

Hydrological impacts of the floodplain on river discharges and water balance of Lake Tana, Ethiopia.

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Abstract

This paper presents a study on an extensive floodplain adjacent to Lake Tana (Ethiopia) and its lowland tributaries, to enhance our understanding of the runoff transfer to the lake and to better manage the lake and the natural resources in the floodplain. Runoff discharge measurements made at 12 river stations in 2012 and 2013 and a simple rainfall-runoff model were used for this purpose. The effects of the floodplain on river discharges and consequently on the water balance of the lake were investigated using the upstream (at the interface of the floodplain) and downstream (in the floodplain) discharge observations of the Gumara, Rib and Megech Rivers and by conducting scenario-based studies. Analyses revealed that runoff abstraction is the dominant hydrological process in the floodplain from the onset of the rainy season to end of July with a corresponding increase in floodplain storage. In contrast, from August until the middle of September the floodplain releases stored water to the lake. Since the floodplain acts as a storage of flood water, the magnitude of peak flood discharges were much smaller downstream than upstream in the floodplain. We found an average yearly runoff abstraction by the floodplain of $420 \times 10^6 \text{ m}^3$ or 6% of river inflows to the lake in 2012 and 2013. Simulated lake levels compare well with the observed lake levels ($R^2 = 0.95$) and the water balance can be closed with a closure error of 82 mm/year (3.5% of the total lake inflow). This study demonstrates the importance of floodplains and their influence on the water balance of the lake and the need of incorporating the effects of floodplains to improve lake water balance studies.

Keywords: Floodplain; Lake Tana; Water balance; rainfall-runoff model