Water resources at risk in horticulture ?

Assessment of land suitability and water resources potential for horticultural irrigation in Grand-Duchy of Luxembourg

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Summary

Context

- Political will to promote horticultural crop expansion
- Need to identify land suitability, water needs and available resources
- Pressures : water consumption, climate change

Explored solutions

1. Identification of land suitable for irrigated hoticulture
2. Water needs through a communication interface AquaCrop – Python
3. Water resources : ground water recharge estimation and surface waters availability
4. Water needs and resources confrontation
5. Development of a national potential irrigation map

Introduction

There is a political will to promote and sustain the horticultural sector in the Grand Duchy of Luxembourg. At the same time, water resources are under pressure as a result of demographic, economic and agricultural growth, and climate change. This situation requires an update on the state of available water resources and its users; and to study the potentials and limits to develop irrigated horticulture.

To do so, this study aims to identify areas conducive to sustainable irrigated horticulture.

Methods and materials

1. Climatic variables :
   In order to explicitly represent local conditions as much as possible, an automatic daily spatial interpolation selection method for climatic variables is implemented.
2. Land suitability :
   The Land suitability is assessed by a pairwise comparison matrix (AHP).
3. Water needs :
   An AquaCrop SA – Python interface is developed to assess the water needs.
4. Surface water resources :
   To preserve surface waters, the « *sustainability boundaries approach* » is used to set water withdrawal limits.
5. Groundwater resources :
   The renewable groundwater use is estimated by the joint use of curve number method and Thornthwaite loop over the available aquifers for agriculture.

Next steps

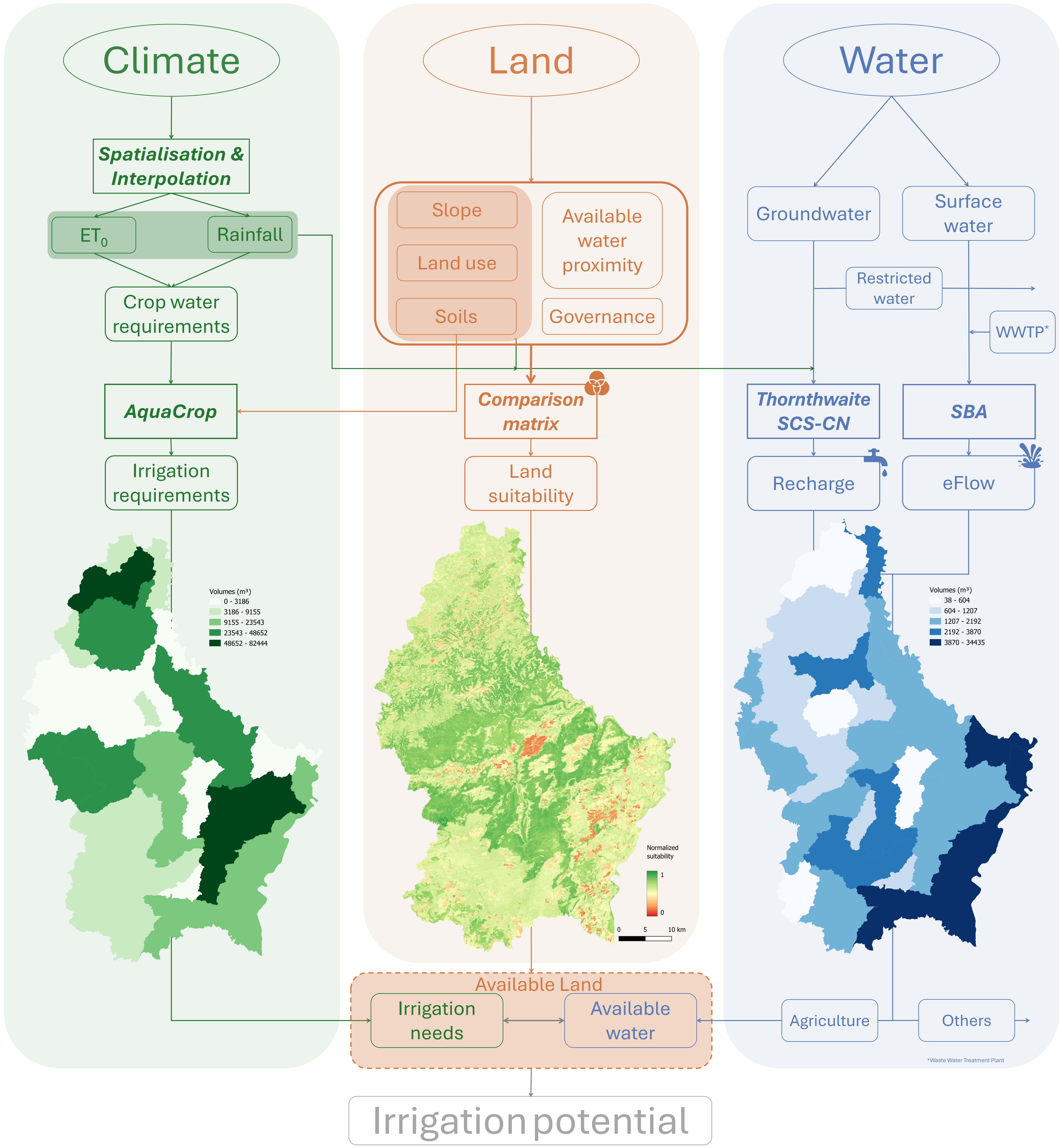
Waters needs and resources confrontation :

- The irrigation needs for each sub-basin are confronted with the available waters to assess different dimensions of water scarcity : volume deficits (available – required) per years, seasons, days.
- The use of retention basins will be explored.

Scenarios - climate and practices :

- Consumer growth and climate change scenarios will be used to assess the evolutions of the water needs and resources while agricultural practices are tested to mitigate them.

The maps shown are for illustrative purposes. They do not constitute the final version of the study.



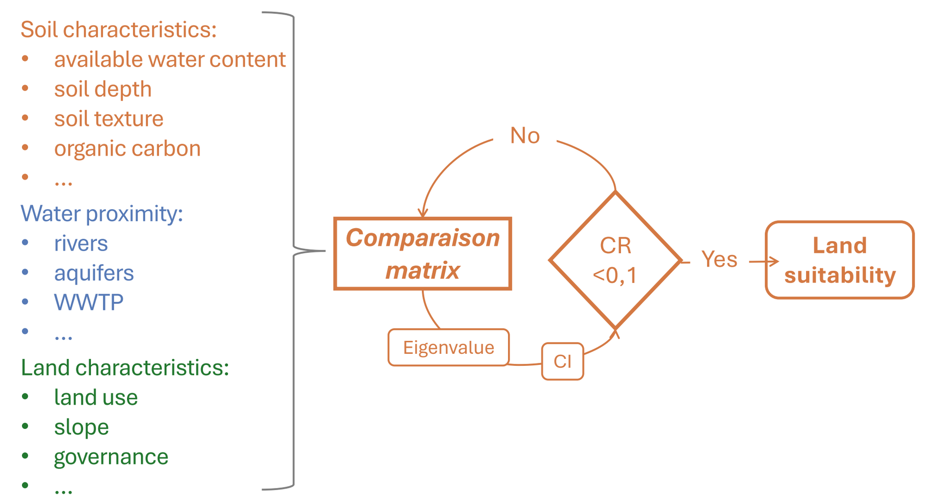


Figure 1 – The comparison matrix consistency evaluation. Firstly, the eigenvalue and the consistency index (CI) of the comparison matrix are assessed. The consistency ratio is evaluated. It must be inferior to 0,1 for the matrix to be consistent.

	Soil Texture	Soil Depth	OC	Drainage	TAW	Slope	WR Prox.	*Pairwise weighting*
Soil Texture	1,00	2,00	7,00	5,00	1,00	5,00	7,00	**0,31**
Soil Depth	0,50	1,00	7,00	3,00	0,50	4,00	5,00	**0,17**
OC	0,14	0,14	1,00	0,33	0,20	0,50	0,11	**0,03**
Drainage	0,20	0,33	3,00	1,00	0,50	5,00	2,00	**0,08**
TAW	1,00	2,00	5,00	2,00	1,00	7,00	7,00	**0,29**
Slope	0,20	0,25	2,00	0,20	0,14	1,00	0,50	**0,04**
WR Prox.	0,14	0,20	9,00	0,50	0,14	2,00	1,00	**0,04**

Table 1 – The comparison matrix developed to create the land suitability map. It shows in row and column the different considered factors. As an example, we can read in the second box of line 1 that soil texture is considered 2 times more important than soil depth. The weight of the factors (last column) shows the overall relative importance of each factor.

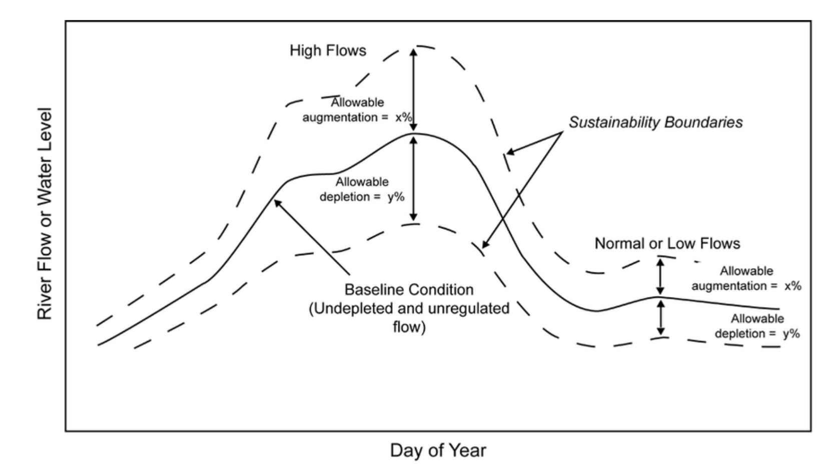


Figure 2 – Sustainability Boundaries Approach. The limits of allowable augmentation or depletion taken from Richter et al. (2010). With this methodology, river flow must continue to pass through a series of values to achieve "good" environmental status. Conservation limits are generally set at 10% or 20%.

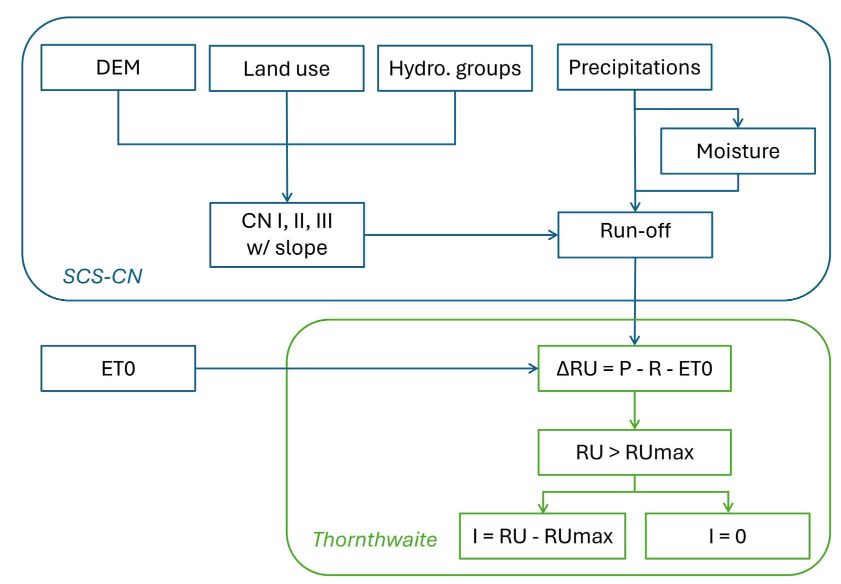


Figure 3 – Recharge estimation workflow. The initial runoff is estimated with the SCS-CN method, next the Thornthwaite balance method is used to estimate the deep percolation. These estimations are applied on the available shallow aquifers for agriculture.

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