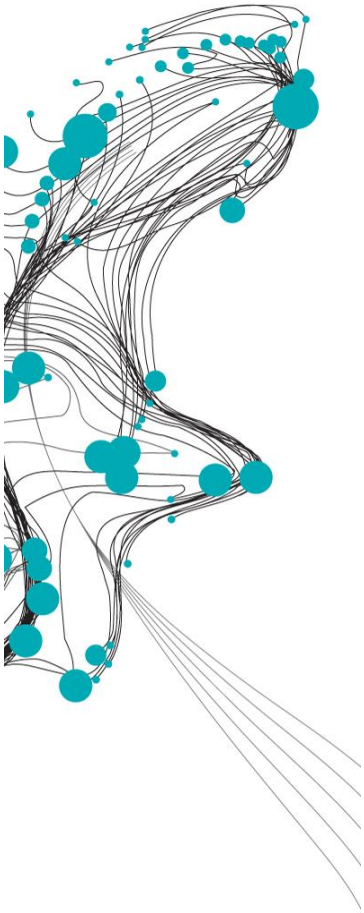
SIMULATING THE WATER FOOTPRINT OF WOODIES IN AQUACROP AND APEX



As the agricultural sector is the largest human water consumer, models that simulate their water use are crucial in global water studies. A promising plant simulation model is Aquacrop, but this model has limitations when simulating woody plants. Apex is a model that is capable of simulating woodies, but is supposed to be less stable under changing conditions.

This study compares the yield and evapotranspiration of Aquacrop and Apex for the apple tree, the grapevine, the olive tree and the oil palm for point-picked locations under various environmental conditions. The input and the parametrization of the models is harmonized to make an honest comparison possible. To simulate woodies with Aquacrop, the model is set-up to cover the yield and evapotranspiration characteristics of a woody as realistically as possible. As a result, Aquacrop can simulate only a full-grown woody plant; the development phase before a plant is full-grown is not covered by this model.

When we compare the yield and evapotranspiration of full-grown woody plants between Aquacrop and Apex, it becomes visible that the predicted evapotranspiration rates lie quite close to each other and to literature values, while the yield values can differ quite a lot between the models. Both models in general overestimate the yields compared to literature values. For the apple tree in Shandong the average full-grown yield and evapotranspiration rate are shown in figure 1.

The simulations in the models are affected by the climate and soil conditions. The response of the evapotranspiration on the climate variability is very similar in the models, but yield fluctuations in especially Apex show little resemblance. Aquacrop reacts stronger on a changing soil than Apex.

To calculate the water footprint, the development phase should also be taken into account. Apex is capable of this, and an example of the development of yield and evapotranspiration is shown in figure 2. Because of a lower yield in the development years, the lifelong average yield is about 20 percent lower than if we would only consider full-grown years. The evapotranspiration development does not significantly influence the lifelong results. With this in mind we can calculate the water footprints. For the apple tree in Shandong this water footprint is shown in figure 1. For all plants the water footprints show a similar pattern as the full-grown yields, in which the difference between the models can be significant, but especially the deviation from literature is concerning.

In conclusion, Aquacrop and Apex both show some peculiar behavior, but Aquacrop does not seem to be inferior to Apex. This despite the fact that it is not designed for simulating woodies. Additional research is required to further analyze the performance of the models.

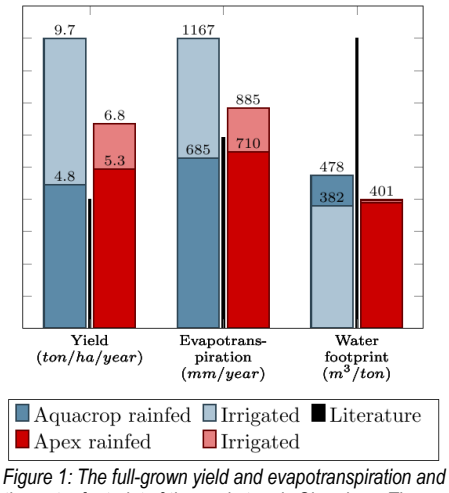


Figure 1: The full-grown yield and evapotranspiration and the water footprint of the apple tree in Shandong. The literature values are mainly based on Mekonnen et. al. (2010) and Faostat (2015)

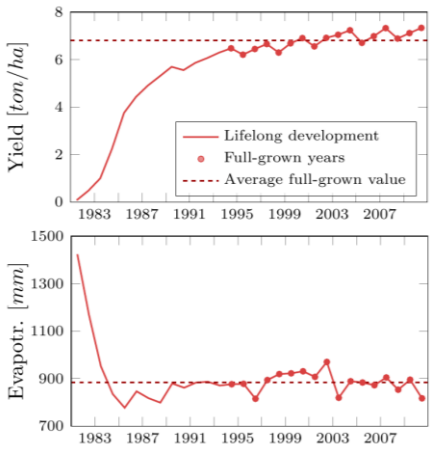


Figure 2: The lifelong (developing years and full-grown years) yield and evapotranspiration rate for the apple tree in Shandong.

Faostat (2015). Faostat database, downloaded on 22-12-2015, http://faostat3.fao.org/.
Mekonnen, M.M. and A.Y. Hoekstra (2010). The green, blue and grey water footprint of crops and derived crop products. Value of Water Research Reports Series no. 47, Unesco-IHE.

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