



“Gheorghe Asachi” Technical University of Iasi, Romania



MULTI-MATRIX DISTRIBUTION AND RISK ASSESSMENT OF SELECTED ELEMENTS IN PADDY FIELDS: CASE STUDIES OF THRACE AND MARMARA REGIONS

Kaan Dincer, Sibel Mentese*

Environmental Engineering, Faculty of Engineering, Canakkale Onsekiz Mart University, Canakkale, 17020, Türkiye

Abstract

Rice cultivation may be associated with trace-element contamination because metal(loid)s can persist in soil and enter the food chain through rice consumption. This study assessed the distribution and spatiotemporal variation of major and trace elements and the dietary risks of selected potentially toxic elements in paddy systems in two major rice-producing regions of Türkiye, Ipsala and Biga, during the 2024 cultivation season. Soil, field water, shoots, stubble, husk, and rice grain were collected across growth stages and analyzed by ICP–MS following acid digestion. Enrichment factors (EF) and bioaccumulation factors were used to assess elemental accumulation and soil-to-grain partitioning, while non-carcinogenic and carcinogenic risks were estimated for adults and children.

Element concentrations showed clear matrix-dependent partitioning, with generally higher levels in plant residues, particularly stubble, and lower levels in husk and grain. EF results indicated site-dependent enrichment of several elements, particularly Cd, Hg, Pb, Sn, and Zn. Soil-to-grain bioaccumulation factors showed a higher apparent Cd grain-to-soil concentration ratio in Biga than in Ipsala, suggesting greater relative food-chain partitioning rather than direct evidence of a higher transfer rate. The non-carcinogenic hazard index remained below 1 for adults in Ipsala (HI = 0.236) but exceeded it for children (HI = 1.24). In Biga, HI exceeded the threshold for adults (1.20) and children (6.28), where arsenic was the main contributor. Total cancer risk exceeded 1.0×10^{-4} in both regions and was higher in Biga than in Ipsala, where nickel was the dominant contributor. These findings highlight the importance of multi-matrix environmental monitoring throughout cultivation and support multi-season studies incorporating source-apportionment approaches to clarify the drivers of variability.

Key words: health risk assessment, paddy, rice, selected elements

Received: February, 2026; Revised final: August, 2026; Accepted: September, 2026

* Author to whom all correspondence should be addressed: E-mail: sibelm@comu.edu.tr, sibelmentese@gmail.com;
Phone: +90 286 2180018/ext20041; Fax: +90 286 2180541