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

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Since the 1960s, the Luxembourgish agricultural sector has been largely influenced by the common agricultural policy. Luxembourg authorities have expressed a desire to make a transition in their agricultural production to focus on national needs and self-sufficiency. A new financial support will be introduced to favor vegetable (horticulture) and fruit growers. At the same time, water resources are under pressure as a result of demographic, economic and agricultural growth. Moreover, climate change exacerbates these pressures. 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.

Firstly, land potentially suitable for irrigated horticulture was assessed via a pairwise comparison matrix ranking importance of land features, soil characteristics and water accessibility (i.e Worqlul et al., 2015; Gonfa et al., 2021; Danbara and Zewdie, 2022), enabling the identification of opportunities and challenges that horticulture producers may face.

Secondly, water needs for those zones are compared to available conventional (Altchenko & Villholth, 2015) and unconventional water resources (Paul et al., 2020). The spatialized net irrigation water requirements for major horticultural crops are computed through the water-driven crop growth model, AquaCrop (Raes et al., 2009). An interface communication between Aquacrop SA and Python is developed to run numerous spatialized simulations based on retrieved data from soil, crop, climatic condition databases and agricultural practices.

Most papers consider a single water source type for irrigation. One of this study's novelties is to explore the possibilities of combining different types of water resources for irrigation. Available groundwater has been estimated by considering recharge rates calculation as well as surface water and non-conventional water (e.g. treated wastewater), which both were obtained from monitoring data. A hydrological method of ecological flow estimation is used to address environmental needs (European Commission, 2015), while non-agricultural needs are taken into account via consumption data. Another innovative aspect of this study is the assessment of three

combined aspects regarding potential future scenarios. On one hand, consumer growth and climate change scenarios alterations on water balance are evaluated. On the other hand, impacts of agricultural practices are quantified through AquaCrop to show the required adaptation of horticulture to those future developments.

This approach enabled the simulation of water needs of several agricultural scenarios (crop selection, agricultural practices, climate change and competing water users' impacts), and their confrontation with available water resources. Combined with suitable land for horticulture, zones with different irrigation potential are assessed, providing a decision support aid for the development of irrigated horticulture and water ressources allocations at a national scale.