MONITORING AND EVALUATION OF NATURE-BASED SOLUTION (NBS) APPROACH IMPLEMENTATION FOR FLOOD RISK REDUCTION USING EVIDENCE-BASED DYNAMIC SURFACE WATER-GROUNDWATER ISOTOPE COMPOSITIONS ASSESSMENT IN A LOWLAND CATCHMENT OF THAILAND

SASIN JIRASIRIRAK[1], AKSARA PUTTHIVIDHYA[1], SOMKIAT PRAJAMWONG[2]

[1]Water Resources Engineering Department, Faculty of Engineering, Chulalongkorn University, Bangkok, Thailand.

[2]Senior Expert, National Water Committee, Thailand.

Abstract: There is increasing global interest in employing nature-based solutions (NbS) to help reduce risks to economies and society, including floods, droughts, and water pollution reduction that are likely to become worse under future extreme climate. Thai government has implemented flood retention system since 2017 along Yom and Chao Phraya rivers and their tributaries to create "*room for the river*". This flood retention scheme concept, already in place, consistently serves as a potential NbS for reducing disaster risks and impacts as well as for adaptation to those impacts, however, evidence on the benefits of the approach is still quite limited. This study therefore aims to provide and enhance an evidence-based quantitative and qualitative indicators for NbS monitoring and evaluation stemmed from available and reliable data using a dynamic surface water-groundwater isotope composition assessment. The stable isotope fingerprinting technique has been demonstrated to be invaluable in helping understand basin-scaled functioning and are widely used in catchment hydrology. The study area is located in the downstream of Yom river basin known as Bang Rakam model where the lowland has been employed as flood retention areas to prevent overflowing from Yom river into agricultural zones and reduce flood risks in lower Chao Phraya river basin and Bangkok city further downstream. Local precipitation, surface water, and groundwater along the main Yom river courses and their tributaries are directly sampled (inside and outside of the Bang Rakam area). Extensive precipitation isotopic composition database from existing IAEA monitoring network (GNIP) along with local Bangkok precipitation isotope signature are compared with precipitation from Chiang Mai province to better identify the rainfall isotopic compositions. In addition to the isotopic differentiation in the area, its impacts on isotopic characteristics of surface water and groundwater are additionally explored. LMWLs (Local Meteoric Water Line) for local rainfall in Bangkok and Chiang Mai are generated with some seasonal variation due to rain out effect. Surface water is influenced by evaporation at some degree, revealing that rainfall may not be the primary source of surface water. Yom river's isotope values are far more D and ^{18}O-enriched

compared to Ping's and Nan's, revealing the mixing of groundwater with river water and/or the source of surface water may come from dry-period precipitation. The isotopic similarity with the more depleted dD and $d^{18}O$ of groundwater samples suggests the potential mixing of groundwater with river water by different mixing processes (54% from river water and 46% from rainfall). Isotope composition analyses of groundwater samples collected from the Bang Rakam area are more depleted (up to 25%) in heavy isotopes compared to those from groundwater baseline. A shift in groundwater origin (61% from river water and 39% from rainfall) suggests the direct enhancement of groundwater recharge from flood water retention in lowland area along Yom river. d-excess stable isotope analyses are beneficial to identify the relative contributions of the wet and dry seasonal sources to the groundwater recharge. The results indicate that groundwater sources are composed of ~71.4% wet seasonal sources and ~28.6% dry seasonal sources.

Keyword: Groundwater, isotope, isotopic, Yom river, Thailand

Corresponding author: dr.aksara.putthividhya@gmail.com