LETTER

Use of inadequate data and methodological errors lead to an overestimation of the water footprint of *Jatropha curcas*

In their recent article, Gerbens-Leenes et al. (1) calculated the water footprint (WF), the amount of water required to produce 1 GJ of energy, of several bioenergy crops. The water footprint of *Jatropha curcas* was remarkably high (8.6 times higher than the WF of sugar beet, the most water-efficient crop), which may have serious implications for its future management.

However, we strongly believe that jatropha's WF was dramatically overestimated because of inappropriate use of data and methodological errors.

For their calculations of jatropha's WF, the authors relied on a nonpeer-reviewed report (2), providing data of the total available water in plantations, summing rainfall and irrigation, but not of evapotranspiration, required to calculate WF correctly. Hence, ignoring discharge by using total available water, Gerbens-Leenes et al. (1) overestimated jatropha's WF.

In addition, severe doubts concerning the calculation method can be formulated. The lack of statistical processing makes it impossible to derive sound conclusions from the WF estimates. The jatropha dataset used consists of one plantation in five different countries, which does not allow estimating WF of the entire country in which these plantations are located, as claimed by the authors. Furthermore, it is unclear how the authors obtained the other parameters necessary to calculate the WF of jatropha (f_{fat}, f_{diesel}, and HHV_{diesel}), as these cannot be found in any of the articles to which they are referring. In addition, cultivation aspects were ignored (e.g., were the plantations situated in regions with suitable climatic conditions and were the agronomic practices adequate?).

Moreover, all jatropha data used originated from immature plantations between one and four years old (2). As all tree species, jatropha invests mainly in the build-up of nonreproductive biomass during its first growth years. This leads to low seed productivity in its first years, after which productivity rises steadily, attaining a constant and maximal productivity when maturity is reached after 5–8 years, depending on the growing conditions (3). Therefore, relying on data of immature plantations instead of taking the entire rotation period into account caused an additional overestimation of the WF of jatropha.

In strong contrast with the findings of Gerbens-Leenes et al. (1), recent literature on plant–water relations of jatropha suggests a low WF. Typical of a stem succulent species, jatropha strongly controls its stomatal conductance, resulting in a relatively high transpiration efficiency (5.81 ± 0.19 mg/g) and conservative water use (4), with a transpirational crop coefficient (K_{cb}) of 0.540 ± 0.026 (derived from data of ref. 4). Furthermore, conversion of jatropha oil into biodiesel through transesterification is a very efficient process (3).

In an immature jatropha plantation in Egypt, a crop water-use efficiency of 0.393 kg of oil per m^3 water was reported under optimal irrigation (5), which would imply a WF for jatropha (with HHV_{diesel} = 39.65 MJ/kg, f_{diesel} = 0.99; after ref. 3) of 65 m^3/GJ, only 16% of the estimate of Gerbens-Leenes et al. (1). Although based on a dataset limited in time and number of replications, this estimate agrees well with recent literature on plant–water relations and indicates that Gerbens-Leenes et al. (1) indeed dramatically overestimated the water footprint of jatropha.

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