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INSTITUTUL DE CERCETĂRI INTERDISCIPLINARE ÎN BIO-NANO-ȘTIINȚE
Str. August Treboniu Laurian Nr. 42
CLUJ – NAPOCA, RO-400271
TEL. 0264 454554
E- mail : secretariat.icibns@ubbcluj.ro
Web: icibns.institute.ubbcluj.ro/

Doctoral (Ph.D.) Dissertation Review

on **Tettey-Larbi Lordford's** doctoral thesis manuscript titled **"Survey of Naturally Occurring Radionuclides in Soils, Water, and Rice from Artisanal and Small-Scale Gold Mining Affected Areas in Ghana"**,
which was prepared in the frame of the **Doctoral School of Chemical Engineering and Material Sciences at the University of Pannonia** with the supervision of **Edit Tóth-Bodrogi, PhD**

The presented work examines the distribution of naturally occurring radionuclides (^{238}U, ^{226}Ra, ^{232}Th, ^{228}Th and ^{40}K) and their radiological health impacts across various environmental media, including soil, cyanide tailings ponds, surface water, well water and rice crops, in communities affected by unregulated artisanal gold mining in Ghana. It addresses the issue of unregulated mining, which significantly increases radionuclide concentrations and the radiation dose received by local populations through ingesting contaminated food and water. By evaluating the underlying causes of this environmental contamination, the study highlights the urgent need for improved monitoring and environmental remediation, as well as stricter regulatory oversight in mining-affected regions. The objective is clear, the choice of topic is both timely and interesting, and the tools and methods used are appropriate.

The thesis is structured and proportionate in its composition. In the literature review section, the candidate presents the origin of natural radionuclides, possible pathways of excess doses caused by them and the measurement methods employed. In the Materials and Methods section, following the literature review, the candidate presents the materials examined (soils, water samples and rice), as well as the measurement methods and equipment used. In the results section, the candidate presents the results of the tested materials separately and draws

conclusions. In addition to classical measurement methods, correlational studies are also conducted. Following the summary, the thesis presents its main thesis points. The thesis concludes with a bibliography and a list of publications. The structure of this thesis meets the requirements set by the Chemical Engineering and Material Sciences Doctoral School at the University of Pannonia.

The dissertation is written in an appropriate style, and the text is clear and logical. Following a review, stylistic inaccuracies were corrected and the author incorporated the editorial suggestions, resulting in only the occasional spelling or typographical error remaining in the thesis. The number of figures and tables is logical and straightforward; they are clear, well designed and easy to understand. The thesis has an attractive appearance.

The thesis draws on nearly 200 sources, primarily articles from international journals, technical documents, and relevant Ghanaian and international legislation. The quality and quantity of the references used are adequate.

The research proposal's objectives are achievable using the state-of-the-art procedures and analytical methods employed in the research. The experimental section of the dissertation is presented clearly and is well structured; the topics flow logically from one to the next, and the figures and tables help to clarify the results.

The theses are concise and understandable and are supported by the results. I accept the results presented in the thesis as scientific findings.

In his dissertation, the candidate demonstrated his ability to conduct independent research and produce high-quality publications. The candidate is the author of three publications related to the topic of his dissertation, as well as the author or co-author of 11 unrelated publications and 53 conference presentations. His publication record exceeds the minimum requirements set forth in the regulations of the Chemical Engineering and Material Sciences Doctoral School at the University of Pannonia.

The dissertation meets the requirements of a doctoral dissertation in both content and form. I consider the dissertation suitable for public defense, and in the event of a successful defense, I support the awarding of the doctoral degree.

Questions:

1. What are the opportunities for mitigating the environmental and human impact of theillegal mining activities, preferrably listing some potential legal, economic and technological options.

2. What is the opinion of the candidate on the validity of the LNT model and based on that and the international literature would the candidate say that the current Ghanaian legal framework for assessing the impact of mining is too loose, matches international trends or is too strict.

I am glad to state, the dissertation written by **Tettey-Larbi Lordford** fulfils all the conditions for gaining a PhD degree in Chemical Engineering and Material Sciences Doctoral School at the University of Pannonia, Hungary and reached the scientific level of the degree required.

Date: Cluj-Napoca, 30.04. 2026

Asoc.Prof. dr. Begy Robert-Csaba