

## **Tropical deforestation, people and flooding**

L.A. (Sampurno) Bruijnzeel, Albert I.J.M. van Dijk, Meine van Noordwijk, Nick A. Chappell & Jaap Schellekens

### **A recent global analysis claiming that tropical deforestation amplifies flood risk and severity proves less than solid.**

Floods occur when more water has entered a river channel than can be stored or passed on downstream<sup>1</sup>. Floods thus depend on the nature and storage volume of the river channel, the rate of entry and the rate of outflow. All three can be influenced by land use and human activity. FAO-CIFOR<sup>2</sup> concluded that there is no hard evidence that tropical forests protect people from (extreme) floods or that reforestation reduces the risk. Bradshaw *et al.*<sup>3</sup> claimed to now have such evidence from an analysis of a pan-tropical data-set of measures of frequency, duration and damage from all but the most extreme floods between 1990-2000. Laurance (*Nature*, 27 September 2007) considered this ‘a landmark study’, which ‘provides strong correlative evidence that native forests do reduce the frequency and severity of floods in developing nations’<sup>4</sup>.

The idea that a good forest cover reduces or even prevents floods remained largely unchallenged until the late J.D. Hewlett demonstrated that presence or absence of forest did not appreciably influence the magnitude of the largest flow events, although events of low and intermediate size increased after forest harvesting<sup>5</sup>. Partially due to spatial variation in rainfall events, peak flows tend to scale by area to the power 0.7<sup>1</sup>. At the mechanistic level there is broad consensus<sup>6-8</sup> on the way infiltration, storage, percolation and vegetation water use influence river bank overflow, with urbanization and extent of highly degraded land as key post-forest influences<sup>9,10</sup>. Attribution of observed floods to ‘deforestation’ as major cause and expectations that ‘reforestation’ will stem the tide are, however, strong simplifications. This, unfortunately, is also the case with the Bradshaw data and their analysis:

- Data from the Dartmouth Flood Observatory combine remote sensing and press reports on floods<sup>11</sup>. Loss of forest cover makes floods more visible, while more people in an area increases the chance of floods being reported. Local flash-flooding and prolonged events over large areas are summarized in a ‘flood frequency’ that does not do justice to spatial and temporal variability.

- River basins would be a more natural unit of analysis than countries. Floods in countries such as Bangladesh, Vietnam, Mozambique or Brazil often originate elsewhere. Moreover, comparing floods from countries differing 1,000-fold in size requires non-linear normalisation for area<sup>1</sup>.
- The land cover data for ‘forest’ and ‘degraded lands’ sometimes exceed the size of the country, in other cases there is a lot of ‘non-degraded, non-forest’ land. Of these three, the ‘degraded lands’ has the strongest and ‘forest’ the weakest relationship with flood frequency. After various data transformations, Bradshaw *et al.* accounted for 9 – 16% of extra variance by including forest cover; this is a small gain given the likelihood of multi-collinearity between variables (e.g. forest and mean annual rainfall).
- Bradshaw *et al.* tabulated country population numbers but did not use these as an explanatory variable. Doing so reveals very strong correlations between flood frequency and country population totals ( $r^2=0.82$ ), or population density and floods per area<sup>0.7</sup> ( $r^2=0.83$ ). Critically, adding ‘forest cover’ to models that include human population does not increase the variance accounted for.

In conclusion, the interpretation by Bradshaw *et al.* ignores (for conservation’s sake?) the simpler alternative explanation that changes in flooding intensity (if any)<sup>2</sup> depend primarily on what happens to the land after forest conversion<sup>6,9</sup>, as affected, in turn, by population numbers. As Sherlock Holmes once remarked: ‘It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts’<sup>12</sup>. There are many good reasons to protect remaining natural forests, but the hypothesis of ‘flood protection’ at national scale remains unsupported.

L.A. (Sampurno) Bruijnzeel is with the Faculty of Earth and Life Sciences, Vrije Universiteit, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands.

email: [sampurno.bruijnzeel@falw.vu.nl](mailto:sampurno.bruijnzeel@falw.vu.nl); Tel. +31 20 598 7294; Fax +31 20 6462457

Albert I.J.M. van Dijk is with CSIRO Land and Water, Canberra, Australia (Email: Albert.VanDijk@csiro.au)

Meine van Noordwijk is with the World Agroforestry Center, Bogor, Indonesia (Email: M.VAN-NOORDWIJK@CGIAR.ORG)

Nick A. Chappell is with the University of Lancaster, Lancaster, U.K. (Email: n.chappell@lancaster.ac.uk)

Jaap Schellekens is with Delft Hydraulics, Delft, The Netherlands (Email: jaap.schellekens@wldelft.nl)

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