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ENERGY, WATER, AND ECONOMIC IMPLICATIONS OF WATER RE-USE IN RICE-BASED IRRIGATION SYSTEMS, THE PHILIPPINES

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Efficient use of water and energy resources are significant requirements for increasing irrigated rice productivity. However, the ever increasingly complex interplay between energy and agriculture in feeding both machinery and people, respectively, plus the added impact on climate change, have significant implications on the management of our natural resources. This paper analyses a rice-dominated gravity-fed irrigation system in the Upper Pampanga River Integrated Irrigation System (UPRIIS) in Central Luzon, the Philippines, to quantify the water, energy and economic implications of water reuse at five different spatial scales. The variables water re-use, daily surface water inflows and outflows, rainfall, evapotranspiration, and the amount of water internally reused through check dams and shallow groundwater pumping, were aggregated into seasonal totals for five spatial scales during the dry season of 2001. Energy auditing was later used to evaluate the energy implications of water re-use.

Results show that ~30% of the total surface water applied was reused by internal check dams and pumping from shallow groundwater. Across the five spatial scales, water productivity of water reuse was always higher than without water reuse, which reflects the significance of water reuse. The cost-benefit ratio indicates enhanced rice profitability at all five spatial scales with and without water reuse. However, economic benefits of water reuse were lower than economic benefits from surface water, which was mainly due to the higher costs of pumping. Irrigation requires a significant expenditure of fossil energy for pumping and delivering water to crops. Total energy inputs of water reuse were 28% higher than the energy inputs without water reuse, which was mainly attributed to higher diesel energy inputs.

Whilst water reuse contributes significantly to water productivity across the five spatial scales, it does increase energy use due to pumping. Our analysis indicated a trade off between yield and energy use. Achieving higher water productivity would require additional use of fossil energy, which in turn could increase the energy use competition and decrease economic returns. Given the increasing global concerns about climate change and sustainable energy use, an optimal combination of water and energy use is absolutely essential.