



Levels and Health Risk Assessment of Heavy Metal Contamination in Soil and Different Varieties of Rice from Jere Agricultural Locations, Borno State, Northeastern Nigeria

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ABSTRACT

The present study was conducted to evaluate the levels, ecological and health risk of some heavy metals which include Hg, As, Pb, Cd, Ni and Cr from agricultural soils in Maiduguri Metropolis agricultural Location, North East Nigeria. The levels of the studied heavy metals were determined using Atomic Absorption Spectroscopy (AAS). The concentrations of the studied metals in the soil samples were significantly higher at a depth of 0-5 cm, while 10-15 cm showed the lowest. The concentrations of all the metal in the soil from both locations were relatively lower than the WHO/FAO permissible limits, while that of rice were all above the said WHO/FAO limits. Results from potential ecological risks assessment and potential ecological risk index (RI) indicate low ecological risk, except Cd. Also, AEI results for all the metals were greater than 1, indicating a possibility of likelihood to induce adverse biological effects to benthic organism with exception to Hg and Cd. The geo-accumulation index, contamination factor and pollution load index were observed to be low contamination and polluted for all the heavy metal except for Pb (Igeo) and Hg (CF). The soil ADD values for children and adult via ingestion and dermal contact were lower than their individual RfDs, which shows no threat from non-carcinogenic risk as a result of metal contamination. Inhalation routes for children and adult were higher than the RfDs values, indicating human health risk. The HQ and HI via ingestion and dermal pathways were lower than the threshold values, with exception of HQ and HI inhalation for both locations were much greater than 1, an indication of high potential non-cancer related illness. For all the varieties of rice, the HQ and HI values for all the metals were less than the US EPA permissible safety limit of 1, and therefore does not pose any serious health risk concern, except As which is greater than one (1), indicating high potential non-cancer health risk via consumption of rice. Carcinogenic health risk values of As, Pb and As in the soil via inhalation pathway for children and adult with ranged of $2.23\text{E-}03$ to $8.10\text{E-}01$ were higher than the said regulatory acceptable values of 1.0×10^{-6} to 1.0×10^{-4} showing possibility of inducing cancer risk, though CR_{ing} and CR_{dermal} contact values for children and adult were within safety limits. Also, the potential health risk for children via the exposure pathways was greater than for adults, with exception of inhalation. Hence, the main exposure pathway of heavy metals for both children and adults is inhalation, followed by ingestion and dermal contact. Findings from this study suggest that values of some metals were high enough to cause health risk to human. The study further recommends regular monitoring of heavy metal in the soil and varieties of rice within the study locations in order to protect human health.

1. Introduction

Rice (*Oryza sativa*) is one of the most cereal crops cultivated worldwide and is consumed globally in Africa. In Asia countries, rice account for about 50-80% of daily caloric in-take. In Africa, rice serves as an important food

crop with a yield of about 5082 kg ha^{-1} [1]. In Nigeria in the country as they all provide favourable to support the cultivation of food crops. FARO is the acronym for Federal Agricultural research *Oryza* in Nigeria. FARO

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