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Do Forests have an impact on Water Availability? Assessing the effects of heterogeneous land use on streamflow in two monsoonal river basins

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Abstract

The aim of this thesis is to assess the effects of land use changes on streamflow in two river basins, the upper Bhavani in south India and the upper Nam Pong in northeast Thailand. In the Nam Pong basin, the forest cover has decreased from 80% to 27% in the last 30 years. Despite this, almost no changes in streamflow patterns or amounts were found. The figures depicting a drastic reduction of indigenous forest are partly misleading. In areas, where swidden agriculture has been the cause of forest encroachment, large numbers of shade trees were retained thus the density of trees in the catchment has not been as radically reduced (219 trees ha^{-1} to 104 trees ha^{-1}) as the amount of forest cover indicates. Many abandoned plots of land, have also been rapidly replaced with secondary vegetation, which attain evapotranspiration rates close to that of mature forests in only a few years. This would indicate that substituting indigenous forest with a mosaic of open land and mixed trees does not affect the streamflow amounts as drastically as has been observed in small catchments where an area of forest is cleared simultaneously and replaced with homogeneous cropland.

People in both catchments valued trees highly for productivity functions such as firewood, food items, medicines and aesthetic reasons. Forests were also believed very closely linked with a sustained water availability in terms of rain and streamflow. Because of how highly forests are valued, there was a strong interest in both conserving the indigenous forests that still exist today as well as retaining and planting scattered trees. This would aid the maintenance of a landscape mosaic that should according to the results presented in this thesis, not drastically affect streamflow regimes from more heavily forested conditions.

Study work in the upper Bhavani catchment, India, was riddled with data uncertainties that made modelling work wrought with extra challenges. Even in areas such as this, where data is insufficient in relation to the area's hydrological and climatological complexities, people have an interest in understanding their local hydrological regime. It is therefore justifiable to model these areas, if the available data is assessed until an acceptable level of reliability is obtained. Results should then be presented and interpreted in light of these data uncertainties. Results from the modelling of different land use scenarios supported the results from the upper Nam Pong catchment, Thailand where more heterogeneous land use conditions, showed little changes in streamflow regimes compared to a hypothetical indigenous scenario. Most extreme changes in annual water

yield were caused by the scenarios representing total conversion of the catchment to agriculture (+19%) and plantations (-33%) while changes in assured yield at the Bhavanisagar reservoir, a measurement indicating downstream water sustainability, were more modest.

In summary, the retention of heterogeneous land use can buffer the effects of large changes in streamflow as found in small-scale catchment studies. It is very likely that people that enter a forested area to undertake small-scale agriculture will maintain existing forests and plant scattered tree groves for the many products and services that trees are perceived to provide, thus propagating a landscape mosaic.

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