

ESTIMATING CURRENT AND POSSIBLE FUTURE IRRIGATION WATER REQUIREMENTS

AN APPROACH FOR THE RHINE BASIN DURING THE GROWING SEASON IN PERIODS OF DROUGHT

The year 2018 was an extremely dry year in the Rhine basin, and the growing season was very dry in the years 2019 and 2020. This has led to alarmingly low water levels in main rivers such as the Rhine, and negatively impacted sectors dependent on these water flows. The agricultural sector, as the largest water consuming sector in the world, is one of these sectors. Especially in dry years, crops are dependent on irrigation water. The goal of this study is to estimate the current and possible future irrigation water requirements of the agricultural sector in the Rhine basin and consequently, its impacts on the Rhine discharge during growing seasons. With the help of the Aqua21 water footprint accounting model and the Delft-Agri water demand and allocation model, water requirements are quantified, compared with historic data for validation, and assessed for future scenarios.

The four most important irrigated crops in terms of irrigation water use – sugar beet, potatoes, maize, and oats – are used for the estimation of current and future water requirements.

The Delft-Agri model calculates gross water requirement, and the model package RiBaSIM determines river discharges. In this study, agricultural input data for the Delft-Agri model for the Rhine basin were taken from Aqua21. The Aqua21 model turns out to perform well for the variables production and yield at small scale (NUTS-1) for both average and dry years. The Delft-Agri model performs well for the variable of net water requirement but does not account for drought damage to production. The performance of RiBaSIM for the variable of river discharge is rather low for low flows, limiting the analysis on estimating the impact of changing river flow under various scenarios. To scope possible future irrigation water use in the Rhine basin, four scenarios are designed with the help of the story-and-simulation approach: combining modest or much global warming with intensive or sustainable agriculture.

This study shows that under drought, the current irrigation water requirement of the agricultural sector in the Rhine basin over the growing season can reach $94 \cdot 10^6$ m³/month. For a future with intensive agriculture, by 2050 water requirements can be expected to increase by 96% (modest global warming) to 130% (much global warming). The sustainable agriculture scenarios show an increase of 12% (modest global warming) to 33% (under much global warming) compared to current.

The impact of the irrigation water requirement on river discharge is small (below 1% of reference discharge) for both the main river as the side rivers.

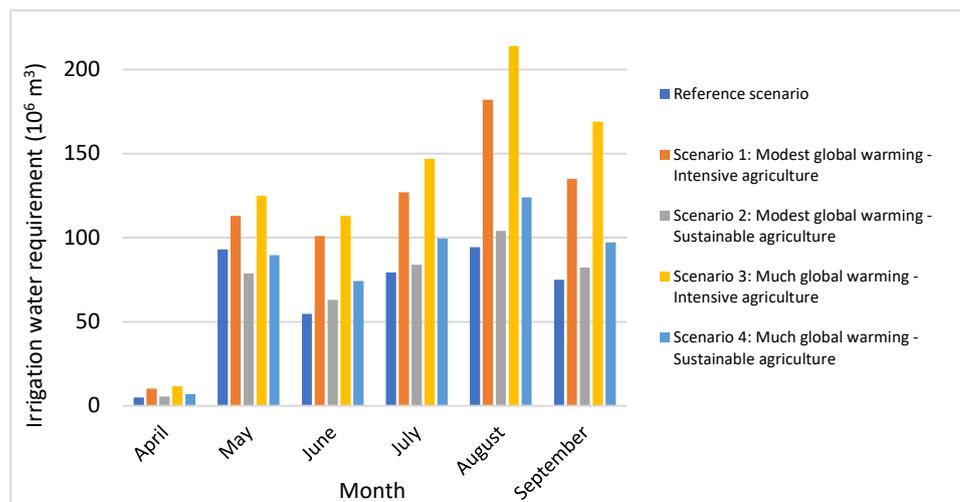


Figure: Monthly irrigation water requirement for the Rhine basin during the growing season for the dry year "2003" per scenario

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