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Improved water footprint of oil palm products using eddy covariance measurements of evapotranspiration

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The global population growth and changes in human lifestyle and consumption patterns put immense pressure on the limited freshwater resources in the world. Aiming at sustainable use and equitable allocation of the water resources, it becomes crucial to know the water appropriation for the production of different commodities and consumer goods. These days, oil palm (*Elaeis guineensis*) is one of the highest-demanded crops around the globe since the oil of its fruits and kernel is widely used as biofuel and major ingredients in food and cosmetic industries. Given this massive demand, the areas under oil palm cultivation in the tropics have continuously been expanding in the last decades, particularly in Indonesia. With the oil palm boom, not only biodiversity loss, and carbon dioxide emissions from deforestation have been increasing, but also the consumptions of blue and green water resources are of concern.

In this ongoing research, the concept of water footprint (WF) is employed to quantify the green and blue water use of oil palm production in the Bajubang district, Batanghari regency, Jambi province, Sumatra, Indonesia. This is one of the first studies that uses field-measured data of evapotranspiration (ET) from oil palm plantations in different growth stages over seven years for the purpose of WF assessment, compared to the available literature where ET was estimated using modelling approaches. The multi-year measurements were conducted using the eddy covariance technique, which continuously measures water vapor (H_2O) fluxes at the ecosystem level over the plantation. Based on these measurements, specifically, the WF assessment is performed on a product basis during the plantation life cycle, per area and time unit, for the oil palm fruit yield and oil palm derived products (palm oil, palm-oil biodiesel). Besides the crop water consumption at the plantation (i.e. ET) as the core element, other water consumptions in the products' processing chain are included in the WF assessment. Preliminary results indicate a WF of 2440 $m^3\ t^{-1}$ for palm oil and 65 $m^3\ GJ^{-1}$ for palm-oil biodiesel. This is about 50% lower than the global average estimates. Local WF account of oil palm products has a critical contribution to product transparency while being useful for comparative purposes. Contrasting the WFs of products serving the same function (e.g., palm oil biodiesel, soybean biodiesel) is of essential importance, aiming at conscious product choices in a world of freshwater scarcity.

Keywords: water footprint, oil palm, palm oil, Indonesia, eddy covariance, evapotranspiration