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Application of the Water Footprint Assessment method to compare theoretical and real blue water use in Spanish bioethanol crops

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Introduction & Background

The topic of 'water' in LCA has emerged as an important approach to quantify the related effects of water use from consumption of goods and services.

After the introduction of Water Footprint (WF) concept by Hoekstra in 2000s as an indicator of freshwater appropriation [1], LCA community began to develop methodologies to include environmental impacts related to water in LCAs, and started to furtherly develop the ISO 14046:2014 standard. It provides principles, requirements, and guidelines for conducting and reporting a water footprint assessment as a stand-alone assessment, or as part of a more comprehensive environmental assessment [2]. Then, several assessment methods have been proposed by the scientific community, encompassing both the computation of water use and its impacts, but differing in the communication of results.

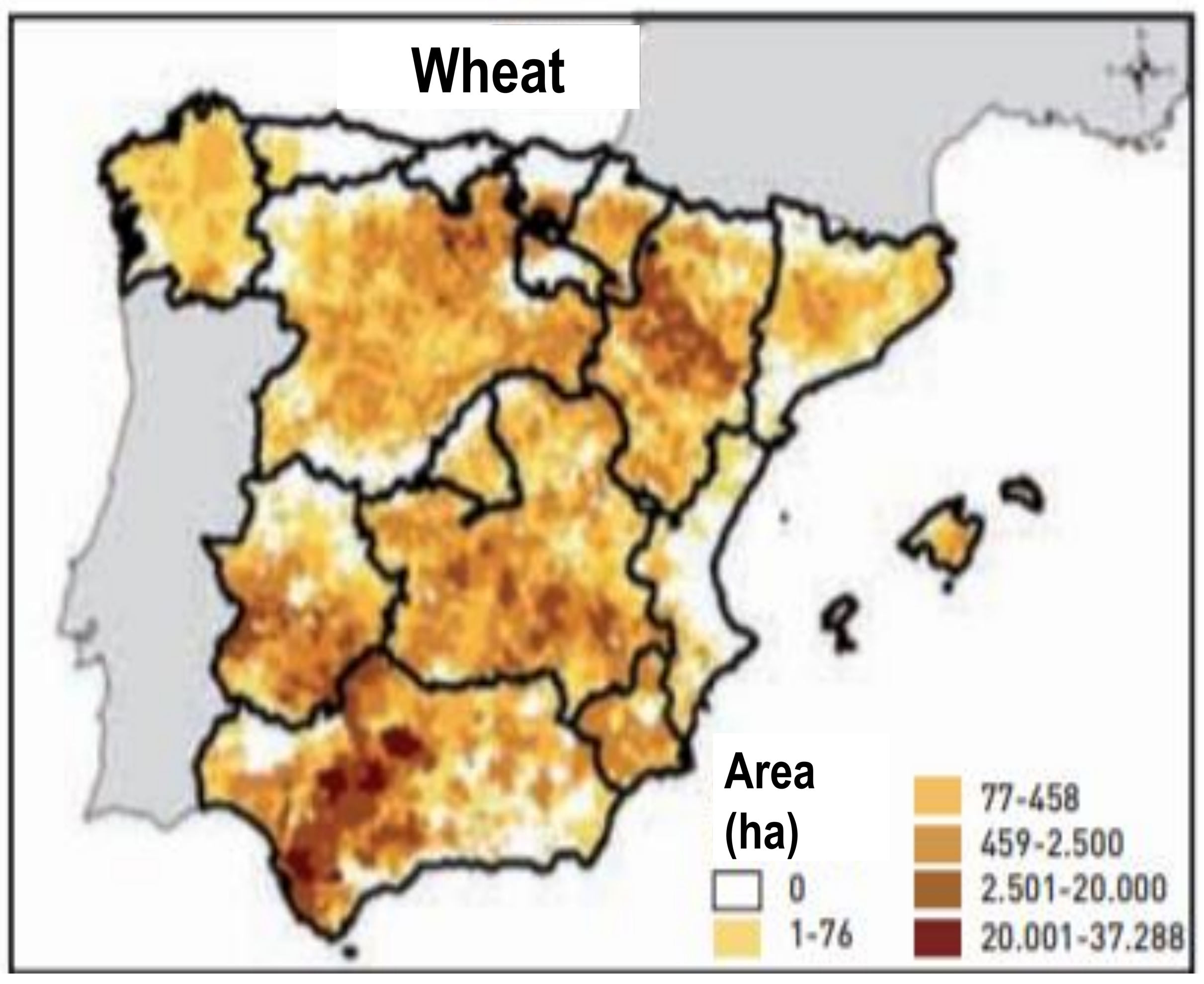
The main objective of this study is to compare the theoretical water needs of bioenergy-crops (specifically crops for bioethanol production) by means of the **Water Footprint Assessment (WFA)** methodology [3] to the real amount of water used in Spain, taking into account several variables such as climatology and the different types of soil.

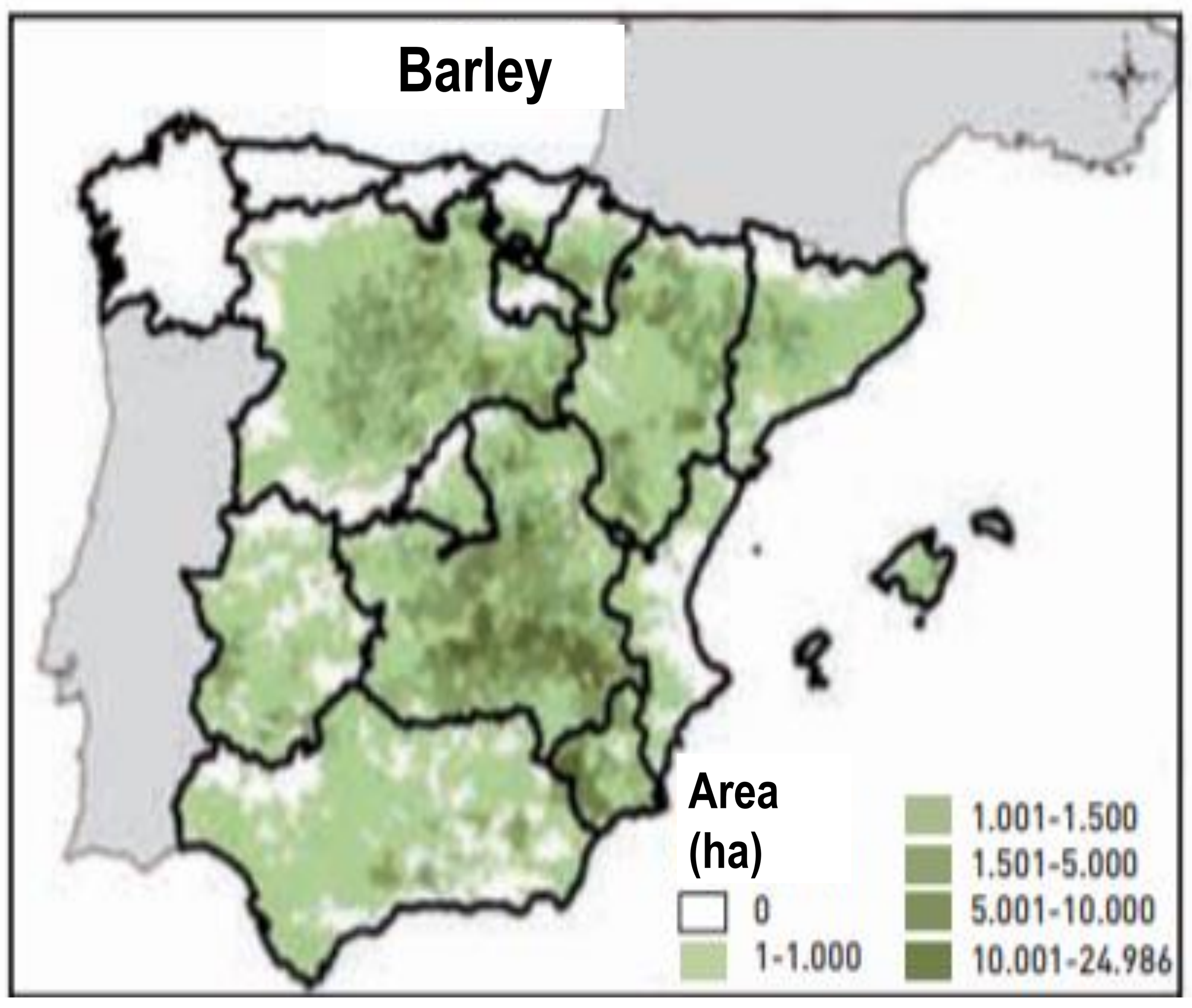
Materials & Methods

WFA method considers the volume of freshwater used to produce the product, measured over the full supply chain. It is a multidimensional indicator, showing three types of WF [3]:

- **Blue water,** which refers to consumption of blue water resources (surface and groundwater) along the supply chain of a product.
- **Green water,** which refers to consumption of green water resources (rainwater insofar as it does not become run-off).
- **Grey water,** which refers to pollution and is defined as the volume of freshwater that is required to assimilate the load of pollutants.

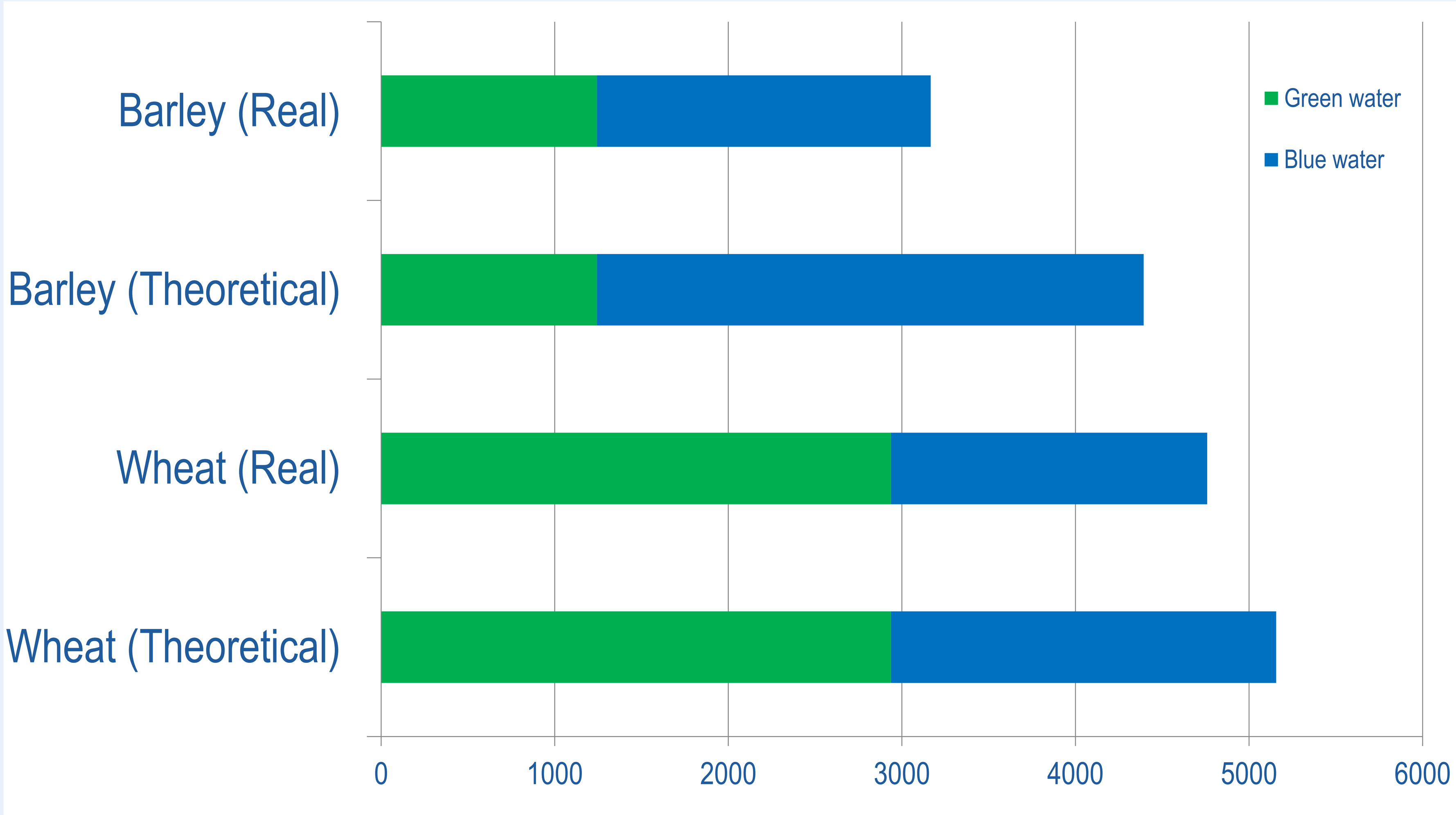
WFA has been applied for calculating both the theoretical blue and green water of cultivation of crops in order to manufacture bioethanol from wheat and barley. Next figures show the cultivation area of wheat and barley along the Spanish surface [4].





Results & Discussion

The different types of water in agricultural phases for bioethanol from irrigated wheat and barley are shown in the next figure. Green water and theoretical blue water have been calculated by means of CROPWAT 8.0 software, a decision support tool developed by FAO for the calculation of crop water and irrigation requirements based on climate, soil and crop data. Real blue water has been obtained directly from [4]. Results are expressed in m^3/ha and show the differences between real and theoretical blue water, demonstrating the overestimation given by the software.



Global results have been also compared to those global calculated by Hardy & Garrido [5] in 2010. These authors calculated values about 3500-5000 m^3/ha and 3200-4300 m^3/ha for wheat and barley respectively, then our preliminary results are in the same range.

Conclusions & Further Developments

Due to the freshwater scarcity in the world, the calculation of WF of products, more specifically, of agricultural products, is of vital importance.

In this current project, the total WF for the whole life cycle of biofuels production in Spain will be calculated. In addition, other recent methods as AWARE (*Available WAter REmaining*, developed by WULCA) [6] will be also considered in order to complete a more comprehensive study of biofuels environmental impact in Spain.

References

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