Do larger catchments respond different to forest cover change? Re-analysing global data sets

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1. Continued discussion about the impact of forestation and deforestation on streamflow. Recently, three summary papers (Filoso et al.; Zhang et al.; Zhou et al.) reviewing and analysing large global datasets of impacts of forestation on streamflow have been published. These three papers, using three different approaches, all find a relationship between forestation/de-forestation and streamflow. However, all highlight several modulating factors that influence the impacts of forestation. For example, two of the studies point to a relationship between catchment area and impact, while the third highlights the relationship between aridity and impact. The data bases from these three papers were reviewed, combined and re-analysed to focus on answering the following key questions: 1) How is streamflow impacted by the change in forest cover; and 2) how is this relationship conditioned by area of the catchment, the length of the study, and climate? Finally, we investigate whether the method of analysis, the age of the study and other possible variables impact the observed change in streamflow. Generalised additive models (GAM) were used to run flexible regressions including multiple variables to address these questions. The percentage change in flow was log transformed to stabilize the residuals. The results indicate that, based on the reported data, changes in forest cover cause changes in streamflow, and this change is also affected by climate, with warmer climates (closer to the equator) indicating larger changes in streamflow. There is no indication that the area of the catchment affected the results, but this is potentially caused by the wide variety in reported results from small scale paired catchment studies (Figure 1). These smaller studies also dominate the database with 42% of the data < 1 km2 and 65% of the data < 10 km2. As a result, the paired catchment study assessment technique increased the change in flow by 135%. Length of the study and age of the study did not affect the change in flow, in contrast to other reported studies. Overall, these results provide new insights in the impacts of forestry on hydrology, but also indicate that there are still many unanswered questions in the relationship between streamflow and forest cover.

Figure 1 relationship between change in forest cover and change in streamflow. EA is elasticity analysis, HM is hydrological modelling, PWE is paired watershed experiment, QPW is quasi-paired watershed experiment and SH is combined statistical and hydrograph analysis (after Zhang et al. 2017)

1. Statistical analysis, forestry streamflow connection

References

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