold mining alone contributing nearly 95% of these earnings of about $20 billion. However, these mining activity activities are directly linked to environmental contamination and dispersion of naturally occurring radionuclide in environmental media such as the air, water resources, soil, plants and animals with the human population the ultimate endpoint to ionizing radiation and its associated risk. The furtherance of illegal mining activities in the affected areas have led to land and soil degradation, contamination of surface water resources that serve as drinking and irrigation water resources and locally grown rice farms within these mining communities. This would have grave effect on surface water irrigation resources and rice cultivation as rice it is the second most consumed stable food in Ghana with about 1.7 million metric tons annual consumption rate.

Some unfolded mines with leaching facilities have also left sites with huge amounts of leftover heap pad without proper decommission and reclamation of the site. Hence there was consideration of determining their suitability to be incorporated into building materials while helping to properly decommission and reclaim the site.

The migration of these naturally occurring radionuclides into these environmental media has the potential of leading to the public externally and internally exposed to ionizing radiation of the natural radionuclides and or subsequent decay daughter radionuclides as well as the potential or increasing risk of developing radiological health related cancers.

OBJECTIVES

This study objective of the study is to assess the concentrations of natural radionuclides of ^{238}U, ^{232}Th, and ^{40}K in soils and leftover heap pads; ^{226}Ra, ^{228}Th, and ^{40}K in surface water resources used for drinking and irrigation; screen borehole water resource for gross alpha and beta activity as a means of alternative drinking water; and ^{226}Ra, ^{232}Th, and ^{40}K in locally grown rice within selected illegal mining affected communities, including the evaluation of soil-to-rice and water-to-rice concentration ratios. Additionally, to determine the associated radiological risks through the estimation of external and internal effective doses and excess lifetime cancer risk (ELCR); and to ascertain the radiological suitability of soils and heap materials for use as building materials, as well as the safety of surface water, groundwater, and locally produced rice for consumption and agricultural purposes.

METHODOLOGY

Soil, leftover heap pads, surface water, borehole water, and locally grown rice were systematically sampled from selected illegal mining affected communities. This was followed by laboratory analysis using gamma spectrometry fitted with a HPGe detector to quantify ^{238}U, ^{226}Ra, ^{232}Th, ^{228}Th, and ^{40}K, in the soil, heap pad, surface water and rice samples. Whereas an automatic gasless gross alpha/beta counting system fitted PIPS detectors was used to screen the borehole water samples. Quality assurance was ensured through calibration, background correction, and reference materials. After measurements, the activity concentrations, radiological risk indices including external and internal effective dose and excess lifetime cancer risk (ELCR), were determined and transfer factors (soil-to-rice and water-to-rice) were also calculated. The results were compared with international guideline values to evaluate public safety and suitability for construction, consumption, and agricultural use.

THESIS POINTS OF THE DOCTORAL (PHD) DISSERTATION

I. Thesis

I investigated the distribution of naturally occurring radionuclides of ^{238}U, ^{232}Th, and ^{40}K in soils, within artisanal and small-scale mining affected communities in Ghana. I found mean activity concentrations in soils of 24±3 Bq/kg (^{238}U), 25±3 Bq/kg (^{232}Th), and 328±63 Bq/kg (^{40}K), with maximum values of 87, 72, and 1168 Bq/kg, respectively. The calculated Ra_{eq} of 85±12 Bq/kg; absorbed dose rate of 40±6 nGy/h; indices below 1 and annual effective dose 0.05±0.01 mSv/y generally remained below international safety thresholds, with some localized hotspots exceeding UNSCEAR (2000) world averages and of low-risk radiological concern.

II. Thesis

I investigated the distribution of naturally occurring radionuclides of ^{238}U, ^{232}Th, and ^{40}K in heap pad soils. Heap pad soils showed lower levels of 11–29 Bq/kg for ^{238}U and ^{232}Th, and 213–236 Bq/kg for ^{40}K, with absorbed dose rates of 30–32 nGy/h, Ra_{eq} dose rates of 66–70 Bq/kg, gamma index, external hazard index and internal hazard index below 1, and effective doses of 0.15–0.16 mSv/y, confirm that radiological properties of the heap pad soil fall well within the EU-BSS and IAEA safety criteria for unrestricted reuse in building and construction applications. Hence the heap soils are a radiologically sustainable resource that can be incorporated into building materials without exceeding the public dose limit of 1 mSv per year.

III. Thesis

I assessed radionuclide concentrations in water resources (surface waters, boreholes, and hand-dug wells) from the same mining communities. Mean activity concentrations were 1.15±0.21 Bq/L (^{226}Ra), 1.60±0.35 Bq/L (^{228}Th), and 20.70±3.60 Bq/L (^{40}K). The committed effective dose from water ingestion averaged 0.41±0.08 mSv/y, about four times higher than the WHO guideline of 0.1 mSv/y, with maximum values reaching 1.64 mSv/y. Excess lifetime cancer risk (ELCR) averaged 1.59×10^{-3}, above the recommended threshold of 0.39×10^{-3}, presenting an increasing risk for developing cancer if water from these surface water sources are used as drinking water. However, water samples from the borehole and wells screened for gross alpha and beta activities were within WHO and Ghana Standards Authority guidelines making them radiological safe for drinking water.

IV. Thesis

I investigated the possible transfer of radionuclides into rice cultivated in the study areas. Mean concentrations of ^{226}Ra, ^{232}Th, and ^{40}K were 5.03±1.75 Bq/kg, 1.76±0.57 Bq/kg, and 39.10±10.12 Bq/kg, with maximum values of 10.63, 3.80, and 63.88 Bq/kg, respectively. The estimated annual committed effective dose from rice ingestion ranged between 0.016–0.151 mSv/y, well below the 0.3 mSv/y ICRP limit for ingestion, with an average ELCR of 0.291×10^{-3}, significantly lower than the global average of 1.16×10^{-3} for ingestion (ICRP, 2007). This finding indicates that the current dietary habits of the population do not pose a significant radiological risk or risk of developing cancer hence the consumption of rice from the district does not pose a significant radiological health risk to the population.

V. Thesis

I assessed the possibility of natural radionuclides transfer from soil and irrigation water to rice. The findings of the transfer metrics indicated the presence of distinct uptake pathways for the radionuclides. ^{226}Ra demonstrated a high water-to-rice concentration ratio ($CR_W\approx4.37$), thus indicating that irrigation water is an important pathway. In contrast, ^{40}K exhibited a higher soil-to-rice transfer factor ($TF\approx0.12$), and possible additional uptake from the irrigation water ($CR_W\approx1.89$) which is consistent with its uptake from soil as an essential nutrient. Conversely, the ^{232}Th exhibited both a low $TF\approx0.07$ and a $CR_W\approx1.10$, suggesting suboptimal bioavailability. These findings suggest that rice may be used as a bioindicator of environmental radioactivity for radium uptake from water and potassium uptake from soil but is not a reliable bioindicator of thorium.

VI. Thesis

I evaluated the overall radiological risk from soil, water, and rice in the studied communities. Although the total annual effective doses ($\leq$ 1 mSv/y) were within ICRP (2007) limits; the continuous illegal mining with relative high concentration of radium and thorium in the surface water and the irrigation water to the rice farms highlight a potential long-term health risk. This work provides critical baseline data for radiological risk assessment in artisanal mining environments in Ghana and emphasizes the need for regular monitoring, remediation measures, and regulatory oversight to safeguard environmental and public health.

LIST OF PUBLICATIONS

Publications related to the subject of the thesis

Articles published in international referred journals (3)

1. Faanu, Augustine; Tettey-Larbi, Lordford; Akuo-ko, Esther Osei; Gyekye, Prince Kwabena; Kpeglo, David Okoh; Lawluvi, Henry; Kansaana, Charles; Adjei-Kyereme, Serwaa; Efa, Alexander Opoku; Tóth-Bodrogi, Edit; Kovács, Tibor; Shahrokhi, Amin. Radiological landscape of natural resources and mining: Unveiling the environmental impact of naturally occurring radioactive materials in Ghana's mining areas (2024). Heliyon 10: 3 Paper e24959 (2024), https://doi.org/10.1016/j.heliyon.2024.e24959. Rank: Q1. IF: 3.6.
2. Kansaana, Charles; Tettey-Larbi, Lordford; Faanu, Augustine; Sam, Frederick; Akrobortu, Emmanuel; Akomaning-Adofo, Emmanuel; Ampene, Adriana Asare; Osei, Rita Kwabea; Annan, Ruth Araba Tawiah; Tóth-Bodrogi, Edit; Kovács, Tibor; Shahrokhi, Amin. Environmental Radiological Impact and Risk Assessment of Natural Radioactivity at the Heap Leach Facility of Tarkwa Goldmine, Ghana: Radiotoxicity and Public Exposures. Environments 11: 8p. 168 (2024), https://doi.org/10.3390/environments11080168. Rank: Q1. IF: 3.7.
3. Amin, Shahrokhi; Lordford, Tettey-Larbi; Esther, Osei Akuo-ko; Edit, Tóth-Bodrogi; Tibor, Kovács. The New Conception of Radiological Sustainability Possibilities by Reutilisation of Residues Products and Building Materials. Sustainability 15:13 paper: 10647 (2023), https://doi.org/10.3390/su151310647. Rank: Q1. IF: 3.3.

Conference publications (19)

1. Lordford Tettey-Larbi, Philomena Dickson-Agudey, Serwaa Adjei-Kyereme, Thomas Onumah, Andrew Baah MacClever, Beant Kaur Guron, Edit Tóth-Bodrogi, and Kovács Tibor. Bioindicator Potential of Rice for Surveillance of Natural Radionuclides in Mining-Impacted Agro-Ecosystems. V. International British Congress on Interdisciplinary Scientific Research and Practices (2026)
2. Amin Shahrokhi, Lordford Tettey-Larbi, Serwaa Adjei-Kyereme, Esther Osei Akuo-ko, Thomas Onumah and Tibor Kovács. Radiological impacts of waste managements and mining activities in Ghana: Addressing environmental and public health challenges. 19th International Conference on Chemistry and the Environment – ICCE 2025 Environmental Chemistry for Sustainability (2025)
3. Esther Osei Akuo-ko, Amin Shahrokhi, Lordford Tettey-Larbi, Serwaa Adjei-Kyereme, Thomas Onumah, Anita Csordás, and Tibor Kovács. The prospective for radiological sustainability through the reuse of NORM residues in construction materials. Canadian Radiation Protection Association 2025 Annual Conference (CRPA 2025) (2025).
4. Esther Osei Akuo-ko, Francie Otoo, Lordford Tettey-Larbi, Serwaa Adjei-Kyereme, Thomas Onumah, Anita Csordás, and Tibor Kovács. A comprehensive radiological investigation of soils and water resources in artisanal gold mining areas in Ghana. Mining activities vs radiological risks. Canadian Radiation Protection Association 2025 Annual Conference (CRPA 2025) (2025).
5. Tettey-Larbi Lordford, Adjei-Kyereme Serwaa, Onumah Thomas, Tóth-Bodrogi Edit, and Kovács Tibor. Radiological Risk Assessment and Transfer Pathways of Naturally Occurring Radionuclides in Rice Cultivated within Unregulated Artisanal

Mining Areas in Ghana. PhD hallgatók anyagtudományi napja XXV Materials science day XXV of PhD students (2025)

6. Esther Osei Akuo-ko, Lordford Tettey-Larbi, Francis Otoo, Anita Csordás, Tibor Kovács. Analysis Of Radionuclides Dissolved in Water Resources Within Gold Mining Areas, Ghana. 7th International Ankara Multidisciplinary Studies Congress (2024).
7. Esther Osei Akuo-ko, Serwaa Adjei-Kyereme, Lordford Tettey-Larbi, Tuvshinsaikhan Ganbaatar, Thomas Onumah, Anita Csordás and Tibor Kovács. Radiological Assessment of Surface Water Resources within Gold Mining Areas, Ghana. PhD hallgatók anyagtudományi napja XXIV, XXIV Material Science Day Conference for PhD Students (2024).
8. Esther Osei Akuo-ko, Serwaa Adjei-Kyereme, Lordford Tettey-Larbi, Thomas Onumah, Anita Csordás, Tibor Kovács. Investigations of Radioactivity Levels in Soils from Various Gold Mining Communities in Eastern Region, Ghana. 6th International Anatolian Scientific Research Congress (2024)
9. Lordford Tettey-Larbi, Esther Osei Akuo-ko, Amin Shahrokhi, Edit Tóth-Bodrogi, Tibor Kovács. The Conception of Radiological Sustainability Possibilities by Reutilization of NORM Residues in Building Materials. 10th International New York Conference on Evolving Trends in Interdisciplinary Research & Practices, (2024).
10. Lordford Tettey-Larbi, Esther Osei Akuo-ko, Gergely Tóth, Augustine Faanu, Amin Shahrokhi, Edit Tóth-Bodrogi, Tibor Kovacs. Assessments of Naturally Occurring Radionuclides in Soils and Water in Some Mining Communities in Ghana. International Radiation Protection Association Health Physics Society, 16th International Congress, 69th Annual HPS Meeting (2023).
11. Lordford Tettey-Larbi, Esther Osei Akuo-ko, Tuvshinsaikhan Ganbaatar, Gergely Tóth, Máté Novák, Serwaa Adjei-Kyereme, Thomas Onumah, Edit Tóth-Bodrogi, Tibor Kovács. Gross Alpha and Beta Activity Screening in Water: A Baseline Study in the Vicinity of a Gold Mine in Ghana. PhD hallgatók anyagtudományi napja XXIV, XXIV Material Science Day Conference for PhD Students (2024).
12. Lordford Tettey-Larbi, Thomas Onumah, Esther Osie Akua-Ko, Serwaa Adjei-Kyereme, Edit Toth-Bodrogi, Tibor Kovács and Amin Shahrokhi. An overview of industrial enhanced radionuclides dispersion over mining area in Ghana. IX. Terrestrial Radioisotopes in Environment International Conference on Environmental Protection (TREICEP) (2024).
13. Esther Osei Akuo-Ko, Lordford Tettey-Larbi, Francis Otoo, Anita Csordás, Tibor Kovács. Surveying the Quality of Groundwater Resources in Gold Mining Communities in Eastern Region of Ghana. 4th International Mediterranean Scientific Research Congress (2023).
14. Esther Osei Akuo-ko, Lordford Tettey-Larbi, Francis Otoo, Aissa Benselhoub, Anita Csordás, Amin Shahrokhi, Tibor Kovács. Radiological safety of water resources within selected gold mining areas in the Eastern region of Ghana. The 4th International Symposium on Mineral Industry and Environment (4SIMINE23) (2023)
15. Lordford Tettey-Larbi, Esther Osei Akuo-ko, Tuvshinsaikhan Ganbaatar, Gergely Tóth, Máté Novák, Amin Shahrokhi, Edit Tóth-Bodrogi, Tibor Kovács. Investigating the Naturally Occurring Radionuclide Activity Concentrations in Ghana's Mining Communities. 5th International Black Sea Modern Scientific (2023).
16. Lordford Tettey-Larbi, Esther Osei Akuo-ko, Tuvshinsaikhan Ganbaatar, Gergely Tóth, Máté Novák, Amin Shahrokhi, Edit

Tóth-Bodrogi, Tibor Kovács. Environmental Impact of Naturally Occurring Radionuclides in Ghana's Mining Areas. PhD hallgatók anyagtudományi napja XXIII, Materials science day XXIII of PhD students (2023).

17. Lordford Tettey-Larbi, Esther Osei Akuo-ko, Edit Tóth-Bodrogi, Tibor Kovács. Naturally occurring radionuclides contamination of River Pra due to illegal mining activities. The 4th International Symposium on Mineral Industry and Environment (4SIMINE23) (2023)
18. Lordford Tettey-Larbi, Amin Shahrokhi, Esther Osei Akuo-ko, Edit Tóth-Bodrogi, Tibor Kovács. Surveying the NORM contamination of soils, sediments and water, due to mining activities from the lower basin of river Pra in the Central and Western Regions of Ghana. Eleventh International Conference on Radiation: Natural Sciences, Medicine, Engineering, Technology and Ecology, RAD 2023 Conference, (2023).
19. Lordford Tettey-Larbi, Edit Tóth-Bodrogi, and Tibor Kovács. Surveying the NORM Contaminated Areas by Combining Different Measuring Techniques and (Geo) Statistical Interpretation. International Graduate-Student Seminar on Radiation Medicine and Protection (2023).

Other publications

Articles published in international referred journals (11)

1. Dickson-Agudey, Philomena; Tettey-Larbi, Lordford; Adjei-Kyereme, Serwaa; Lawluvi, Henry; Asare, Eric; Osei, Rita Kwabea; Ampene, Andriana Asare; Shahrokhi, Amin. Radiological risk assessment of natural radioactivity in imported rice consumed in Ghana and its implications for food safety and public health. Scientific Reports, 16, 6266 (2026), https://doi.org/10.1038/s41598-026-37317-0. Rank: Q1. IF: 4.3
2. Akuo-ko, Esther Osei; Otoo, Francis; Glover, Eric Tetteh; Amponsem, Eunice; Tettey-Larbi, Lordford; Ganbaatar, Tuvshinsaikhan; Csordás, Anita; Shahrokhi, Amin; Kovács, Tibor. Radiological Implications of Industrial Activities on Soil and Water: An Environmental Analytical Chemistry Perspective in Artisanal Gold-Mining Regions of Atiwa West. Applied Sciences-Basel 15: 18 p. 9857 (2025). Rank: Q2. IF: 2.5.
3. Akuo-ko, Esther Osei; Otoo, Francis; Glover, Eric Tetteh; Amponsem, Eunice; Tettey-Larbi, Lordford; Shahrokhi, Amin; Csordás, Anita; Kovács, Tibor. A comprehensive radiological survey of groundwater resources in artisanal mining communities in the Easter region of Ghana: Water quality vs. mining activities. Water 16: 1 paper: 62, 14 p. (2024), https://doi.org/10.3390/w16010062. Rank: Q1. IF: 3.0.
4. Faanu, A.; Adukpo, O. K.; Tettey-Larbi, L.; Lawluvi, H.; Kpeglo, D. O.; Darko, E. O.; Emi-Reynolds, G.; Awudu, R. A.; Kansaana, C.; Amoah, P. A.; Efa, A. O.; Ibrahim, A. D.; Agyeman, B.; Kpodzro, R.; Agyeman, L. Natural radioactivity levels in soils, rocks and water at a mining concession of Perseus gold mine and surrounding towns in Central Region of Ghana. SpringerPlus 5, Paper: 98, 16 p. (2016). DOI 10.1186/s40064-016-1716-5. Rank: Q1. IF: 1.6
5. Faanu, Augustine; Adukpo, Oscar Kwaku; Kansaana, Charles; Tettey-Larbi, Lordford; Lawluvi, Henry; Kpeglo, David Okoh; Darko, Emmanuel Ofori; Emi-Reynolds, Geoffrey; Awudu, Razak Abdul; Amoah, Peter Atta; Efa, Alexander Opoku; Ibrahim, Ali Doe; Agyeman, Benice; Kpodzro, Rita; Agyeman, Lilian. Impact assessment of naturally occurring radioactive materials on the public from gold mining and processing at Newmont Golden Ridge Limited, Akyem, Eastern Region of Ghana. Radiation Protection and Environment 39: 3 pp. 155-164, 10 p. (2016). DOI: 10.4103/0972-0464.194962.

6. Abdalsattar, Kareem Hashim; Laith, Ahmen Najam; Tettey-Larbi, Lordford. A Study of Radon Concentration in Different Brands Tobacco Cigarette in Iraqi Market, Influencing Factors and Lung Cancer Risk. International Journal of Science and Technology 5; 10 pp. 1-8, 8 p. (2015).
7. Adukpo, O. K.; Faanu, A.; Lawluvi, H.; Tettey-Larbi, L.; Emi-Reynolds, G.; Darko, E. O.; Kansaana, C.; Kpeglo, D. O.; Awudu, A. R. Distribution and assessment of radionuclides in sediments, soil and water from the lower basin of river Pra in the Central and Western Regions of Ghana. Journal of Radioanalytical and Nuclear Chemistry 303: 3 pp 1979-1685. (2015), https://doi.org/10.1007/s10967-014-3637-5. Rank: Q2. IF: 1.6
8. Tettey-Larbi, L.; Poku, L. O.; Darko, E. O.; Faanu A.; Appiah, A. A.; Baidoo, I. K.; Osei, R. K. Determination of the Concentration of Potassium in Lippia Multiflora and Bridelia Ferruginea for the Treatment of High Blood Pressure (Hypertension). International Journal of Science and Technology 5: 1 pp. 24-27, 4 p. (2015).
9. Kansaana, C.; Darko, E. O.; Adukpo, O. K.; Faanu, A.; Shitsi, E.; Opata, N.S.; Tettey-Larbi, L. Measurement Of Activity Concentrations of ^{226}Ra, ^{232}Th, ^{40}K and ^{137}Cs in Some Common Spices Consumed by Inhabitants in Accra Metropolis, Ghana. International Journal of Food Science, Nutrition and Dietetics 2: 8 pp. 75-80, 6 p (2013). http://dx.doi.org/10.19070/2326-3350-1300014.
10. Tettey-Larbi, L.; Darko, E. O.; Schandorf, C.; Appiah, A. A.; Sam, F.; Faanu, A.; Kpeglo, D. O.; Lawluvi, H.; Agyeman, B. K.; Kansaana, C.; Amoah, P. A.; Osei, R. K.; Agalga, R.; Osei, S. Gross Alpha and Beta Activity and Annual Committed Effective Doses due to Natural Radionuclides in Some Medicinal Plants commonly used in Ghana. International Journal of Science and Technology 3: 4 pp. 217-229, 13 p. (2013).
11. Tettey-Larbi, L.; Darko, E. O.; Schandorf, C.; Appiah, A. A. Natural radioactivity levels of some medicinal plants commonly used in Ghana. SpringerPlus 2: 1 Paper: 157, 9 p. (2013). DOI: 10.1186/2193-1801-2-157. Rank: Q3, IF: 1.5

Conference publications (34)

1. Adjei-Kyereme Serwaa, Tettey-Larbi Lordford, Onumah Thomas, Tóth-Bodrogi Edit, and Kovács Tibor. Evaluation of Fission and Activation Products Contamination in Fish from Aquatic Systems within the Semipalatinsk Test Site. PhD hallgatók anyagtudományi napja XXV Materials science day XXV of PhD students (2025)
2. Amin Shahrokhi, Lordford Tettey-Larbi, Esther Osei Akuo-ko, and Tibor Kovács. Brief overview on the potential possibility of integrating nanotechnology for corrosion and material enhancement in nuclear industry applications. 13th International Conference on Radiation, Natural Sciences, Medicine, Engineering, Technology and Ecology, RAD 2025 Conference, (2025).
3. Amin Shahrokhi, Lordford Tettey-Larbi, Serwaa Adjei-Kyereme, Esther Osei Akuo-ko, Thomas Onumah and Tibor Kovács. An Overview of the Feasibility of Leveraging Deep Learning for Environmental Radioactivity: Opportunities, Challenges, and Interdisciplinary Solutions. 8th International Conference on Environmental Radioactivity (ENVIRA 2025) (2025)

4. Amin Shahrokhi, Esther Osei Akuo-ko, L. Maud Naa Dedei Palm, Lordford Tettey-Larbi, Serwaa Adjei-Kyereme and Tibor Kovács. Sustainability – socioeconomic and environmental effects of climate-induced seawater quality changes on coastal fisheries: A case study on temperature and salinity shifts. 19th International Conference on Chemistry and the Environment – ICCE 2025 Environmental Chemistry for Sustainability (2025)
5. Lordford Tettey-Larbi, Serwaa Adjei-Kyereme, Thomas Onomah, Amin Shakrokhi, Edit Tóth-Bodrogi, and Tibor Kovács. Review of the Radiological Excess Lifetime Cancer Risk Assessment in Tobacco Cigarette. 12th International New York Conference on Evolving Trends in Interdisciplinary Research and Practices (2025)
6. Máté Novák, Zsolt Homoki, Lordford Tettey-Larbi, Gergely Tóth, Edit Tóth-Bodrogi, Anita Csordás and Tibor Kovács. Determination of Radon Exhalation and Emanation of Hungarian Soil Samples. Radiation Environment and Medicine (2025).
7. Sarpong Linda, Abrefah Rex, Tettey-Larbi Lordford and Nooni Isaac. Long term Spatio-Temporal Analysis of Climate Trends in Ghana: Implication for Nuclear Power Plant siting and sustainability. International Conference on Resilience of Nuclear Installations against External Events from a Safety Perspective – Focus on Climate Change. NIRC - 2025 (2025).
8. Tóth Gergely, Novák Máté, Homoki Zsolt, Tettey-Larbi Lordford, Gyöngyösi Csaba, Csordás Anita and Kovács Tibor. Radium Determination in Spring Waters of Veszprém County by Liquid Scintillation. Radiation Environment and Medicine (2025).
9. Amin Shahrokhi, Lordford Tettey-Larbi, Serwaa Adjei-Kyereme, Thomas Onumah, Esther Osie Akua-Ko, Edit Toth-Bodrogi, and Tibor Kovács. Atmospheric Remote Sensing for Environmental Sustainability: How Radiation Sensing Can Help Achieve Sustainability During Extreme Weather Events. IX. Terrestrial Radioisotopes in Environment International Conference on Environmental Protection (TREICEP) (2024)
10. Amin Shahrokhi, Esther Osei Akuo-ko, Lordford Tettey-Larbi, Tuvshinsaikhan Ganbaatar, Serwaa Adjei-Kyereme, Thomas Onumah, Edit Tóth-Bodrogi, Tibor Kovács. Atmospheric radon: Reliability and its potential as an earthquake precursor. IX. Terrestrial Radioisotopes in Environment International Conference on Environmental Protection (TREICEP) (2024)
11. Amin Shahrokhi, Tuvshinsaikhan Ganbaatar, Serwaa Adjei-Kyereme, Lordford Tettey-Larbi, Thomas Onumah, Esther Osei Akuo-ko, Edit Tóth-Bodrogi, Tibor Kovács. How the biomonitoring indicators can be used as a management tool in contaminated sites: case study earth worms. IX. Terrestrial Radioisotopes in Environment International Conference on Environmental Protection (TREICEP) (2024)
12. Esther Osei Akuo-ko, Lordford Tettey-Larbi, Francis Otoo, Eric Tetteh Glover, Anita Csordás, Tibor Kovács. Evaluation of Radioactivity Concentrations in Soils from Gold Mining Areas in Eastern Region, Ghana. 10th International New York Conference on Evolving Trends in Interdisciplinary Research & Practices, (2024).
13. Esther Osei Akuo-ko, Francis Otoo, Eric Tetteh Glover, Lordford Tettey-Larbi, Anita Csordás, and Tibor Kovács. Evaluation of Activity Concentrations of ^{226}Ra, ^{232}Th, ^{40}K and ^{222}Rn in Soils from some Gold Mining Communities in Atiwa West, Ghana. The Heath Physics Society (HPS) 16th International Radiation Protection Association (IRPA) Congress (2024).
14. Esther Osei Akuo-ko, Mohammemad Adelikhah, Serwaa Adjei-Kyereme, Lordford Tettey-Larbi, Thomas Onumah, Anita Csordás

and Tibor Kovács. Investigations of Indoor Radon Levels in Dwellings and Its Associated Health Risks. 6th International World Health Congress (2024)

15. Gergely Tóth, Máté Novák, Zsolt Homoki, Lordford Tettey-Larbi, Csaba Gyöngyösi, Anita Csordás and Tibor Kovács. Radium Determination in Spring Waters of Veszprém County by Liquid Scintillation. The 11th Educational Symposium on Radiation and Health by Young Scientists (ESRAH) (2024).
16. Gergely Tóth, Máté Novák, Zsolt Homoki, Lordford Tettey-Larbi, Tuvshinsaikhan Ganbaatar, Edit Tóth-Bodrogi, Anita Csordás and Tibor Kovács. Radiological survey of two hiking routes near a closed uranium mine in Hungary. Fifth National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-V) (2024).
17. Gergely Tóth, Máté Novák, Zsolt Homoki, Lordford Tettey-Larbi, Edit Tóth-Bodrogi, Anita Csordás, Tibor Kovács. Determination of massic exhalation rate and emanation factor of Transdanubian soil samples. IX. Terrestrial Radioisotopes in Environment International Conference on Environmental Protection (TREICEP) (2024)
18. Máté Novák, Zsolt Homoki, Lordford Tettey-Larbi, Gergely Tóth, Edit Tóth-Bodrogi, Anita Csordás and Tibor Kovács. Determination of Radon Exhalation and Emanation of Hungarian Soil Samples. The 11th Educational Symposium on Radiation and Health by Young Scientists (ESRAH) (2024).
19. Máté Novák, Dániel Vincze, Lordford Tettey-Larbi, Gergely Tóth, Tuvshinsaikhan Ganbaatar, Edit Tóth-Bodrogi, Anita Csordás and Tibor Kovács. Comparison of different sample preparation techniques for ^{210}Po and ^{210}Pb measurement in soil samples. Fifth National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-V) (2024).
20. Novák Máté, Vincze Dániel, Lordford Tettey-Larbi, Tóth Gergely, Tuvshinsaikhan Ganbaatar, Tóth-Bodrogi Edit, Csordás Anita, and Kovács Tibor. Mintaelőkészítési technikák összehasonlítása ^{210}Pb és ^{210}Po meghatározására talajmintákban. PhD hallgatók anyagtudományi napja XXIV, XXIV Material Science Day Conference for PhD Students (2024).
21. Serwaa Adjei-Kyereme, Lordford Tettey-Larbi, Esther Osei Akuoko, Tuvshinsaikhan Ganbaatar, Gergely Tóth, Máté Novák, Thomas Onumah, Edit Tóth-Bodrogi, Tibor Kovács. Potassium and Essential Mineral Profiling in Lippia Multiflora and Bridelia Ferruginea: Implications for Hypertension Treatment. PhD hallgatók anyagtudományi napja XXIV, XXIV Material Science Day Conference for PhD Students (2024).
22. Serwaa Adjei-Kyereme, Lordford Tettey-Larbi, Thomas Onumah, Esther Osie Akua-Ko, Edit Toth-Bodrogi, Tibor Kovács and Amin Shahrokhi. The migration simulation of natural radionuclides in groundwater of Ghana with help of COMSOL Multiphysics modelling program: a case study of the greater Accra region. IX. Terrestrial Radioisotopes in Environment International Conference on Environmental Protection (TREICEP) (2024)
23. Thomas Onumah, Lordford Tettey-Larbi, Esther Osie Akua-Ko, Serwaa Adjei-Kyereme, David Kpeglo, Francis Otoo, Eva Tabuaa Gyamfi, Toth-Bodrogi Edit, and Tibor Kovács. Determination of Bioaccessibility of Radionuclides in Herbal Medicines for Internal Dose Assessment. PhD hallgatók anyagtudományi napja XXIV, XXIV Material Science Day Conference for PhD Students (2024).
24. Tien Chu Trung, Van-Hao Duong, Duc-Thinh Ta, Dinh-Cuong Le, Thanh-Xuan Pham-Thi, Miklós Hegedűs, Lordford Tettey-Larbi, and Tibor Kovács. Health Risk Assessment of Cesium, Niken, Copper, Zinc, Chromium and Mangane in Asian Green Mussels in Coastal of Hai Phong, Vietnam. Fifth National Conference on

Radiation Awareness and Detection in Natural Environment (RADNET-V) (2024).

25. Tóth Gergely, Novák Máté, Homoki Zsolt, Tettey-Larbi Lordford, Tóth-Bodrogi Edit, Csordás Anita, and Kovács Tibor. Fajlagos radon exhaláció és radon emanáció meghatározása dunántúli talajmintákból. PhD hallgatók anyagtudományi napja XXIV, XXIV Material Science Day Conference for PhD Students (2024).
26. Van-Hao Duong, Tien Chu Trung, Thanh-Xuan Pham Thi, Duc-Thinh Ta, Lordford Tettey-Larbi, Edit Tóth-Bodrogi, and Tibor Kovács. The radiological risk assessment of radon and natural radionuclides in selected underground floor of high building at Hanoi Capital, Vietnam. Fifth National Conference on Radiation Awareness and Detection in Natural Environment (RADNET-V) (2024).
27. E. O. Akuo-ko, L. Tettey-Larbi, T. Ganbaatar, T. Gergely, M. Novák, A. Shahrokhi, A. Csordás, T. Kovács. Polonium-210 activity concentrations in different brands of cigarettes smoked in Ghana and evaluation of the induced radiation dose. PhD hallgatók anyagtudományi napja XXIII, Materials science day XXIII of PhD students (2023).
28. Esther Osei Akuo-ko, Lordford Tettey-Larbi, Tuvshinsaikhan Ganbaatar, Toth Gergely, Máté Novák, Amin Shahrokhi, Anita Csordás, Tibor Kovács. ^{210}Po Activity Concentrations, Annual Effective Dose and Lung Cancer Risk Assessment of Cigarettes Smoked in Ghana. 5th International Black Sea Modern Scientific Research Congress (2023).
29. Fehérvári Máté, Lordford Tettey-Larbi, Edit Tóth-Bodrogi, Gergely Tóth, Tibor Kovács. Soil radon exhalation measurements in Transdanubia, Hungary. Eleventh International Conference on Radiation: Natural Sciences, Medicine, Engineering, Technology and Ecology, RAD 2023 Conference (2023).
30. Lordford Tettey-Larbi, Esther Osei Akuo-Ko, Amin Shahrokhi, Edit Tóth-Bodrogi, Tibor Kovács. Naturally Occurring Radionuclide Gross Alpha and Beta Activity Concentration and Annual Committed Effective Doses of some Ghanaian Medicinal Plants. 2nd International Congress on Natural & Medical Sciences (2023).
31. Tuvshinsaikhan Ganbaatar, Amin Shahrokhi, Lordford Tettey-Larbi, Esther Osei Akuo-ko, Edit Tóth-Bodrogi, Tóth Gergely, Fehérvári Máté, Tibor Kovács. The New Conception of Radiological Sustainability Possibilities by Reutilization of Residues Products and Building Materials. PhD students' materials science day XXIII (2023).
32. Esther O. Akuo-Ko, Mohammademad Adelikhah, Lordford Tettey-Larbi, Anita Csordás and Tibor Kovács. Mapping of indoor radon concentration in residential homes in Accra, Ghana. The 9th Educational Symposium on Radiation and Heath by young Scientists (ESRAH2022) (2022)
33. Lordford Tettey-Larbi, Tibor Kovács, Edit Tóth-Bodrogi, Emmanuel Ofori Darko, Cyril Schandorf and Alfred Ampomah Appiah. Terrestrial radionuclide concentration of some Ghanaian medicinal plants. PhD hallgatók anyagtudományi napja XXII, Materials science day XXII of PhD students (2022)
34. Lordford Tettey-Larbi, Máté Novák, Máté Fehérvári, Anita Csordás, Edit Tóth-Bodrogi, and Tibor Kovács. Investigating the Suitability of Mosses as Bioindicators; analysis of the ^{210}Po content of Moss samples collected in Veszprem County. The 9th Educational Symposium on Radiation and Heath by young Scientists (ESRAH2022) (2022).