Doctoral Thesis

Long-term Variation in Water and Nutrient Balances for Last 8 Decades in a Rapid Urbanized Coastal Catchment Influenced by Complex Anthropogenic Activities

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Abstract

Land use is a key factor affecting water balance, which in turn affects water resource availability. Increasing urbanization has altered water balances in river catchments. Although urbanization impacts have been widely investigated, most studies focus on changes in land use area only, the percent imperviousness of urban was usually ignored. Furthermore, the water balance in upstream forest zones is known to be affected by vegetation community types, phenology, and forest density. Since the 1980s, climate change and new forest management policies have yielded unprecedented modifications in forest ecosystems. Meanwhile, most semi-enclosed seas have experienced serious eutrophication owing to high nutrient loading from rivers during periods of rapid population growth. In Japan, the coastal areas of some megacities (e.g., Tokyo and Osaka) experienced significant economic growth during the 1960s–1970s. Thus, it is important to know the amount of nutrient loading during this period to take timely and appropriate coastal environmental measures for conservation. Unfortunately, achieving such goals is challenging because water quality data in Asian countries are usually limited or unavailable during early historic years. The water quality records in Asian countries usually started late and it is difficult to obtain data from early ages. In this study, streamflow, and nutrient loading in the Yamato River catchment (an urbanized coastal catchment in Asia) was reconstructed using the Soil and Water Assessment Tool. This study comprehensively analyzed anthropologic factors, including land use change, density change in urban

areas, economic policy impact on forest growth, fertilizer usage change, construction of wastewater treatment facilities, and climate change exacerbated by human factors in long-term catchment-scale. Results showed that (1) the impact of percent imperviousness of urban on surface runoff and baseflows is sometimes more important than area changes in a catchment area, especially those characterized by rapid urbanization; (2) forest evapotranspiration has increased in recent decades and young or well-managed forests were more affected; (3) in cases where population growth occurs before urbanization processes, the nutrient load tends to be very high; (4) various anthropological activities including the improvement of wastewater treatment equipment effects on nutrient loading are stronger than climate change effects on long-term scales.

Contents

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