ABSTRACT

Ensuring water and food security in the Anthropocene requires an understanding of combined climate change patterns and land and water management options from local to global scale. In many regions, irrigation from river and groundwater sources is being used at unsustainable rates and climate change will further threaten those water sources. Optimizing the use of precipitation in agricultural water management becomes a necessary improvement to adopt at larger scales, especially in vast rainfed arid and semi-arid regions where it represents the only source of water. This thesis explores the patterns of change in hydroclimate and the land and water management options to provide guidance to scale-out sustainable agricultural practices. In particular, this thesis focuses on where and to what extent practices related to water harvesting can represent a sustainable agricultural innovation to cope with climate change with a social-ecological lens. It also provides a simple data-driven methodological approach that can be replicated and adapted at different spatial scales to be used as a policy-guiding tool to spread water harvesting implementations.

In the first manuscript focused on Africa (**Hydroclimate manuscript**), I investigate the projected impact of climate change on the water cycle based on the main hydroclimatic parameters of precipitation, evapotranspiration, runoff and soil moisture and two hydroclimatic indices; the aridity index and the evaporative ratio. The manuscript identifies continent-wide patterns in hydroclimatic change that are found to be consistent between the two representative climate change scenario corresponding to the Paris agreement and the business as usual, respectively. The manuscript not only highlights the importance of pursuing the climate policies to increase adaptation to future hydroclimatic change, but also suggests the urgency to implement sustainable land and water management practices (e.g. water harvesting) to make the best use of water resources in the different hydroclimatic-change regions identified in the manuscript.

In the second manuscript (**Water harvesting manuscript**), I analyse the potential of water harvesting to be successfully implemented in the current global agricultural area, drawing from a large dataset of successful case studies. This manuscript provides methodological insights on geographical out-scaling of local case studies using similarity in social-ecological characteristics as a condition to replicability. The results identify two main successful hotspot regions in Wester Africa and South-Easter Asia where the social-ecological conditions make WH suitable for increasing crop production in large portions of the current agricultural land.

The outcomes of both manuscripts can be used by local, regional and international stakeholders to develop policies of sustainable agricultural in the face of climate change.