Water demand of agroforestry systems in a changing climate

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Introduction

Faidherbia albida is a widely promoted agroforestry species due to low water demand during the crop season[1,2]. Climate change is projected to affect water availability in sub-Saharan Africa with implications for agricultural systems. Whereas future water demand of single crops is mostly know, this remains vague for more complex systems.

This study thus aims at assessing the future water demand of *Faidherbia* parkland systems to understand its resilience and upscaling potential.

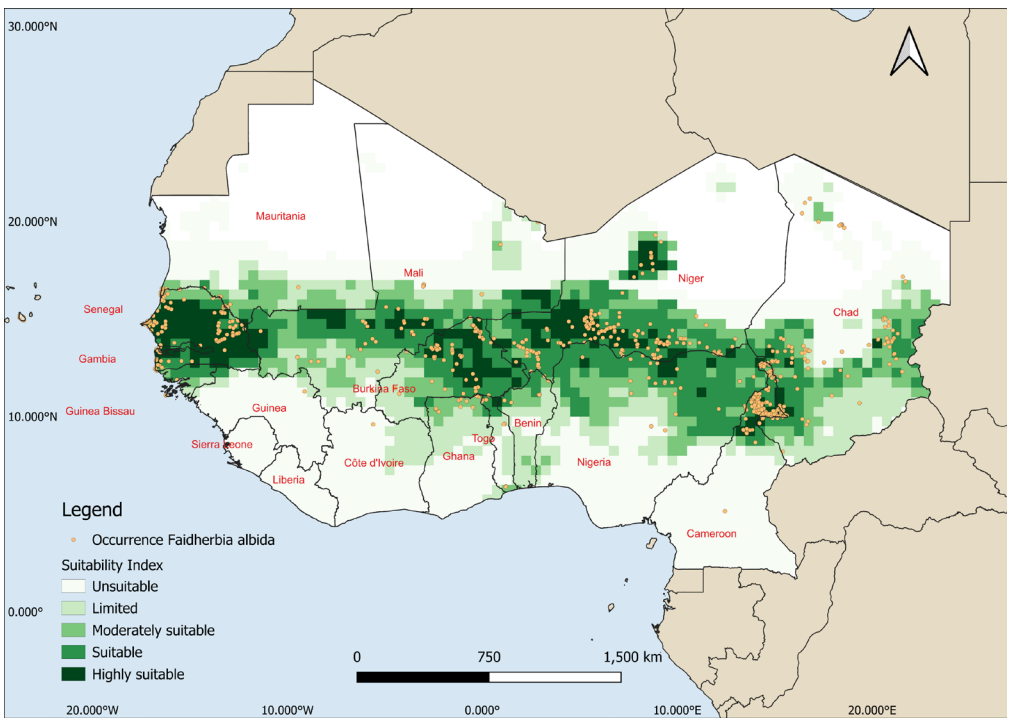

Fig. 1 Map of of current suitability for Faidherbia albida in West and partially Central Africa with occurrence data points. The analysis was done with MaxEnt using 6 agro-climatic indicators, soil pH and groundwater depth. AUC=0.88, cross-validation mean AUC = 0.82.

Methods

We plan to use the process-based model APSIM-X integrating different input data following the workflow shown in Fig. 2. The basis will be a dynamic *Faidherbia* model.

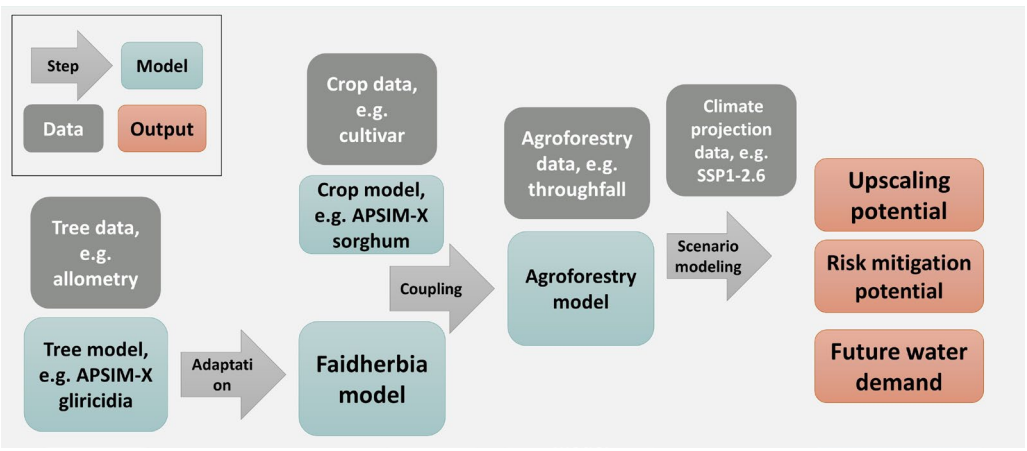

Fig. 2 Modelling workflow with data input, model, step and relevant outputs.

Conceptual framework

Due to its facultative phreatophytic behavior as well as its reverse phenology, *Faidherbia* minimizes competition for water and light for crops under historical climatic conditions. However, it is yet unclear how e.g. prolonged dry seasons may affect this.

By building scenarios adapting the relevant factors that influence the evapotranspiration (ET), we aim at assessing how the ET and thus water demand of the system will change in the future.

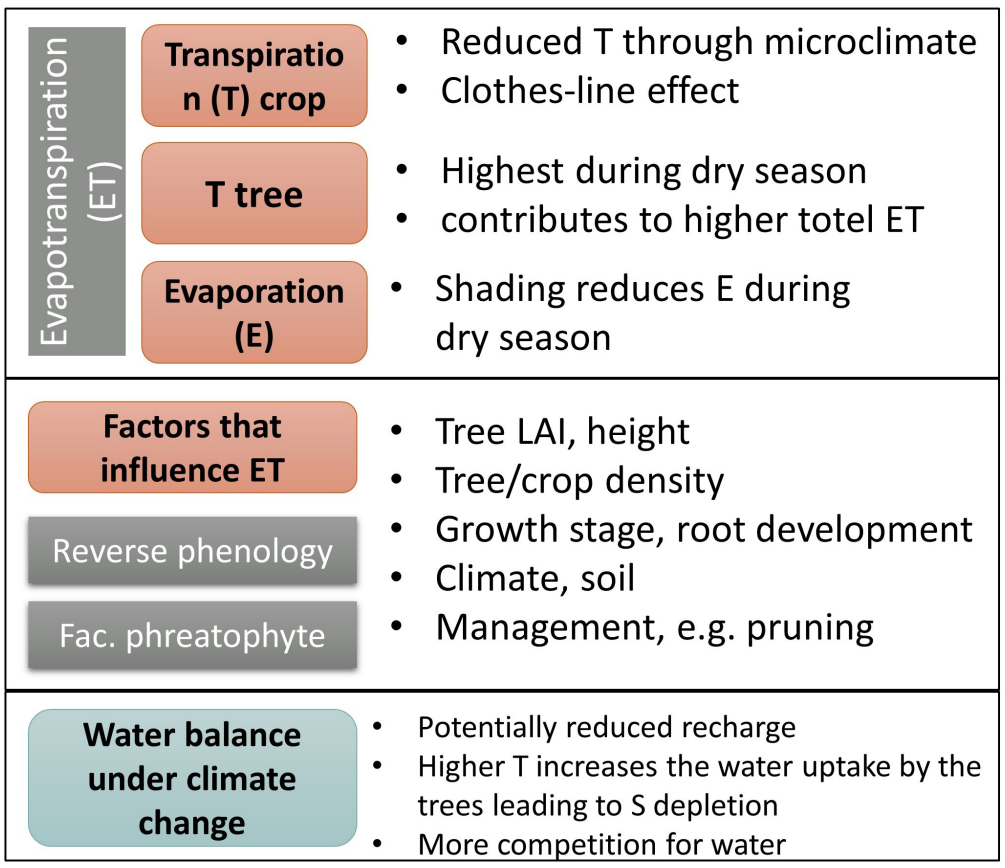

Fig. 3 Conceptual framework[1,2,3,4,5,6,7] describing relevant factors for evapotranspiration and water balance for a Faidherbia system under climate change.

Next steps

Estimating the allometric equation for *Faidherbia*. Please reach out if you have information on allometric data!

Working on reverse phenology simulation in APSIM-X.

References: 1: Roupsard et al. (1999). Reverse phenology and dry-season water uptake by Faidherbia albida (Del.) A. Chev. Functional Ecology. 2: Diongue et al. (2023). A probabilistic framework for assessing the hydrological impact of Faidherbia albida in an arid area of Senegal. Journal of Hydrology. 3: McDonald et al. (2011), 4: Grossiord et al. (2018). Prolonged warming and drought modify belowground interactions for water among coexisting plants. Tree Physiology. 5: Jacobs et al. (2022). Modification of the microclimate and water balance through the integration of trees into temperate cropping systems. Agricultural and Forest Meteorology. 6: Mwangi et al. (2016). Modelling the impact of agroforestry on hydrology of Mara River Basin in East Africa. Hydrological Processes. 7: Allen et al. (2011). Evapotranspiration information reporting: I. Factors governing measurement accuracy. Agricultural Water Management.

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