REPLY TO VAN NOORDWIJK AND ELLISON:

Moisture recycling: Key to assess hydrological impacts of land cover changes, but not to quantify water allocation to competing demands

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Moisture recycling—the contribution of evapotranspiration (ET) in a certain area to precipitation in the same area—can be substantial (1), particularly in forests (2). Land cover changes can affect local ET and, consequentially, local precipitation (3, 4). We agree with van Noordwijk and Ellison (5) that moisture recycling on land is an important process to consider when assessing the impact of land cover changes on terrestrial hydrology. However, when we address the question in Schyns et al. (6) of how limited green water resources are being allocated to human use, we are not interested in changes in hydrology. Rather, we want to know the extent to which green water flows, as they are, are made productive for different competing consumption goods. For this purpose, the rate of moisture recycling is irrelevant, as we will illustrate by means of an example for the green water footprint (WF) of forestry products.

Consider a forested area with a precipitation (P) in a certain time period of 100 water units, which splits up into 60 units of ET and 40 units of runoff. Suppose an internal moisture recycling rate of 10%. Suppose that the forest is a production forest with a wood harvest equal to the maximum sustainable harvest and no economic value other than wood production. Thus, according to standard WF accounting procedures, ET in the basin (60 units) counts as the green WF of the derived wood products. The recycled moisture is six units (10% of 60 units). This means that six of the 100 units of P originate from local ET. Pointing at this moisture recycling, one can argue that the six water units can be used again and that the green WF should refer only to the part of the ET that does not come back (7). With such accounting, the green WF would not be 60 water units, it would be 54. However, one should not count oneself rich: P remains 100 units since it already includes the recycled six units; P will not grow to 106 units due to the recycling. ET, fully used for wood production, remains 60 units. Adjusting WF accounts based on moisture recycling is therefore mistaken. The green WF is not 54 water units, but remains 60 units because the six units of recycled water are not available for other uses; they are already used. WF accounting is thus independent of the rate of evaporation recycling.

Our analysis in Schyns et al. (6) should be interpreted not as a call to reduce terrestrial ET, but as a warning to the increasing human appropriation of limited ET. To reduce the green WF does not mean to reduce ET, but rather to reduce the human appropriation of that ET.

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5 van Noordwijk M, Ellison D (2019) Rainfall recycling needs to be considered in defining limits to the world's green water resources. *Proc Natl Acad Sci USA*, 10.1073/pnas.1903554116.

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