

Transboundary Pollution after Natural Disasters: Scenario Analyses for Uranium at Kyrgyzstan-Uzbekistan Border

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Abstract : Failure of tailings management facilities (TMF) of radioactive residues is an enormous challenge worldwide and can result in major catastrophes. Particularly in transboundary regions, such failure is most likely to lead to international conflict. This risk occurs in Kyrgyzstan and Uzbekistan, where the current major challenge is the quantification of impacts due to pollution from uranium legacy sites and especially the impact on river basins after natural hazards (i.e., landslides). By means of GoldSim, a probabilistic simulation model, the amount of tailing material that flows into the river networks of Mailuu Suu in Kyrgyzstan after pond failure was simulated for three scenarios, namely 10%, 20%, and 30% of material inputs. Based on Muskingum-Cunge flood routing procedure, the peak value of uranium flood wave along the river network was simulated. Among the 23 TMF, 19 ponds are close to the river networks. The spatiotemporal distributions of uranium along the river networks were then simulated for all the 19 ponds under three scenarios. Taking the TP7 which is 30 km far from the Kyrgyzstan-Uzbekistan border as one example, the uranium concentration decreased continuously along the longitudinal gradient of the river network, the concentration of uranium was observed at the border after 45 min of the pond failure and the highest value was detected after 69 min. The highest concentration of uranium at the border were 16.5, 33, and 47.5 mg/L under scenarios of 10%, 20%, and 30% of material inputs, respectively. In comparison to the guideline value of uranium in drinking water (i.e., 30 µg/L) provided by the World Health Organization, the observed concentrations of uranium at the border were 550–1583 times higher. In order to mitigate the transboundary impact of a radioactive pollutant release, an integrated framework consisting of three major strategies were proposed. Among, the short-term strategy can be used in case of emergency event, the medium-term strategy allows both countries handling the TMF efficiently based on the benefit-sharing concept, and the long-term strategy intends to rehabilitate the site through the relocation of all TMF.

Keywords : Central Asia, contaminant transport modelling, radioactive residue, transboundary conflict

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