Flooding Policy Makers with Evidence to Save Forests

Deforestation damages the well-being and livelihoods of billions of people worldwide (1–3). One of the most direct impacts is a change in hydrological cycles, leading to a higher incidence and frequency of devastating floods (defined as the rising of water bodies and their overflowing onto normally dry land) (4). Floods kill or displace millions of people annually and cause billions of dollars in damage to property and infrastructure, with the most severely affected being the world's poorest from mainly developing tropical countries (4) (Fig. 1). Yet ironically, the most immediate (and often only feasible) option to increase personal and local societal capital available to these disadvantaged people is to continue destroying the very resource on which the long-term persistence and strength of their economies depend—the surrounding forests.

Despite the mounting evidence for a link between deforestation and heightened flood risk and severity, there is considerable debate on the issue arising from political imperatives, economic incentives (e.g., "perverse" subsidies for logging), and the paucity of high-quality temporal and spatial data (4–6). The latter issue has fostered a perception that the absence of evidence can be taken as evidence of no connection (7, 8). Indeed, nongovernmental organizations (NGO) such as the Center for International Forestry Research (CIFOR), the United Nations Food and Agriculture Organization (FAO), and the International Council for Research in Agroforestry actively promote the view that forests do not mitigate flood risk. This conveniently aligns to the stated mandate of these NGOs: to promote "sustainable" forestry, which provides employment and income for poor communities (7, 9). The corollary is that such dissenting campaigns have been used by logging companies to justify the expansion of broad-scale logging projects—indeed, the San Jose Timber Corporation attempted to use the FAO/CIFOR report (7) to justify their proposal to log a protected area of primary forest in the Philippines (10).

In reality, there are ample data now available to support the forest–flood protection link. Both global (4) and fine-scale (11–15) evidence strongly defends the notion that deforestation leads to higher incidence of floods and erosion due to increased runoff of surface water. As an example, replicated experiments in tropical savannas of northeastern Australia revealed that hill slopes with small denuded patches have 6–9 times more runoff, and up to 60 times more sediment loss than fully vegetated slopes (12). In some cases, the increase in sediment loss with reduced vegetation is nonlinear (13), with the corollary that extensive deforestation may precipitate even greater-than-expected flood frequency and intensity.

We argue that fence-sitting or dissenting policy makers who justify their stance based on speculative critiques (5) of the available evidence (4) have not adequately gauged the robustness of the counterarguments. For example, the inclusion of "extreme" flood events (those arising from typhoons, cyclones, dam breakage, and

Figure 1. Floods in the developing world. High deforestation rates in Java, Indonesia, likely contribute to the devastating floods in Jakarta in early 2007 (Photo: Y. Agung).

tsunamis; $n = 168$ from 1990–2000 [16]) still predicts that a 10% loss of native forest cover increases flood frequency by 2.9%–25.3%, people killed by 1.0%–6.9%, and people displaced by 0.7%–5.1% (see reference 4 for a detailed description of analysis structure). This reinforces the view that deforestation leads to greater flooding risk and severity (4), even for "larger scales and for larger events" (5). Other weak critiques that the effects of plantations were not properly developed and outliers were excluded (5) are equally irrelevant to the bigger picture. In most developing nations, plantations occupy considerably smaller areas than native forests (17), and the reliability of the plantation-area data is highly questionable (3). Regardless, we do know that plantations can release pollutants, cause erosion, and reduce soil fertility (18), and so their hydrological role is also likely to differ substantially from native vegetation. Outlier data (from China) were excluded (4) because they precluded model convergence, and the reported gains in total and natural forest cover from 1990–2000 were considered unreliable given this country's recent history of misreporting natural resource statistics such as fishery takes (19).

The growing correlative and experimental evidence therefore suggests that policy-lobbying organizations must embrace a united front in promoting the forests–flood protection link if they are to persuade governments to protect forests. The most convincing case would be mounted by a more active collaboration among hydrologists, risk analysts, ecologists, and forestry scientists, so that policy organizations are provided with a consistent message that is supported by multifaceted, interdisciplinary evidence. Only

then will the education of politicians and bureaucrats convince the majority of the world's poor that their long-term prosperity and indeed, survival, may depend on their own decisions to restrict deforestation. International donors and a future global carbon offsets market should make forest regeneration in flood-prone and poverty-stricken areas a high priority, with active programs to restrict further deforestation (especially of primary forests) by compensating for short-term opportunity losses created by making the choice to forego land clearance.

As the world's human population expands and places mounting pressure on the Earth's finite resources, especially in developing nations, some argue that it is only by the clear demonstration of how personal well-being is sustained by healthy ecosystem services will people be ultimately convinced to avert ecological disaster and socioeconomic damage (20). The simple act of convincing the world's poor and their governments of this important relationship will lead to numerous positive outcomes for biodiversity and essential ecosystem services. A heightened fear of personal loss of life and property—backed by sound, quantitative scientific evidence—will assuage the erosion of carbon sequestration, pollination, water purification, and disease suppression services the world's forests provide.

References and Notes

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21. This research was supported by the National University of Singapore (R-154-000-264–112).

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