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

R. Willem Vervoorta,b, Eliana Nervic, Jimena Alonsod

aARCIITC DARE, bThe University of Sydney, Australia, cProject manager FPTA 358, dIMFIA, School of Engineering, Universidad de la República, Uruguay

Email: willem.vervoort@sydney.edu.au

1. Chart, scatter chart

   Description automatically generatedRecently, three summary papers (Filoso et al., 2017; Zhang et al., 2017; Zhou et al., 2015) review and analyse large global datasets related to impacts of forest cover on streamflow. Using three different approaches, they all find a strong relationship between forestation/de-forestation and streamflow. However, all studies indicate different confounding factors on the impact of forestation. Particularly, two of the studies point to a relationship between catchment area and magnitude of the impact, while the third highlights the relationship between aridity and impact. The past approaches in the literature are variable and can be substantially improved in statistical rigour. Therefore, the data these three papers were reviewed, combined and re-analysed to answer the following new and older questions: 1) How is streamflow impacted by the change in forest cover as a function of catchment area; 2) how is this relationship conditioned by the length of the study, and climate; and 3) do the reported method, the age of the study and other possible variables impact the observed change in streamflow? Generalised additive models were used to run flexible regressions including multiple variables. The results indicate that, changes in forest cover still cause changes in streamflow, however this change is different between deforestation and reforestation, and also affected by climate, with warmer climates (closer to the equator) indicating larger changes in streamflow. Deforestation causes a 32% greater change in flow compared to reforestation. In contrast to the older work, 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% in the model. Length of the study and initial year of the study did not affect the change in flow, in contrast to other reported studies. These results provide new insights in the impacts of forest cover change on hydrology but also indicate many unanswered questions in the relationship.

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)

Statistical analysis, forestry streamflow connection, quantitative literature review

References

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