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Developing a Multi-Scale Model for Sustainable Water Management in Vietnam's Mekong Delta

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Abstract

The Mekong River Delta in Vietnam (VMD) is the world's third largest river delta, and is an important agricultural area providing for a large proportion of national rice production. To adapt to changing environmental conditions during the dry and wet season, low-lying coastal farms practice a rotational rice-shrimp system. However, decreasing freshwater availability, especially from rainfall, impedes the transition from shrimp to rice, and has forced many farmers to shift towards a more profitable shrimp monoculture system. Consequently, coastal areas lose their protective function against seawater intrusion deeper inland, and salt concentrations in ground and surface water increased along with the associated salt accumulation in the soil. Climate change impacts, such as rising sea level, shifts in precipitation patterns, and freshwater scarcity will accelerate salt water intrusion and are a major threat for ecosystems, environments, and food security particularly in Asian Mega Deltas. This study presents a modeling concept to develop a sustainable water management and land-use approach, including spatial and temporal adaptation and mitigation strategies, for rice farmers in the VMD. Seasonal dynamics of flooding and salinity, and other related water problems, such as freshwater scarcity will be considered. The study uses a multi-scale modeling approach by linking two models: (1) Water evaluation and planning system (WEAP) for crop-water requirements and soil-water dynamics in the catchment; (2) MODFLOW and MODPATH for simulating groundwater flows, soil-groundwater interactions and salinity concentrations in the groundwater. The results of the model will be validated with data collected in three different case study sites, representative of different conditions in the delta. The results will show varying salinity levels and freshwater availability in different temporal and spatial scales to identify hotspots of production constraints. Different management options, such as dynamic irrigation techniques to improve freshwater availability and reduce salt concentrations in soils and groundwater throughout the delta, will be tested in the model.

Keywords: Integrated management, land-use change, MODFLOW, MODPATH, rice, sea-level rise, WEAP

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