

Nitrate Dual-Stable Isotope Analysis Identifies Sources of Groundwater Nitrogen Pollution in the Silang-Sta. Rosa Subwatershed of Laguna de Bay

*Osbert Leo Alcantara Privaldos^{1,2}, Ken'ichi Osaka³, Yoshitoshi Uehara⁴, Asano Satoshi⁵, Lei Fujiyoshi⁴, Chikage Yoshimizu⁴, Ichiro Tayasu⁴, Adelina C. Santos-Borja¹, Maria Pythias B. Espino², Noboru Okuda⁴

1. Laguna Lake Development Authority, 2. Institute of Chemistry, University of the Philippines-Diliman, 3. The University of Shiga Prefecture, 4. Research Institute for Humanity and Nature, 5. Lake Biwa Environmental Research Institute

Excess nitrogen in freshwater systems contributes to water quality degradation and eutrophication. Nitrates (NO_3^-) in river and ground waters are constantly turned over by internal biogeochemical processes. Dual-stable isotope measurement provides conclusive information in tracing NO_3^- sources and forms. Signatures of nitrate stable isotopes ($\delta^{15}\text{N}$, $\delta^{18}\text{O}$) in the river and ground waters of Silang-Sta. Rosa subwatershed –measured using denitrifier method. Nitrate sources in the study site were ammonia (NH_4^+) from fertilizer and precipitation, soil NH_4^+ in the upstream and midstream, and manure and septic waste in the downstream area both in river and ground waters. The concentrations of nutrients and metals were also analyzed to determine the anthropogenic activities, industrialization, and urbanization effects in the subwatershed. The movement of water between river and ground waters provides a pathway for chemical transfer such as nutrients between terrestrial and aquatic systems. Principal component analysis of these concentrations shows that the movement of ions in ground waters is from upstream to downstream. This suggests chemical contamination caused by nitrate fertilizers used in farming lands in the upstream affecting the characteristics of aquatic systems by altering biogeochemical processes, especially in the downstream area.

Keywords: nitrate stable isotopes, denitrified method, Silang-Sta. Rosa subwatershed