Title of the project:
Alternative ways to translate the blue WF cap in a large river basin to caps per sub-catchment: case study for the Yellow River basin

Assignment no.: 32.18	**Internal/external:** External (China)
Head graduation committee: Prof.dr.ir. Arjen Y. Hoekstra	**Daily advisor:**
Name(s) of participating institute: Prof.dr. La Zhuo, Northwest A&F University, Yangling, Shaanxi, China	**Start of the project:** Flexible

Short description and objective of the project:
Setting monthly blue water footprint caps – maximum levels for blue water consumption – per river basin is crucial for ensuring sustainable water use (Hoekstra, 2014). A blue water footprint cap is the sustainable upper-limit to the blue water footprint (WF), that is the consumption of surface water and ground water, in a river basin. The blue WF cap in a river basin depends on the precipitation that becomes runoff and the need to maintain a minimum flow for sustaining ecosystems and livelihoods, i.e. the environmental flow requirement (EFR). Blue WF, natural runoff, EFR and the blue WF cap vary spatially and temporally. Over the past decades, human interventions like reservoir construction and land use changes reduce water scarcity in upstream parts of river basins but aggravate water stress downstream (Veldkamp et al., 2017). The method to formulate monthly blue WF caps for a river basin as a whole is available (Hoekstra, 2014), also for the case in which reservoir storage plays an important role in the basin (Zhuo et al., 2019). It's however still an open question how to translate caps formulated for a river basin as a whole to specific caps for each sub-catchment within a basin. When the overall maximum level of water consumption in a month for the basin as a whole is given, this water consumption can still be spatially allocated in different ways, although upstream catchments have their own specific limitations given local water availability. Water that is sustainably available in an upstream catchment doesn't need to be used in that upstream catchment but can also be used somewhere downstream instead. However, downstream use of water beyond what is generated and sustainably available downstream subtracts from the WF cap to be set upstream. It is thus possible to transfer part of the theoretical blue WF cap for an upstream catchment to downstream, thus increasing the downstream blue WF cap.

In this project, the Yellow River Basin (YRB) (Figure 1) will be taken as a case study. The YRB is China's second largest river basin, with a drainage area of 795×10^3 km^2, feeding 9% of the national population, and contributing 13% of the national grain production, with only 2% of the national water resources (YRCC, 2013). The YRB faces moderate to severe blue water scarcity during seven months a year (Hoekstra et al., 2012; Zhuo et al., 2016).

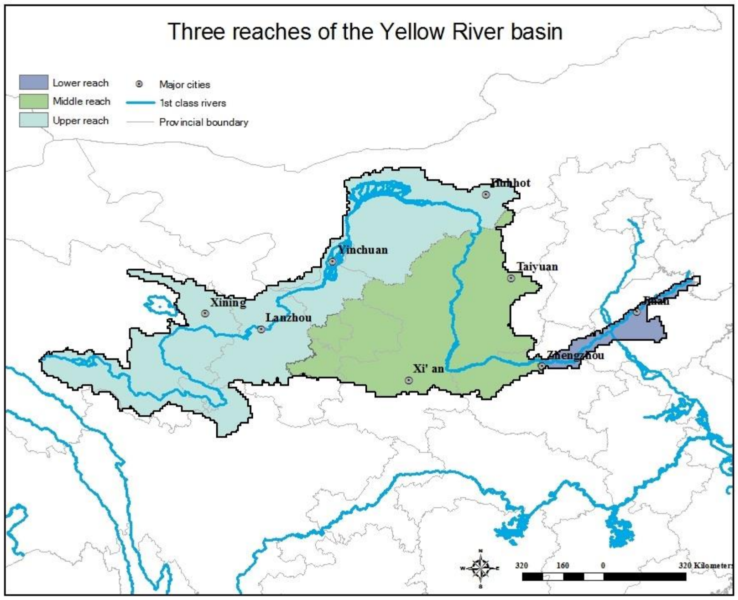

Figure 1. The three reaches and main river stream in the Yellow River Basin.

Objective

To investigate alternative ways to translate the monthly blue water footprint cap for a large river basin to sub-catchment level. The YRB over 2010-2014 will be the study case.

Method

The project will be carried out in five steps:

(1) Monthly natural runoff simulations for each sub-catchment using the SWAT model. The sub-catchments will be generated in SWAT model according to main stream flow directions.
(2) Estimation of monthly EFRs per sub-catchment based on two or three EFR estimation methods, e.g. Richter et al. (2012) and Pastor et al. (2014).
(3) Aggregating monthly blue WF data for agriculture, and downscaling the WF of industry and household to sub-catchment levels.
(4) Develop two or three alternative ‘principles’ (procedures) for translating river-basin level monthly blue WF caps to catchment level.
(5) Quantify, for each principle, the monthly blue WF caps at sub-catchment level, and quantify the level of exceedance of current blue WFs per catchment in each case.

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