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High-frequency water isotopic analysis using an automatic water sampling system in rice-based cropping systems

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This study aims to gain a necessary hydrological process understanding that facilitates maintenance of fundamental water-related ecosystem services, decreases environmental impacts, and increases the water productivity of rice-based cropping systems. To improve our understanding of ecohydrological processes, high-resolution spatial and temporal data are important. Water stable isotopes (2H and 18O) allow the tracing of relevant water exchange and transport processes in the soil-plant-atmosphere domain. Therefore, for this purpose, effects of altered flooding regimes (flooded vs. non-flooded) and crop diversification (wet rice vs. dry rice vs. maize) were studied using water stable isotopes of various water sources in rice-based cropping systems of the International Rice Research Institute (IRRI) in the Philippines.

Since rice-based cropping systems show a high variability in water management within small scales, high spatial coverage of water stable isotopes measurements is needed in investigating multiple cropping systems. Our automatic sampling set-up facilitated in-situ analysis of water stable isotopes in spatially differentiated agricultural fields via a web-based control software. Our measuring network consisted of 18 sampling points from different water sources. We measured high-resolution water isotopic data (30-minute sampling intervals) of groundwater, surface water, rainwater, and irrigation water. We used Wavelength-Scanned Cavity Ring-Down Spectrometry system (WS-CRDS) (L2120-i, Picarro, Santa Clara, CA, USA) for δ2H and δ18O analyses connected to a diffusion sampler.

First results indicate that groundwater is mostly a mixture of rain and irrigation water, which is enriched during the recharge process. The water balance during the growing season of maize is less affected by evaporation losses compared to that of wet and dry rice. Isotopic data show the highest enrichment of surface water at daytime compared to night-time reflecting the daytime evaporation effect. Since rice cropping systems show high variability in water and nutrient management within small scales, high-resolution on-site monitoring allows us to understand the highly dynamic hydro-chemical behaviors of it.