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A multiregional Input-Ouptut model for the evaluation of Spanish water flows

Ignacio CAZCARRO, Rosa DUARTE, Julio SÁNCHEZ CHÓLIZ

> "You know that Red is the Spain of southern Spain, the one of carnations sprinkled with the blood of bulls (Rubén Dario), the one of tissues of Manila, of *cante jondo* and atavism of blood, the blood dwells…You know that Yellow is Spain's central *plateau*, the infinities of arid brown, that of eternal sea of spikes, the grim despotism of the mystics, that of the great captains, the mighty spirit of stale. You know, finally, that the Green Spain is mine, the slope of the foothills overlooking the turbulent and rebellious Cantabrian.
>
> Pérez de Ayala (1903)

1 Introduction

Water security is a serious environmental concern in Spain. Spanish geographical characteristics, especially its location between temperate and warmer latitudes, its great extension and the effect of isolation that exert their mountain ranges, generate large climatic differences between the North and the South, the East and the West as well as between the coastal areas and the large extensions of the interior. This climatic variation appears both in terms of temperature and precipitation. Rainfall can be erratic which results in cyclical and recurring droughts, especially in Central and Southern Spain.

Natural and regional characteristics have coexisted, historically, with increasing demands of water, linked with the Spanish process of growth and development. Agriculture has been a central economic sector in Spain for centuries, and despite its reduction in GDP and employment share, irrigated areas have increased notably during the 20^{th} century. Since the second part of the past century, the extension of irrigation, the orientation towards more profitable but water intensive crops (citrus, feed, ...), the boom of tourism development in coastal Spain and the urban and suburban population growth have led to significant increasing water demands and pressures. Traditionally, these have been tried to address from a called "supply-perspective", with water regulation and the ensuring of flows through dams, pipelines, control of distribution networks, etc.

This started to change however in last decades, especially since the adoption of the European Water Framework Directive, towards an emerging "demand-perspective" for water management in the Spanish Water Institutions, putting the focus on the existence of room for water savings by the different users, and a certain view of shared responsibility between direct and end-users in the water demands and pressures on resources.

In this regard, Spain has been a pioneer country including the Water Footprint (WF) in its water planning. More specifically, Ministerial Order (ARM/2656/2008) included the Water Planning Instruction for the development of new water management plans in Spain, adapting the Spanish law to the Water Framework Directive (2000/60/EC).

This Ministerial Order states that Basin Water plans must include a study of the "different economic activities that affect water use, providing aggregate data for the river basin and, where appropriate, for the regional level". In this regard, in the next Water plans "there will be an analysis of the WF of different socio-economic sectors, defined as the total domestic water and net water balance of imported and exported".

Thus, since Water Planning in Spain is nationally established, and driven in coordination with the regional Water Agencies, we consider that the disaggregated and multiregional character of Multiregional Input-Output (MRIO) models is highly appropriate as informative tool for water policy and allows to analyze the environmental and socioeconomic regional effects of the implementation of water policies, new Water Plans and Irrigation Plans in Spain. In this context, we develop the first full MRIO model for Spain (considering all 17 Spanish regions, plus the European Union and the Rest of the World) extended for computing water flows.

With this model, and without losing the international perspective (i.e., maintaining two regions in the model for the rest of the world), we rise an important implication, i.e., the importance of the interregional flows and the different role of the Spanish regions as net importers or exporters. The relevance of this analysis is justified in the fact that trade flows between regions explain, to a great extent, water pressures in some Spanish areas where regional water availability is low.

The year chosen for the analysis is 2005, which is the year with the major number of available official regional input-output tables and environmental satellite accounts. Moreover, we deal in the analysis with green and blue water looking both for environmental effects and some policy implications.

As result, we obtain the WFs of the Spanish regions, the water exports and imports among regions and with the rest of the world, and we relate these water flows and demands with the regional water availability, in order to offer some insights on the Spanish water stresses.

The results show an important imbalance between the origin of water resources and the final destination/use in Spain, with significant water pressures in the south, Mediterranean and some central regions. Madrid and Barcelona are important drivers of water consumption in Spain. It also confirms the net importer character of the Spanish economy.

The rest of the paper is structured as follows. In section 2 we review some of the international and national (for Spain) precedents in constructing environmental (and particularly for water) interregional or MRIO models. The methodology and data necessary to construct the model are described in section 3. Section 4 analyzes the results of regional water flows and WFs. Section 5 closes the paper with some conclusions and policy implications.

2 Background

The study of embodied or virtual environmental flows and footprints, especially driven by an increasing social awareness of our impacts on the planet, has increased in recent decades. In the case of the study of our pressure on the water resources, the virtual water (VW) concept has been defined as the embodied water content in a product, meaning the volume of water that has been necessary to produce it. Closely linked to the concept, the WF has been used to measure the human appropriation of the natural assets in terms of the necessary water volumes for human consumption (Hoekstra and Hung, 2002, Hoekstra, 2009). This represents a more comprehensive analysis that moves from an exclusive producer responsibility in the use and degradation of resources, towards a shared producer- consumer responsibility.

In the case of Spain, where water scarcity is a concern, and where WF reduction should also be enhanced since it has been ranked as one of the countries with highest WF in the world (Chapagain and Hoekstra, 2004), studies of the WF have been relatively common. Examples are those focused on Spain as a whole or on a Spanish region (Duarte et al., 2002, Dietzenbacher and Velázquez, 2007, Cazcarro et al., 2010, and Cazcarro et al., 2012), as well as some international studies, where the results for Spain capture the interrelations with other countries (Chapagain and Hoekstra, 2004, Hoekstra and Chapagain, 2007). Relevant results are expected from the implementation of existing international projects of input-output (IO) data compilation, GTAP, WIOD, EXIOPOL and AISHA.

MRIO models have often been constructed to evaluate environmental pressures (emissions) in trade or associated with consumption. To study water flows, a few works have used to a more or less extent multidirectional data, Peters (2007), Berritella et al. (2007). The present study is closer to those interregional input-output models constructed to study water flows and impacts of regions in China (Okadera et al., 2005, Guan and Hubacek, 2007, 2008, Feng et al., 2011), Australia (Lenzen, 2008, 2009), Mexico (Duchin and López, 2011). See Wiedmann (2009) and Daniels et al. (2011) for further review of MRIOs and discussion of their methodological strengths and difficulties.

Finally, regarding MRIO construction in Spain, the main precedents to build an interregional matrix are Llano (2004, 2009) and Perez et al. (2009). The first interregional IO model (INTERTIO) was built for 1995 for the 17 Spanish Autonomous Communities (ACs). In any case, the initial information was not homogeneous in their adaptation to criteria of the SEC-95, and the original regional IO tables for 1995 were only 5. As we will see in the following section, the availability, homogeneity and reliability of IO tables and trade data is highly improved in the information we use, which also results notably updated (around the year 2005).

3 Methodology and Data

3.1 Basic MRIO model

Our MRIO for Spain will have 19 regions corresponding to the 17 Spanish ACs (Andalusia, Aragon, Castile-La Mancha, Asturias, Islas Baleares, Canarias, Cantabria, Castile and León, Catalonia, Galicia, La Rioja, Madrid, Navarre, Basque Country, Extremadura, Murcia-which also includes the autonomous cities of Ceuta y Melilla-, and Valencian Conmunity), which we will design with subscripts i = 1,…,17, and two other regions regarding the European Union (EU) and the Rest of the World (RW) (i= 18 and 19). For each region we consider 40 economic sectors. The model is based on the traditional multiregional model of Isard (1951).

The key elements in this MRIO are the multiregional matrix of technical coefficients $\mathbf{A}^{\oplus}$ and its Leontief inverse $\mathbf{L}^{\oplus}$, the output matrix $\mathbf{X}^{\oplus}$ and the final demands matrix $\mathbf{Y}^{\oplus}$.

$$\mathbf{A}^{\oplus} = \begin{bmatrix} \mathbf{A}_{1,1} & \mathbf{A}_{1,2} & \dots & \mathbf{A}_{1,19} \\ \mathbf{A}_{2,1} & \mathbf{A}_{2,2} & \dots & \mathbf{A}_{2,19} \\ \dots & \dots & \dots & \dots \\ \mathbf{A}_{19,1} & \mathbf{A}_{19,2} & \dots & \mathbf{A}_{19,19} \end{bmatrix}; \; \mathbf{L}^{\oplus} = \left(\mathbf{I} - \mathbf{A}^{\oplus}\right)^{-1} = \begin{bmatrix} \mathbf{L}_{1,1} & \mathbf{L}_{1,2} & \dots & \mathbf{L}_{1,19} \\ \mathbf{L}_{2,1} & \mathbf{L}_{2,2} & \dots & \mathbf{L}_{2,19} \\ \dots & \dots & \dots & \dots \\ \mathbf{L}_{19,1} & \mathbf{L}_{19,2} & \dots & \mathbf{L}_{19,19} \end{bmatrix};$$

$$\mathbf{X}^{\oplus} = [\mathbf{x}_1, \mathbf{x}_2, ..., \mathbf{x}_{19}] = \begin{bmatrix} \mathbf{x}_{1,1} & \mathbf{x}_{1,2} & \cdots & \mathbf{x}_{1,19} \\ \mathbf{x}_{2,1} & \mathbf{x}_{2,2} & \cdots & \mathbf{x}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{x}_{19,1} & \mathbf{x}_{19,2} & \cdots & \mathbf{x}_{19,19} \end{bmatrix};$$

$$\mathbf{Y}^{\oplus} = [\mathbf{y}_1, \mathbf{y}_2, ..., \mathbf{y}_{19}] = \begin{bmatrix} \mathbf{y}_{1,1} & \mathbf{y}_{1,2} & \cdots & \mathbf{y}_{1,19} \\ \mathbf{y}_{2,1} & \mathbf{y}_{2,2} & \cdots & \mathbf{y}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{y}_{19,1} & \mathbf{y}_{19,2} & \cdots & \mathbf{y}_{19,19} \end{bmatrix}$$

These matrices verify the following characteristic equilibrium equation in a MRIO model:

$$\mathbf{X}^{\oplus} = \mathbf{A}^{\oplus}\mathbf{X}^{\oplus} + \mathbf{Y}^{\oplus} \Leftrightarrow \mathbf{X}^{\oplus} = (\mathbf{I} - \mathbf{A}^{\oplus})^{-1}\mathbf{Y}^{\oplus} \qquad (1)$$

In $\mathbf{A}^{\oplus}$, each 40x40 matrix $\mathbf{A}_{rr}$ indicates the domestic technical coefficients in the region *r*. The 40x40 off-diagonal matrices $\mathbf{A}_{rs}$ indicate the coefficients of the region *s* of imported inputs from *r*. In this way, each characteristic element a_{rs}^{ij} of the matrix $\mathbf{A}^{\oplus}$ expresses the quantity of output of sector *i* produced in *r* and consumed as input by sector *j* of region *s*, per unit of total output of sector *j* in *s*.

Matrix $\mathbf{Y}^{\oplus}$ is formed of 19 column vectors $\mathbf{y}_s$ with vector $\mathbf{y}_{ss}$ (40x1) representing the domestic final demand of *s*, and with the other $\mathbf{y}_{rs}$ being the final demands of goods from *s* to *r* not consumed as productive inputs, i.e., the imports of finished products from *r* to *s*.

Finally, matrix $\mathbf{X}^{\oplus}$ is formed of 19 column vectors $\mathbf{x}_s$ which each of them represents, according to (1), the production needed to obtain final demand $\mathbf{y}_s$. This production can be broken down into $\mathbf{x}_{ss}$ (a 40x1 vector), which is the production of *s* used to fulfil the final demand $\mathbf{y}_s$, and vectors $\mathbf{x}_{rs}$ which quantify the additional production needed from the other regions *r*.

According to the model expressed in (1), if we define $\mathbf{w}_r$ (19×1) as the vector of coefficients of water consumption per output of region *r*, whose characteristic element w_r^i indicates the quantity of water per unit of output of sector i in region *r*, we can estimate the consumption of water associated with the production of each region as follows:

$$\begin{bmatrix} \mathbf{h}_{1,1} & \mathbf{h}_{1,2} & \cdots & \mathbf{h}_{1,19} \\ \mathbf{h}_{2,1} & \mathbf{h}_{2,2} & \cdots & \mathbf{h}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{h}_{19,1} & \mathbf{h}_{19,2} & \cdots & \mathbf{h}_{19,19} \end{bmatrix} = \begin{bmatrix} \hat{\mathbf{w}}_1 & \mathbf{0} & \cdots & \mathbf{0} \\ \mathbf{0} & \hat{\mathbf{w}}_2 & \cdots & \mathbf{0} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{0} & \mathbf{0} & \cdots & \hat{\mathbf{w}}_{19} \end{bmatrix} \begin{bmatrix} \mathbf{x}_{1,1} & \mathbf{x}_{1,2} & \cdots & \mathbf{x}_{1,19} \\ \mathbf{x}_{2,1} & \mathbf{x}_{2,2} & \cdots & \mathbf{x}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{x}_{19,1} & \mathbf{x}_{19,2} & \cdots & \mathbf{x}_{19,19} \end{bmatrix} \quad (2)$$

$$= \begin{bmatrix} \hat{\mathbf{w}}_1 & \mathbf{0} & \cdots & \mathbf{0} \\ \mathbf{0} & \hat{\mathbf{w}}_2 & \cdots & \mathbf{0} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{0} & \mathbf{0} & \cdots & \hat{\mathbf{w}}_{19} \end{bmatrix} \begin{bmatrix} \mathbf{L}_{1,1} & \mathbf{L}_{1,2} & \cdots & \mathbf{L}_{1,19} \\ \mathbf{L}_{2,1} & \mathbf{L}_{2,2} & \cdots & \mathbf{L}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{L}_{19,1} & \mathbf{L}_{19,2} & \cdots & \mathbf{L}_{19,19} \end{bmatrix} \begin{bmatrix} \mathbf{y}_{1,1} & \mathbf{y}_{1,2} & \cdots & \mathbf{y}_{1,19} \\ \mathbf{y}_{2,1} & \mathbf{y}_{2,2} & \cdots & \mathbf{y}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{y}_{19,1} & \mathbf{y}_{19,2} & \cdots & \mathbf{y}_{19,19} \end{bmatrix}$$

where ^ in the $\mathbf{w}_r$ indicates diagonalization. With vector $\mathbf{h}_{r,s} = \left(h^i_{rs}\right)$ we obtain the direct and indirect water consumption necessary in sectors *i* of *r* to meet the demands of region *s*.

The elements h^i_{rs} in $\mathbf{h}_{r,s}$ do not distinguish by final demand products, only indicating subscript *i* the sector that directly uses and incorporate water. Water embodied in final demand products can be easily obtained by diagonalizing vectors $\mathbf{y}_{r,s}$ as follows:

$$\begin{bmatrix} \mathbf{H}_{1,1} & \mathbf{H}_{1,2} & \cdots & \mathbf{H}_{1,19} \\ \mathbf{H}_{2,1} & \mathbf{H}_{2,2} & \cdots & \mathbf{H}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{H}_{19,1} & \mathbf{H}_{19,2} & \cdots & \mathbf{H}_{19,19} \end{bmatrix} = \quad (3)$$

$$= \begin{bmatrix} \hat{\mathbf{w}}_1 & \mathbf{0} & \cdots & \mathbf{0} \\ \mathbf{0} & \hat{\mathbf{w}}_2 & \cdots & \mathbf{0} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{0} & \mathbf{0} & \cdots & \hat{\mathbf{w}}_{19} \end{bmatrix} \begin{bmatrix} \mathbf{L}_{1,1} & \mathbf{L}_{1,2} & \cdots & \mathbf{L}_{1,19} \\ \mathbf{L}_{2,1} & \mathbf{L}_{2,2} & \cdots & \mathbf{L}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \mathbf{L}_{19,1} & \mathbf{L}_{19,2} & \cdots & \mathbf{L}_{19,19} \end{bmatrix} \begin{bmatrix} \hat{\mathbf{y}}_{1,1} & \hat{\mathbf{y}}_{1,2} & \cdots & \hat{\mathbf{y}}_{1,19} \\ \hat{\mathbf{y}}_{2,1} & \hat{\mathbf{y}}_{2,2} & \cdots & \hat{\mathbf{y}}_{2,19} \\ \cdots & \cdots & \cdots & \cdots \\ \hat{\mathbf{y}}_{19,1} & \hat{\mathbf{y}}_{19,2} & \cdots & \hat{\mathbf{y}}_{19,19} \end{bmatrix}$$

Now, $\mathbf{H}_{r,s}$ is a 40x40 matrix whose elements H^{ij}_{rs} represent the direct and indirect water necessary in sectors *i* of region *r* to meet the demands of sector *j* in region *s*. Note that it holds $\mathbf{h}_{r,s} = \mathbf{H}_{r,s}\mathbf{e}$.

Finally, the estimates of water uses allow us to know the embodied water in trade flows between regions and estimate their WFs. We can ensure that $\mathbf{H}_{s,s}$ is the matrix of the amounts of water that are used in production activities in region *s* to support region *s* final demand, while $\sum_{\substack{r \\ r\neq s}} \mathbf{H}_{r,s}$ is the matrix de water used in other regions production to support region *s* final demand (VW imports of region *s*) and $\sum_{\substack{s \\ s\neq r}} \mathbf{H}_{r,s}$ the matrix of water used in *r* to support the final demands of other regions (VW exports of region *r*). Then, $\mathbf{e}'\mathbf{H}_{s,s}\mathbf{e}$ is the total amount of water used in region *s* to support its own final demand, this is the domestic component of the water footprint of region *s*. Similarly, $\sum_{\substack{r \\ r\neq s}} \mathbf{e}'\mathbf{H}_{r,s}\mathbf{e}$ is the total VW import of region *s*, and $\sum_{\substack{s \\ s\neq r}} \mathbf{e}'\mathbf{H}_{r,s}\mathbf{e}$ the total VW export of region *r*. Moreover, $\sum_{r} \mathbf{e}'\mathbf{H}_{r,s}\mathbf{e} = \mathbf{e}'\mathbf{H}_{s,s}\mathbf{e} + \sum_{\substack{r \\ r\neq s}} \mathbf{e}'\mathbf{H}_{r,s}\mathbf{e}$ is the water footprint of region *s* and $\sum_{s} \mathbf{e}'\mathbf{H}_{r,s}\mathbf{e} = \mathbf{e}'\mathbf{H}_{r,r}\mathbf{e} + \sum_{\substack{s \\ s\neq r}} \mathbf{e}'\mathbf{H}_{r,s}\mathbf{e}$ the water embodied in production of region *r*. As a consequence, $\sum_{\substack{s \\ s\neq r}} \mathbf{e}'\mathbf{H}_{r,s}\mathbf{e} - \sum_{\substack{s \\ s\neq r}} \mathbf{e}'\mathbf{H}_{r,s}\mathbf{e}$ is the net export of water, which can be positive or negative and reveals the exporter or importer character of the region. In the empirical part of the work, we estimate $\mathbf{H}_{r,s}$ for different $\mathbf{w}_r$, regarding green and blue water.

3.2. Basic data sources

Our first task is to construct the interregional model for Spain for 2005. The main pillar of this model, the availability of formal regional tables, is covered satisfactorily for the first time in 2005, and since up to 10 ACs have matrices published by their Regional Statistical Institute: Andalusia, Aragon, Asturias, Canary Islands, Castile-La Mancha, Castile and León, Catalonia, Galicia, Madrid and Navarre. Therefore we use all the available tables for 2005 (of 10 ACs, plus total Spanish), and the closest tables in time for Balearic Islands for 2004, for Valencian C., 2000, Cantabria, 2007, and La Rioja and the Basque Country, 2008. Besides, since Galicia and the Basque Country have only make and use tables, we calculate the symmetrical table making a hypothesis about the technology (product by product). The tables of the other 2 regions, Extremadura and Murcia (which included the trade of the 2 autonomous cities, Ceuta and Melilla), are obtained using the tables of similar geographically-economically regions (see Escobedo and Oosterhaven, 2011), and the regional Accountancy of National Statistics Institute (NSI, 2011) to update.

The "domestic" table for the EU, has been estimated from an aggregation of EU tables (and compared to check its reliability to the table unified by Rueda Cantuche et al., 2009), while to obtain the "domestic" table for the RW, we add the domestic matrices of the OECD of a number of countries[1]. This process implies further transformations to avoid double counting with intra-trade and with trade with the EU, and to scale the result

[1] We consider the following countries: Australia, Canada, Japan, United States, Korea, Norway, Brazil, China (and Chinese Taipei), Mexico, New Zealand, Switzerland, Turkey, Argentina, India, Indonesia, Israel, Russia and Singapore.

by the share not accounted with the OECD Tables aggregation (Yamano and Ahmad, 2009, assess the coverage of the database in 95% of total OECD USD-based GDP).

The steps above allow us to obtain almost directly the corresponding matrices $\mathbf{A}_{rr}$ and vectors $\mathbf{x}_{rr}$ and $\mathbf{y}_{rr}$ which appear in the model for all the 19 regions, as well as $\mathbf{A}_{18,19}$ and $\mathbf{A}_{19,18}$, still pending to obtain the rest of vectors and matrices corresponding to the trade between regions.

3.3. Bilateral trade distribution between regions

Regional input-output tables described in the previous section allow to know the matrix of imports $\mathbf{M}_s$ for each Spanish region *s*, that is, the one which tells us how to distribute goods in the region coming from other regions, being also possible to break down into a matrix $\mathbf{M}_s^{\text{int}}$ of imports of intermediate products and vector $\mathbf{n}_s$ of imports of finished products, being $\mathbf{M}_s = \mathbf{M}_s^{\text{int}} + \hat{\mathbf{n}}_s$. For several regions it is not only available this table[2], but also it is decomposed into three import matrices from the Rest of Spain (RE), $\mathbf{M}_s^{RE}$, from the EU, $\mathbf{M}_s^{EU}$, and for the RW, $\mathbf{M}_s^{RW}$. Other regions such as Aragon, Andalusia, Catalonia, Madrid and Navarre, do not have different import matrix, but have imports vectors of RE, EU and RW, so the amounts can be identified with the total of imports matrix $\mathbf{M}_s$, assuming its distribution for the 3 origins. Thus, with the available information it is possible to obtain, for all the Spanish regions, matrices $\mathbf{M}_s^{z,\text{int}}$ and vectors $\mathbf{n}_s^z$, being z=RE, EU and RW.

To decompose trade data by regions we use the structural database C-intereg[3], which identifies the trade between regions (interregional, with a double entry table) for various types of goods, with a classification of 5 industries and other of 16 industries. Trade in services is decomposed by the structural data of the same database C-intereg, which identifies trade items in Restaurants, Hotels and Travel agencies. The information of that database departs from official statistics and from other official information of the NSI about road and shipping transport. They are, in our opinion, the best data available at this moment to disaggregate interregional trade by sector and region.

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[2] The exception is Castile-Leon, since the table is of total coefficients, so we have to break down between domestic and imported quantities through import data.
[3] http://www.c-intereg.es/metodologia.asp#Ancla2

More specifically, trade data obtained from C-Intereg is used to decompose the total exports of each region *r* to the RE by each sector, into the exports to each of the regions *s*. This means getting the exports of region *r* to region *s*, $\mathbf{m}_{rs} = \begin{pmatrix} m_{rs}^{1} \\ \dots \\ m_{rs}^{n} \end{pmatrix}$, so m_{rs}^{i} are the imports of product *i*, *i*= 1, 2,…,40, from region *r* to region *s* (noticing that $m_{rr}^{i} = 0$). We divide the vector $\mathbf{m}_{rs}$ by the total imports of *s*, $\mathbf{m}_{rs} / \sum_{r} \mathbf{m}_{rs} = \mathbf{f}_{rs}$, to get the import coefficients of region *s* from region *r*. It should be noticed, that $\mathbf{f}_{rs}$ does not come from a complete matrix of transactions across all sectors from C-intereg, but for a number of important groups of sectors *i**, which is smaller than 40. We solve this lack of information assuming the same $\mathbf{f}_{rs}$ for all sectors *i* of group *i**.

Moreover, knowing $\mathbf{f}_{rs}$ we can estimate the matrices $\mathbf{M}_{rs}$ and vectors $\mathbf{n}_{rs}$ of imports of intermediate and finished products from region *r* to *s* in Spain. Using the matrix $\mathbf{M}_{s}^{\text{int}}$ and vector $\mathbf{n}_{s}$ of imports of intermediate products and finished products of region *s*, $\mathbf{M}_{rs}$ is obtained, splitting matrix $\mathbf{M}_{s}^{RE,\text{int}}$ by origin, as:

$$\mathbf{M}_{rs} = \hat{\mathbf{f}}_{rs} \mathbf{M}_{s}^{RE,\text{int}} \tag{4}$$

which allows us to compute matrix $\mathbf{A}_{rs} = \mathbf{M}_{rs} \hat{\mathbf{x}}^{-1}{}_{ss}$. Analogously, vectors $\mathbf{n}_{rs}$ are obtained as:

$$\mathbf{n}_{rs} = \hat{\mathbf{f}}_{rs} \mathbf{n}_{s}^{RE} \tag{5}$$

which are the $\mathbf{y}_{r,s}$ of the model, that is to say, $\mathbf{y}_{rs} = \mathbf{n}_{rs}$ [4]

Moreover, regarding exports of each of the Spanish regions to the EU and RW, we assume they correspond to both intermediate and final demand goods[5], so those for intermediate goods are distributed for all regions according to the matrix of imports from

[4] At the sectoral level, intra-Spain imports and intra-Spain exports need to match. However, the total intra-Spain import value is on average 10% higher than the total intra-Spain export value reported. We offset the intra-Spain trade discrepancy, due to valuation differences and statistical errors, against the extra-Spain exports. The difference between the original intra-Spain export values and the rescaled intra-Spain export values (resulting in a factor of 1.10, with all values within a 0.03 positive or negative deviation from this value) is automatically taken into account when applying expression (4), since the matrices of imports $\mathbf{M}_{s}^{\text{int}}$ guide the totals introduced in the table. A final GRAS type algorithm is performed to balance the whole table.

[5] Another assumption would be consider that the 16 regions are really small compared to the EU and the RW: $\mathbf{M}_{1,18} = \mathbf{M}_{1,19} = \mathbf{M}_{2,18} = \mathbf{M}_{2,19} = \dots = \mathbf{M}_{17,18} = \mathbf{M}_{17,19} = \mathbf{0}$, considering that all exports from the regions 1 to 17 to the EU and RW, are exclusively destined for final demand, since we want to quantify the total water embodied in exports.

EU and RW, obtaining matrices $\mathbf{M}_{1,18}, \mathbf{M}_{1,19}, \mathbf{M}_{2,18}, \mathbf{M}_{2,19}, \ldots, \mathbf{M}_{17,19}$, and the corresponding $\mathbf{A}_{rs} = \mathbf{M}_{rs}\hat{\mathbf{x}}^{-1}{}_{ss}$, and vectors $\mathbf{y}_{1,18}$, $\mathbf{y}_{1,19}$, $\mathbf{y}_{2,18}$, $\mathbf{y}_{2,19}, \ldots$, $\mathbf{y}_{17,19}$.

3.4. Water data

Finally, the environmental accounting information, specifically agrarian blue and green water components are obtained from Mekonnen and Hoekstra (2011), who distinguish among water consumption of every AC in Spain (except the Canary islands, which we estimate with the same methodology, using Climwat and Cropwat, see FAO, 2003), as represented in Table A1 in the Appendix. Green water only appears in the agrarian sector, and we get blue water by sector for the rest of accounts from the Water Satellite Accounts (WSA, National and regional) provided by the NSI (2011). With this information we compute the corresponding $\mathbf{w}_r$ of the model for the 19 regions. The final total database used is available upon request.

4 Results

In that follows, we present the results of our analysis. We depart from the climatic characteristics of Spain and the distribution of the agrarian activity in Spain. In a second step, this picture will be complemented with the other provided by the regional WFs, also offering results about the water flows traded between regions and with EU and the Rest of the world. Embodied water demands in Spain contradict the Maps of regional water availability. This derives in both, important local water pressures and also water pressures in other regions to produce the inputs needed to support the economic activity (highly water intensive) of some populated and some Mediterranean areas of Spain.

4.1. The colours of Spain. Water availability

Basic climatic areas in Spain can be visually represented by three colours, referring to the Atlantic climate in the northern area (green), a continental Mediterranean climate in the center of Spain (yellow), and a typical Mediterranean climate in the east coast, south and part of the region of Extremadura (red). A quite similar picture is provided in Table A2 in the Appendix and Map 1, where we show the Natural water resources availability to surface ratio, and the Potential Renewable Water Resources (PRWR) to surface ratio. The size of the spheres shows the absolute size of natural availability, which probably is more representative of water stress.

Map 1

According to these data, the three colours, representing the main climatic areas are also maintained when the availability of water resources is considered. As can be seen in Table A2 in the Appendix, the Islands (Canary and Balears) and Murcia are the Spanish areas with the lowest natural water availability in absolute terms, followed by the central areas of Madrid and La Rioja. In the case of Murcia, its situation is slightly better when considering the PRWR. Relating these absolute figures with the size of the region, the most worrying situation appears in the southern part of Spain (Extremadura, Murcia and Andalusia), together with the Canary Islands and Catalonia, being also low the rate shown in other important areas of Spain such as Valencia, Madrid or Aragon.

4.2 Importance of agrarian sectors, and water consumption in origin

Once briefly described the geographical distribution of water availability in Spain, our next step is to contrast this picture with the distribution of the agrarian economic activity, the main direct water consumer sector of green and blue water in Spain.

The size of the agrarian sector, in terms of value of production, is shown with the proportional size of the spheres in Map 2. It stands out, above 12,000 million Euros (€) Andalusia, above 5,000 mill. € the regions of Castile and León, and Catalonia, and around 4,000 mill. € the regions of Murcia, Galicia, Valencian Community and Aragon.

Map 2

Regarding the colors in Map 2, in terms of green to blue water coefficient, it reflects approximately the pattern of precipitations and the irrigation development; precipitations are clearly abundant in the north (west) and hence implying major proportion of green water in the crops (some wheat, corn or wine), and more commonly to the cattle, in the pastures. The same applies to the *plateau* represented by the "Castiles" (Castile-La Mancha and Castile and León), since although precipitations are less frequent, the production of cereals and forage in dryland is the common rule. The use of blue water in Andalusia is highly due to irrigation orientation (vegetables and industrial crops), but it has an important olive tree production in dryland, which somehow contradicts the "blue" expected picture. The east (Mediterranean) coast, especially Murcia and Valencian Community, stand out as the regions with highest percentage devoted to irrigation (especially vegetables and citrus, such as oranges and lemons), and Extremadura is also close to the blue color due to irrigation of corn, rice and vegetables. Aragon and Catalonia have also relevant blue water consumption for corn, alfalfa and fruits.

In summary, with exception of the North, the size, location and orientation of the agrarian activities in Spain show a clear dichotomy. On the one hand, an important part of the agrarian production is obtained without irrigation (Castile-La Mancha, Castile and León and the important olive production in Andalusia) which nevertheless represents less than 50% of the total agrarian value. On the other hand, the agrarian value obtained through irrigation lands (which only cover 7% of the total land, and 13% of the utilized agricultural area) is over 50%, with often profitable products (an hectare in irrigated land produces six times more than dryland), highly demanding from regulated blue water resources. This situation appears in Andalusia, Aragón, and especially in the Mediterranean part of Spain (Catalonia, Valencia and Murcia), regions with low and very low water availability, as have been seen before.

4.3. WFs of the Spanish regions

One of the main advantages of the MRIO model built is the possibility of obtaining the water embodied in the economic activity of the Spanish regions (regional water footprints) as well as to identify the main drivers for these footprints and for the water of production, both geographically (regions) and economically (sectors). For simplicity, the main results appear in Table 1 together with other economic magnitudes and more information is synthesized in Map 3. Detailed results for total, green and blue water footprints and interregional flows are presented in Table 2.

Table 1

Map 3

Table 2

We start with the total water footprints (Green plus Blue Water). We can see in Table 1 that the highest WFs correspond to Catalonia (11,205 hm^3), Madrid (10,953 hm^3), Andalusia (7,254 hm^3), Valencia (6,371 hm^3) and Basque Country (4,379 hm^3), followed by Murcia (3,683 hm^3) and Castile-Leon (3,279 hm^3). It is noteworthy that these seven regions together account for 63% of the WF of Spain, but also account for 63% of its population and 66% of its GDP, implying that they are alone very representative of the whole country.

The map of these WFs contrasts somewhat with that of the water due to production. Thus, the largest uses of water correspond to Andalusia (15,917 hm^3), Castile-León (8,833 hm^3), Castile-La Mancha (8,457 hm^3), Aragon (5,230 hm^3), and Extremadura (3,309 hm^3).

Comparing the water footprints and the water due to production (direct water consumption), we see the net balances of interregional flows of water, as characterized by the net exports. These confirm the important opening of the regional economies in Spain, the interdependence between them in economic terms and the non-correlation between regional availability and water destinations. Thus, three of the four regions with higher WF (Madrid, Catalonia and Valencia) are significant net importers of water, however the fourth (Andalusia) is one that has a highest value of export volume.

Madrid presents net imports of 10,131 hm^3, indicative of net water balances of embodied products into the region, or put another way, indicative of the water that the region prevents from consuming through purchases from the rest of Spain (5,645 hm^3, more than half) and through purchases from the EU and RW (4,586 hm^3), see Table 2. In other words, in this region its high economic activity demands high volumes of water resources both locally (being also high the direct consumption) and the RE and RW, finally being net importer of water.

A similar conclusion can be reached for Catalonia, but here net imports are “only” of 6,876 hm^3 despite the share on Spanish GDP is similar in both regions (Madrid 17.7% and Catalonia 18.7%). The reason is the higher relative availability of water in Catalonia, which uses rainfall in the Catalan Pyrenees. Moreover, the origin of net imports is somewhat different than in Madrid; specifically, Catalonia is more oriented towards international trade, receiving a net amount of 2,774 hm^3 from the RE and 4,102 hm^3 from the RW.

A very different pattern is observed in Murcia, which on overall is a net importer of 2,720 hm^3 of water, being a big net importer from the rest of Spain (2,483 hm^3) and with smaller volumes from abroad (237 hm^3). This last small figure is a result of the compensation of imports with its high exports of agricultural production, giving in total an almost balanced water trade.

The case of Andalusia is very significant. According to Tables 1 and 2, Andalusia has a high WF but also the highest volume of direct consumption of water (water due to production), being its total net exports 8,663 hm^3. These can be split into two parts of similar weight. The first one is the net water ending up in other Spanish regions (3,444 hm^3), being significant the net virtual water export to Murcia, Ceuta and Melilla, Madrid and Catalonia. The second one is the virtual net water export to the EU and RW (5,219 hm^3, which is basically going to the EU since with the RW the virtual water is essentially balanced). Moreover, 45% of the Andalusian WF (3,245 hm^3 out of 7,254 hm^3) is domestic water, the remaining 55% coming from the RE (1,867 hm^3), the EU (316 hm^3), and the RW (1,826 hm^3).

Although when speaking of exporting water the case of Andalusia is usually highlighted, the data show that there are three other Spanish regions with similar situations, although biased to interior trade, Castile-La Mancha, Castile-Leon and Aragon, with net exports of 5,854 hm^3, 5,554 hm^3, and 2,797 hm^3 respectively. The interior situation of these regions and their climatic characteristics (drought and high thermal variability) impose significant pressures on environment, especially in some critique summers.

Finally, Spain as a whole, as deduced from Tables 1 and 2, is a net importer of total water with 6,680 hm^3. The green water import is a relevant volume, 97%, while the blue water import is much lower, probably due to the increase in Spanish irrigation in recent decades. More specifically, Spain is a net exporter towards the EU, but this balance is offset by the high importer character with respect to the RW.

The image above, referred to the total (green plus blue) water, is clearly influenced by the level of development and the weight of agricultural production, which largely determine water flows and its final destination. This picture, although maintaining the general characteristics described below, is even more polarized when one looks specifically at the blue water.

The most industrialized and most populated regions (Catalonia, Madrid, Andalusia and Valencia to a lesser extent, see data in Table 1) are the regions with the highest blue water footprint (2,627 hm^3; 2,294 hm^3; 1,639 hm^3 and 1,445 hm^3 respectively). Madrid and Catalonia are net importers of blue water, while Andalusia and Valencia are net exporters.

Thus, we could say that Madrid and Catalonia, avoid a significant part of their direct consumption of blue water through their interregional and international trade. As example, as can be seen in Table 1, the blue WF for Madrid is 2,294 hm^3, while blue direct consumption (blue water of production) is 494 hm^3 and the blue water associated to its domestic demand is 307 hm^3. Thus, the blue water demands that Madrid directly and indirectly generates are satisfied to a great extent by the rest of Spanish regions (1063 hm^3, as Table 2 shows), especially the "Castillas" and Aragón and by the EU and RW (925 hm^3). Similarly, two thirds of the Catalonian blue WF are satisfied by the RE (mainly Andalusia and Aragón) and by the EU and RW.

Again, we can highlight the clear exporter character of Andalusia in blue water, especially oriented towards the foreign trade. More than a third of its blue water of production is embodied in goods exported to EU or RW. Again Aragón, Castilla-León and Castilla-La Mancha are net exporters of blue water, mainly due to interregional trade inside Spain.

In summary, clear net water exporters are the Spanish regions of Andalusia (as already stated by Dietzenbacher and Velázquez, 2007), Aragon, Castile-La Mancha, Castile and León, and to a lesser extent Navarre, La Rioja and Galicia. Also in general the EU is a net importer of water, while the RW is clearly a net exporter. Moreover, note that the importer and net exporter status of each region does not change when considering the total water or only green water, and only Galicia switches when moving from considering total to blue water. Finally, it can be seen a strong correlation between regional WF and income generation.

4.4. Sectoral Embodied (Virtual) Water Flows and WFs in the Spanish economy

Once the main regional characteristics in terms of WFs and water flows are analyzed, we look now at the WFs through sectors. The results appear in Table 3.

As usual, in the case of green water, the highest embodied water volumes appear in the agrarian, fishing and related activities sector, but also in the food industry activities and services of restaurants, followed by others such as Textile, clothing and leather.

Relative high importance of the agrarian final demand in the explanation of the green WF is found in Castile-La Mancha, Madrid, Navarre, Basque country or Murcia. Also for many regions the meat industry is the second sector regarding embodied water. Noticeably, the embodied water contents through the restaurants sector represent the highest share in the WFs for Andalusia, Aragon, Baleares, La Rioja (where is even superior to the water from the agrarian sector), Galicia, and the Valencian community. In the case of these two last regions, but also for Catalonia, Madrid, Navarre, the Basque Country, the second sector through which more water is consumed is the group of other food industries. Particular cases of embodied water through less common sectors are the those for Aragon in the sectors of Construction, Wholesale and retail trade & trade in automotive fuel, and Public Administrations; or for the cases of Andalusia and Madrid through the "Arts, entertainment and recreation" [6] sector.

[6] On one hand, it involves direct water consumption to maintain golf courses, football pitches and parks. On the other hand, the sector has high embodied water from the purchases of food and live animals for festivities, textile production, catering services, etc.

For the case of blue water, results in Table 3 offer similar conclusions than before regarding the importance of the agrarian sector. The role of the Restaurants sector appears even stronger, and for some regions such as Asturias and Galicia the manufacturing industries are the second sector in importance, being also relevant the weight of Textile, clothing and leather. High relative (compared to their other sectors) virtual water contents through the construction sector again appear for Aragon, Andalusia, Asturias and Cantabria. Also observe important impacts through the Paper and printing sector in Navarre, or the Hotels in Canarias and various services in Cantabria and Aragon.

All these results again highlight the idea that Spain exerts important indirect water impact through many different economic activities, far beyond agricultural and food production by irrigation or hydroelectric production. Without doubt, to assume this fact is essential to carry out an adequate water management in Spain. Water management not only must address the efficiency of irrigation and its environmental impacts, but rather has also to take into account the use of water (green and blue), which depends on the rain but also on the arable land and moisture-retaining capacity of the soil and, in general, on the actions on the territory as a whole.

Other interesting question that arises from our results is the relationship between the regional use of water and the local production of goods in which the region is relatively specialized. In this regard, we often find the highest volumes of virtual water in sectors in which the regions in question are strong in. This means that the social role of water may be quite different in the different regions. Some examples are in Galicia the sectors of Textile, clothing and leather, and other manufacturing industries (indeed looking into further detail, it is revealed that mostly it came from the sectors of Construction and the Vehicles and transport material). Also in the cases of Andalusia and Madrid, through the Arts, entertainment and recreation sector, or, in Aragon, through Public Administration and related activities. High virtual water contents are also found through restaurants for many regions.

4.5 On the regional water stress and pressures

Once the WFs in Spain have been analyzed and the main regional and sectoral characteristics have been drawn, in this section we come back to the relationship between these water flows and the regional water availabilities, as a first approximation to identify regional water stresses and pressures.

We can get a first approach to water stress from the description given by Map 1 and from the total domestic water uses in each region (blue and green), which have been shown in Tables 1 and 2. According to this, the ranking of regions with the greatest uses of water for production is Andalusia, Castile-Leon, Castile-La Mancha, Aragon, Catalonia, Extremadura, Galicia and Valencian C. And regarding the ranking corresponding to the volumes that end up in the region itself are Andalusia, i.e., their WF, Catalonia is the first, followed by Madrid, Andalusia, Valencia C., Basque Country, Murcia, Castile-Leon and Galicia). All but Basque Country and Galicia, are located in arid areas predominantly. We can therefore say that, in general, most Spanish regions are in a situation of high pressure on water resources, which as we have seen is strongly linked to production and income generation. The picture is quite similar if we focus on blue water.
This view can be completed with some ratios, derived from our MRIO estimations, which allow us to go deeper into the regional water pressures. These ratios appear in Table 4.

Table 4

The first is the ratio between the WF and the total domestic uses of water. The second is the ratio between water due to production (direct use of water) and WF. The third is the per capita WF. The first ratio measures the pressure we exert on water from other regions or from other countries to fill our own domestic needs, estimating somehow the needs we have to maintain our production. The second (given that the difference between the magnitudes involved is the net water export) informs about how foreign trade influences the use of water, measuring therefore the stress induced by the external pressure. The third is an index of water impact derived from population lifestyles and can be understood as a proxy of the moral responsibility of a society on the uses of water.

Results show that the highest values for the first ratio appear in Murcia, Madrid, Basque Country, Extremadura, with ratios higher than 10, followed by Valencia, Cantabria, Catalonia, Canarias and Navarra, with ratios higher than 6. They all suffer water stress either because of lacking resources (as shown in Map 1), or because their high level of economic activity, as in the Basque Country.

If we look at the second ratio, the regions with the highest value, 13.32, is Madrid, with a high distance from Basque Country, 6.63, Canarias, Murcia, Valencia and Catalonia. Also above 1 are Baleares, Cantabria, Asturias and Galicia, completing the list of net exporters. Clearly the agribusiness and the industrial component is very strong in them, also indicating that sometimes it is the production for exports (to other regions or abroad) which is generating water stress in many regions.

Finally, regarding per capita WFs of the Spanish regions, the highest are found in the southeastern region of Murcia and the northern regions of La Rioja, the Basque country, Navarre and Aragon, followed by the middle west region of Extremadura, being most of them important in the agroalimentary sectors except for the (industrial) economy of the Basque country. Then the highest is for the strong (especially services, and industry) economies of Madrid and Catalonia. In other words, highly populated regions, typically highly industrialized, and now also specialized in services as is the case of Madrid, Catalonia and the Basque country, show important absolute and relative WFs. Together with these regions, other important local impacts appear in other Mediterranean regions as Murcia, being also significant the high relative water demands of low populated interior regions such as Extremadura, Rioja, Navarra and Aragón. This impact is mainly due to the generation of inputs to satisfy the final demands of other Spanish regions.

5 Conclusions and discussion

In this article we have tried to give a description of the water flows in the Spanish economy, both among its 17 autonomous regions and with other countries. We have constructed a multiregional input-output (MRIO) model extended for computing water flows in Spain. The focus is though not that national water balance, but the clear-cut net VW import or export of some regions, something especially relevant when taken into account their availability of resources.

A first important result has been the already well-known one: Spain is globally a net importer of water, but the distinction between blue and green water allowed us to clarify its meaning. Spain particularly imports blue water, despite having a growing area of irrigated land, to the extent that these imports outweigh exports of green water to give a final balance of net importer.

The MRIO built has shown the imbalances between the natural water availability and the demands (agricultural, industrial) of water, mainly located in widely populated areas, coastal Mediterranean (Murcia, Andalusia), and generally dry regions. This reveals strong differences between use, trade orientation, and availability. On the one hand, agricultural production and food processing, which satisfy important national and foreign demands, generate strong water impacts in regions such as Murcia, Aragon, Castile-La Mancha, Castile-Leon, La Rioja, and Andalusia. In addition, industrial demand from regions such as Madrid, Catalonia and the Basque country generates water requirements that exceed the physical availability. In this regard, we have obtained that an important part of the water embodied in the Spanish final demand comes ultimately mainly from Madrid (and to a lesser extent, from other high populated regions) which plays a significant role in processes of transformation and distribution of goods.

The results show that the consumption of water in a territory is dependent on its economic structure, trade patterns and income. The Spanish economy is importer of water, much of which is used to meet domestic demands, but is also exporting water, especially trough the agricultural products sold to the European Union. Both trends are strong (especially relative to their population or GDP) in most of the regions. So, one should take into account that the lifestyles, the population, the industrial and agricultural demand, etc., have effects on the use of resources far beyond where they occur. Similarly, technological options, technical improvements in water use, and direct savings of water, are obtain to produce goods often ultimately consumed far from where these are introduced. In this respect, policies such as the incorporation into products of traceability indicators of water would be an interesting tool for improving water policy and reduce environmental impacts. In the same line, water policies cannot forget the economic structures of the regions. Our results have shown that significant impacts, both locally and globally, are derived from the trade and development models underlying regional activity.

Finally, a question to assess in future works is whether physical transfers of water (as suggested by some politicians, building channels, pumping, etc.) can be more costly than promoting (or even paying as other incentives) reductions of water uses and increases of water intense imports in scarce regions. We believe that the MRIO constructed is a first step to approach this and other relevant environmental problems in Spain.

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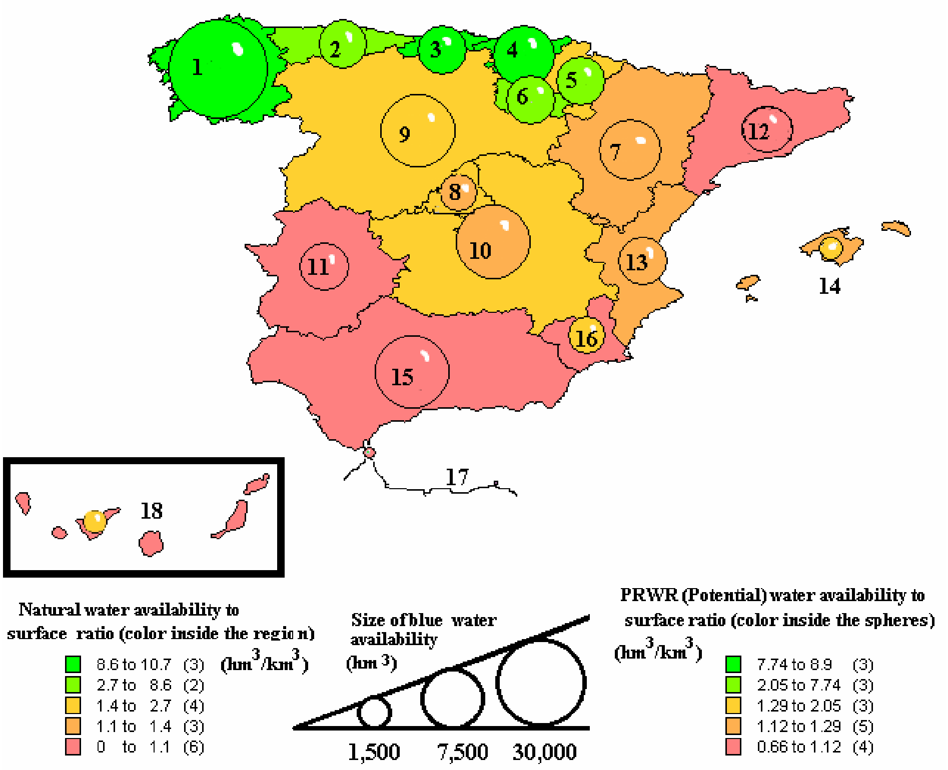
Map 1: Natural water resources availability ratio and Potential renewable water resources availability (PRWR) to surface ratio.

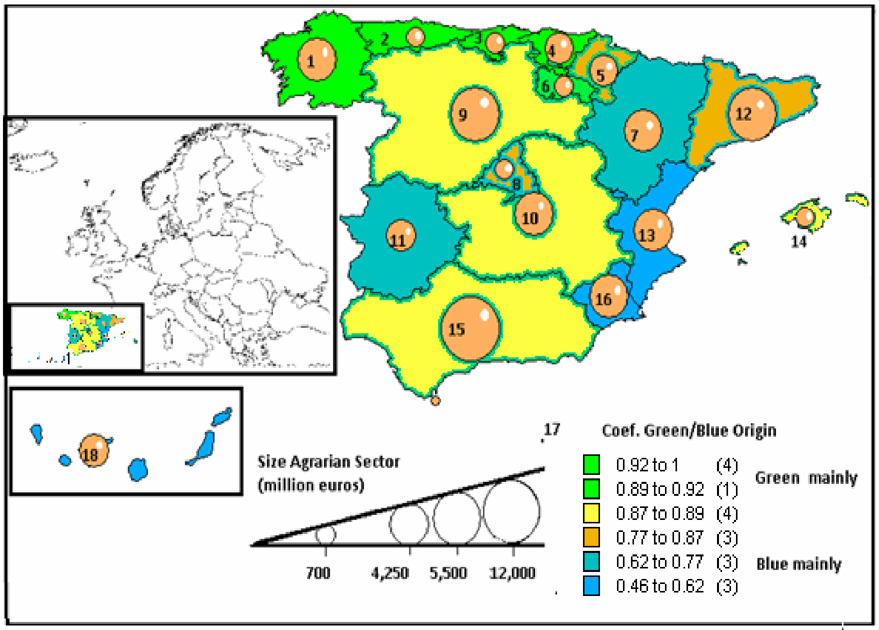


1. Galicia, 2. Asturias, 3. Cantabria, 4. Basque Country, 5. Navarre, 6. La Rioja, 7. Aragon, 8. Madrid, 9. Castile and León, 10. Castile-La Mancha, 11. Extremadura, 12. Catalonia, 13. Valencian C., 14. Islas Baleares, 15. Andalusia, 16. Murcia, 17. Autonomous cities of Ceuta y Melilla (neglible values), 18. Canarias.

Note: Natural water availability refers to the renewable water resources in natural regime. PRWR refers to the previous Natural water resources less restrictions (environmental reserve or international transfers), counting transfers and the reuse and desalination capabilities.

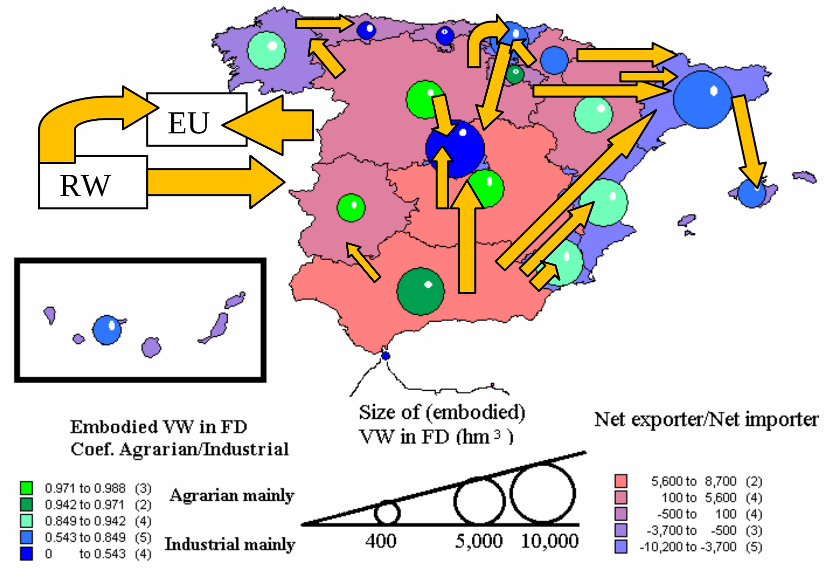
Source: Own elaboration from the statistics on water availability per each (of the 24) Spanish basin, from the Spanish Ministry of Environment and Rural Affairs.

Map 2: Ratio of green to blue water, and size of the agrarian sector (million of €).



Source: Own elaboration based on Cazcarro et al. (2012). Legends corresponding to regions can be seen in Map 1

Map 3: Virtual Water (Blue plus Green) net exports



Source: Own Elaboration.

Note: The size of the spheres shows proportionally the size of Virtual Water contents in regional Final Demand while the color of these spheres ranges from green to blue depending on the representativeness of the agrarian goods with respect to industrial and services goods in the regional final demand (greener implies a higher coefficient of VW from agrarian goods with respect to industrial). Regions are colored according to their net export (positive values) or net import (negative) character. The arrows represented show some (not precise in size, nor exhaustively for representation limits) of the main net (blue and green) VW flows across regions.

Table 1. Total, green and blue regional water use and footprints

Region	of production (green plus blue) (hm3)	Green Water of production (hm3)	Blue Water of production (hm3)	Total Domestic Water of production (green plus blue) (hm3)	Green Domestic Water of production (hm3)	Blue Domestic Water of production (hm3)	Total WF (hm3)	Total Green WF (hm3)	Total Blue WF (hm3)	Net Total (green plus blue) Water Exports (hm3)	Net Green Water Exports (hm3)	Net Blue Water Exports (hm3)	Spanish GDP share	Spanish Population share
Andalusia	15,917	13,339	2,578	3245	2,443	802	7,254	5,616	1,639	8,663	7,723	939	13.8	17.8
Aragon	5,230	3,429	1,802	1014	652	362	2,433	1,784	649	2,797	1,644	1,153	3.1	2.9
Castile-La Mancha	8,457	7,335	1,122	1572	1,343	230	2,603	2,138	464	5,854	5,196	658	3.4	4.3
Asturias	517	353	164	183	110	72	768	578	190	-251	-225	-26	2.2	2.4
Baleares	703	517	186	415	289	126	1,331	1,001	331	-628	-484	-144	2.5	2.2
Canarias	425	167	258	312	102	209	2,159	1,561	597	-1,734	-1,395	-340	4	4.5
Cantabria	362	176	186	82	25	57	648	474	174	-286	-298	12	1.3	1.3
Castile and León	8,833	7,440	1,393	2266	1,842	424	3,279	2,623	656	5,554	4,817	737	5.4	5.7
Catalonia	4,329	2,664	1,665	1446	789	657	11,205	8,578	2,627	-6,876	-5,915	-962	18.7	15.9
Galicia	2,359	2,142	217	809	682	127	3,046	2,469	577	-688	-327	-360	5.1	6.3
La Rioja	669	573	96	147	121	27	637	518	119	32	55	-23	0.7	0.7
Madrid	822	328	494	560	254	307	10,953	8,659	2,294	-10,131	-8,330	-1,800	17.7	13.5
Navarre	1,308	847	461	184	100	84	1,164	878	285	144	-32	176	1.7	1.3
Basque Country	660	326	334	379	185	195	4,379	3,477	902	-3,719	-3,151	-568	6.2	4.8
Extremadura	3,309	2,463	846	174	112	62	1,989	1,629	360	1,320	834	486	1.6	2.35
Murcia C&M	964	419	545	79	14	64	3,683	2,963	720	-2,720	-2,544	-175	2.9	3.45
Valencian C.	2,359	902	1,457	643	182	461	6,371	4,927	1,445	-4,012	-4,025	12	9.7	10.6
EU	306,554	209,793	96,761	191429	129,718	61,711	742,918	584,544	33,962	-436,364	-374,751	-61,614		
RW	4,394,475	3,702,242	692,233	3833221	3,238,677	594,544	3,951,431	3,321,037	594,544	443,044	381,205	61,839		

Source: Own elaboration.

Table 2. Total, green and blue interregional water flows

Total, green and blue water interregional flows		Andalusia	Aragon	Castile-La Mancha	Asturias	Baleares	Canarias	Cantabria	Castile and León	Catalonia	Galicia	La Rioja	Madrid	Navarre	Basque Country	Extremadura	Murcia C&M	Valencian C.	EU	RW	**Water of production (Direct water consumption**	**Net Water Export**
Andalusia	Total	3,245	105	129	34	232	168	22	78	931	146	7	943	77	233	447	995	765	5,209	2,152	**15,917**	8,663
	Green	2,443	90	110	28	197	141	18	66	800	124	5	814	66	202	380	852	661	4,516	1,826	**13,339**	7,723
	Blue	802	15	19	6	35	26	4	13	131	21	1	129	11	31	67	143	104	693	326	**2,578**	939
Aragon	Total	145	1,014	55	14	34	53	21	46	1,288	43	38	540	156	131	26	145	278	702	499	**5,230**	2,797
	Green	93	652	34	9	22	35	14	27	875	29	24	367	105	88	17	99	185	444	310	**3,429**	1,644
	Blue	52	362	21	5	12	18	8	19	414	15	14	173	51	43	9	46	92	258	190	**1,802**	1,153
Castile-La Mancha	Total	682	107	1,572	20	20	62	57	80	554	92	8	1,600	69	97	309	860	662	702	905	**8,457**	5,854
	Green	594	93	1,343	17	18	54	49	66	483	80	7	1,400	60	84	269	754	580	604	782	**7,335**	5,196
	Blue	88	13	230	3	3	8	8	14	71	12	1	200	9	13	39	106	82	98	123	**1,122**	658
Asturias	Total	20	8	3	183	8	3	12	9	26	50	1	16	1	19	5	9	24	64	58	**517**	-251
	Green	17	7	2	110	7	2	7	4	22	45	1	11	1	16	4	8	22	37	30	**353**	-225
	Blue	3	1	1	72	1	1	5	5	4	4	0	5	1	3	1	1	2	27	29	**164**	-26
Baleares	Total	28	4	1	1	415	16	0	1	32	2	0	27	1	2	2	28	53	46	43	**703**	-628
	Green	23	3	1	0	289	12	0	1	26	2	0	20	1	2	2	24	45	35	33	**517**	-484
	Blue	5	1	0	0	126	4	0	0	7	1	0	7	0	0	0	4	8	11	10	**186**	-144
Canarias	Total	12	1	0	0	1	312	0	0	7	1	0	16	0	1	1	3	12	39	18	**425**	-1,734
	Green	7	0	0	0	0	102	0	0	4	1	0	9	0	0	0	1	7	23	10	**167**	-1,395
	Blue	6	0	0	0	1	209	0	0	3	1	0	7	0	1	0	1	5	16	8	**258**	-340
Cantabria	Total	11	4	2	5	2	2	82	35	29	8	1	23	4	40	3	5	13	49	44	**362**	-286
	Green	5	3	1	3	1	1	25	29	20	5	0	11	2	27	3	3	8	17	13	**176**	-298
	Blue	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	**6**	6
Castile and León	Total	282	108	139	94	21	85	139	2,266	642	276	44	1,486	160	1,004	319	187	383	685	513	**8,833**	5,554
	Green	239	93	114	81	18	73	116	1,842	551	235	37	1,278	138	865	274	161	329	572	424	**7,440**	4,817
	Blue	42	15	25	14	3	12	23	424	91	41	8	208	22	138	45	27	54	112	88	**1,393**	737
Catalonia	Total	172	149	24	27	95	85	24	29	1,446	57	7	214	54	103	30	109	210	902	590	**4,329**	-6,876
	Green	112	107	14	15	62	54	15	15	789	34	4	145	35	67	19	74	139	601	363	**2,664**	-5,915
	Blue	60	42	11	12	33	30	9	14	657	23	3	69	19	36	11	35	71	301	227	**1,665**	-962
Galicia	Total	112	43	19	87	15	38	29	63	125	809	3	247	36	109	25	47	78	288	187	**2,359**	-688
	Green	108	41	18	84	14	36	28	58	119	682	2	237	35	104	23	45	75	265	168	**2,142**	-327
	Blue	5	1	1	4	1	2	1	4	6	127	0	10	1	5	1	2	3	23	19	**217**	-360
La Rioja	Total	12	29	5	7	3	4	4	31	48	11	147	48	41	130	3	5	14	74	52	**669**	32
	Green	11	26	5	6	2	4	4	23	43	9	121	42	36	115	3	5	12	64	44	**573**	55

	Blue	2	3	1	1	0	1	1	8	6	1	27	6	5	15	0	1	2	10	7	**96**	-23
Madrid	Total	29	4	12	5	3	16	4	9	18	9	1	560	2	6	18	10	12	54	49	**822**	-10,131
	Green	9	1	5	2	1	3	2	3	5	3	0	254	1	2	11	2	3	13	10	**328**	-8,330
	Blue	20	3	8	3	2	13	2	6	13	6	1	307	2	4	7	8	9	40	39	**494**	-1,800
Navarre	Total	44	48	10	9	23	17	13	22	184	14	30	118	184	162	19	32	33	208	139	**1,308**	144
	Green	27	35	5	7	14	11	8	13	127	9	23	73	100	126	15	22	23	128	80	**847**	-32
	Blue	16	13	5	2	9	5	5	9	57	5	7	45	84	36	4	10	11	80	60	**461**	176
Basque Country	Total	10	6	2	3	3	3	7	13	22	7	3	20	13	379	1	6	9	89	66	**660**	-3,719
	Green	5	4	1	1	1	1	5	8	13	3	2	7	9	185	1	4	5	45	26	**326**	-3,151
	Blue	5	2	1	2	1	2	3	5	9	3	1	12	3	195	1	2	4	44	39	**334**	-568
Extremadura	Total	204	33	28	7	8	19	15	56	110	17	3	340	6	23	174	35	57	1,643	530	**3,309**	1,320
	Green	152	24	21	6	6	15	11	42	82	12	2	255	5	17	112	26	43	1,235	397	**2,463**	834
	Blue	52	8	7	2	2	5	4	14	28	4	1	85	2	6	62	9	14	408	133	**846**	486
Murcia C&M	Total	22	1	7	0	1	2	0	2	11	1	0	42	5	1	1	79	27	289	472	**964**	-2,720
	Green	9	0	3	0	0	1	0	1	5	0	0	20	3	1	0	14	12	137	211	**419**	-2,544
	Blue	12	0	4	0	1	1	0	1	6	0	0	22	3	1	1	64	15	152	261	**545**	-175
Valencian C.	Total	83	47	38	4	30	31	6	11	135	17	1	125	10	36	11	131	643	484	517	**2,359**	-4,012
	Green	32	20	16	2	12	12	3	4	57	6	0	50	4	16	4	53	182	208	220	**902**	-4,025
	Blue	50	27	22	3	18	19	4	7	78	11	1	74	6	20	6	78	461	276	297	**1,457**	12
EU	Total	316	153	81	48	100	177	21	96	874	248	38	641	76	314	64	134	372	191,429	111,375	**306,554**	-436,364
	Green	222	112	55	33	73	126	14	65	631	178	28	432	55	229	46	95	268	129,718	77,413	**209,793**	-374,751
	Blue	93	41	26	15	27	51	7	31	243	70	10	209	20	84	18	39	104	61,711	33,962	**96,761**	-61,614
RW	Total	1,826	571	474	221	317	1,066	191	433	4,720	1,239	305	3,948	269	1,589	531	864	2,726	539,964	3,833,221	**4,394,475**	443,044
	Green	1,506	473	393	176	263	877	156	356	3,927	1,010	261	3,233	223	1,332	446	723	2,327	445,883	3,238,677	**3,702,242**	381,205
	Blue	320	98	81	44	55	189	34	77	793	229	44	716	46	257	86	141	399	94,081	594,544	**692,233**	61,839
Water embodied in final demand (Water Footprint)	Total	**7,254**	**2,433**	**2,603**	**768**	**1,331**	**2,159**	**648**	**3,279**	**11,205**	**3,046**	**637**	**10,953**	**1,164**	**4,379**	**1,989**	**3,683**	**6,371**	**742,918**	**3,951,431**		
	Green	**5,616**	**1,784**	**2,138**	**578**	**1,001**	**1,561**	**474**	**2,623**	**8,578**	**2,469**	**518**	**8,659**	**878**	**3,477**	**1,629**	**2,963**	**4,927**	**584,544**	**3,321,037**		
	Blue	**1,639**	**649**	**464**	**190**	**331**	**597**	**174**	**656**	**2,627**	**577**	**119**	**2,294**	**285**	**902**	**360**	**720**	**1,445**	**158,374**	**630,394**		

Note: The total of the column *s* shows the water (green, blue or total) embodied in the goods consumed in region *s*, i.e., its WF. Moreover, the different elements in each column show the geographical origin of its WF, and allow us to divide the WF of each of the regions *s* in four parts, domestic water, water imported from the rest of the ACs, and the water imported from EU and RW. Looking by rows, the row *r* represents the water embodied in the total final demand de *r*, both by domestic demand and by exports, including the export of imported water. The water consumed in the region will be contained in: the goods finally consumed inside the region, or the goods sold to the other ACs, or in the goods sold to the EU and RW. These two latest components form the regional water exports. In the last column we obtain the water net exports for each region *r* as difference between the water of production of *r* and the water footprint of *r*.

Source: Own elaboration.

Table 3. Total embodied green and blue water in final demand (hm^3) by Spanish autonomous community (region).

Sectors \ Regions	Number of Sectors *	Type of Water	Andalusia	Aragon	Castile-La Mancha	Asturias	Baleares	Canarias	Cantabria	Castile and León	Catalonia	Galicia	La Rioja	Madrid	Navarre	Basque Country	Extremad.,	Murcia, Ceuta & M.	Valencian C.
Agriculture, hunting, fishing and related services	1	Gree	1,467,09	226,676	969,252	102,58	245,938	414,086	143,271	772,744	2,463,16	577,227	136,51	3,299,55	289,65	1,334,08	485,073	991,414	1,242,670
		Blue	237,808	55,667	154,789	7,886	45,604	114,015	22,283	121,371	589,029	58,857	23,301	632,739	61,839	216,240	82,893	195,191	316,932
Extraction of energy products and refining	1	Gree	22,898	2,167	304	1,815	9,941	8,725	2,807	2,768	15,062	5,990	6	26,149	1,254	18,787	13,344	9,826	8,723
		Blue	19,177	2,427	267	2,410	9,132	7,017	5,448	6,198	14,216	6,427	2	21,984	1,195	16,203	12,492	8,646	7,580
Production and distribution of electricity and gas	1	Gree	3,556	7,054	8,467	1,612	604	2,770	661	2,296	12,694	1,860	833	0	567	9,039	710	1,518	3,856
		Blue	23,157	4,774	11,758	6,947	1,990	5,528	3,948	8,668	19,352	5,685	805	0	2,685	16,671	2,786	7,392	12,695
Collection, purification and distribution of water	1	Gree	3,804	3,421	8,584	79	425	713	325	5,845	2,179	348	538	0	143	1,010	637	1,554	428
		Blue	39,931	25,959	10,357	11,935	17,433	26,317	6,989	36,458	94,863	25,419	2,918	0	5,674	34,664	3,064	10,526	58,081
Meat industry	1	Gree	924,875	199,035	200,957	129,85	105,814	205,007	90,885	485,450	1,106,81	293,940	17,886	812,073	115,76	432,101	254,091	446,412	507,754
		Blue	165,474	55,701	35,504	16,792	26,238	42,388	17,779	80,421	268,012	36,792	3,835	155,172	29,499	88,987	47,679	94,930	130,232
Dairies	1	Gree	314,396	140,541	82,649	45,364	65,192	58,719	45,709	132,855	403,745	146,467	15,744	413,525	32,280	175,112	145,367	261,662	271,779
		Blue	56,634	35,584	15,313	5,786	12,806	12,205	7,264	22,065	83,841	15,835	3,315	73,549	8,010	29,888	24,298	49,575	52,989
Other food industries	1	Gree	164,959	177,710	266,628	111,88	140,473	350,144	48,585	235,448	1,979,84	495,467	45,626	905,717	169,14	548,817	177,056	400,867	1,479,096
		Blue	31,522	32,399	43,155	17,246	24,700	60,494	8,489	39,335	336,921	77,198	8,202	154,844	31,560	91,371	26,973	65,203	254,528
Beverages and tobacco	1	Gree	469,634	29,100	67,961	10,797	59,166	52,888	14,663	55,617	125,185	57,494	10,545	181,060	19,946	67,889	149,476	305,472	182,187
		Blue	92,769	8,089	12,093	2,583	13,909	14,108	2,804	11,551	27,264	11,911	2,045	37,003	4,286	12,784	27,490	63,666	45,786
Textile, clothing and leather	1	Gree	142,509	89,926	117,117	35,038	21,494	82,888	26,553	71,208	413,104	124,591	10,934	356,056	26,734	128,233	57,307	84,012	231,868
		Blue	36,762	18,255	23,426	10,035	6,183	21,862	7,597	20,022	86,805	28,538	2,465	68,571	8,913	33,917	13,845	23,813	61,094
Manufacture of wood and cork	1	Gree	8,743	-596	931	803	32	671	840	5,358	13,569	3,282	-36	-80	2,259	5,235	56,815	4,031	8,960
		Blue	2,226	-201	162	98	10	107	140	946	2,767	500	-6	-18	636	911	9,216	738	1,602
Paper and printing	1	Gree	25,038	2,445	2,077	4,169	4,799	5,208	496	11,536	21,103	5,732	197	18,157	2,774	6,145	7,615	17,649	19,674
		Blue	12,779	1,803	867	3,551	4,432	2,864	2,084	5,471	16,935	4,167	164	10,925	11,440	9,110	2,620	7,004	10,854
Chemical industry	1	Gree	31,329	4,367	10,014	7,420	4,623	15,145	3,418	8,076	75,407	23,948	5,115	70,049	4,726	17,390	7,479	16,777	39,023
		Blue	41,358	2,894	9,150	6,530	5,008	14,117	3,795	7,185	58,814	16,324	3,996	36,885	6,296	21,118	9,045	19,783	29,825
All other manufacturing industries	8	Gree	132,293	38,945	49,438	27,078	34,753	73,883	16,995	72,013	305,319	83,556	9,065	293,054	26,559	93,198	25,525	58,307	114,248
		Blue	103,412	36,531	34,997	22,401	26,243	64,248	16,575	46,234	250,944	77,688	7,105	234,483	22,896	69,415	17,476	37,951	74,105
Construction	1	Gree	232,324	152,139	38,402	15,556	27,586	70,683	12,083	103,199	107,829	67,578	23,667	158,975	17,492	74,076	21,378	44,846	137,221
		Blue	185,678	72,369	21,321	15,437	15,838	47,051	15,085	42,499	79,953	32,870	9,753	129,061	20,003	48,053	11,490	24,531	75,537
Wholesale and retail trade & trade in automotive fuel	3	Gree	89,789	167,403	65,323	9,137	30,622	31,133	2,805	71,837	69,398	64,401	5,278	132,122	18,017	31,586	10,680	16,927	15,623
		Blue	76,212	74,192	14,264	11,641	9,938	21,123	3,613	25,203	65,760	19,946	2,397	53,463	10,775	22,512	7,388	13,308	14,544
Hotels	1	Gree	24,785	23,326	12,348	4,468	16,046	55,029	3,703	131,805	81,554	27,113	7,439	348,195	26,102	12,473	2,756	7,436	36,738
		Blue	8,640	7,981	2,922	1,668	7,221	25,545	1,883	26,372	36,301	6,195	1,385	76,136	6,782	2,941	774	1,877	16,494
Restaurants	1	Gree	1,174,73	285,113	153,089	53,809	163,114	72,484	45,529	338,970	1,099,66	398,773	191,40	696,243	95,275	415,002	168,499	233,163	538,553
		Blue	297,598	99,097	39,055	23,110	57,850	54,118	20,119	85,759	381,902	90,190	33,379	216,797	26,843	110,566	38,123	52,923	192,020
Transportation, communications and related activities	3	Gree	14,308	6,659	3,833	1,925	15,995	8,118	1,022	6,883	44,762	7,096	2,286	56,871	2,165	8,954	4,049	8,780	7,081
		Blue	16,356	4,871	2,745	3,680	10,081	9,812	1,364	6,688	32,856	7,353	1,096	44,375	2,873	9,637	3,262	8,800	7,851
All other private services &Personal & Household service)	7	Gree	53,215	65,650	15,700	4,685	12,787	24,781	5,978	19,845	46,050	20,186	9,420	127,338	3,505	25,512	7,065	9,545	15,324
		Blue	47,858	33,077	8,303	6,226	9,516	21,335	9,057	14,483	44,506	14,071	2,906	80,503	5,120	18,707	4,300	8,692	18,958
Education, Health, sanitation and social services	2	Gree	91,539	52,350	42,071	7,057	12,819	5,446	4,172	41,909	96,929	35,537	11,084	295,098	13,030	35,841	15,543	22,683	48,470
		Blue	56,058	24,805	12,309	8,068	9,677	12,130	7,281	23,052	69,255	22,429	4,119	107,982	9,399	19,277	6,795	12,931	36,547

Arts, entertainment and recreation	1	Gree	160,270	18,773	6,109	908	22,759	8,247	1,320	30,792	52,226	15,506	5,830	396,428	7,060	17,062	9,160	8,368	6,036
		Blue	35,208	7,781	1,491	922	8,339	5,180	990	8,349	22,292	7,182	1,433	103,631	3,032	6,710	3,293	3,217	3,349
Public Administration	1	Gree	63,686	92,179	17,158	2,260	5,667	14,556	1,995	16,896	42,693	12,837	8,294	72,032	4,016	19,895	9,198	12,165	11,419
		Blue	52,075	44,484	9,978	4,780	8,551	15,681	9,863	17,643	44,245	11,753	4,234	56,295	5,635	21,949	4,965	9,190	22,955
Total WF	**40**	Gree	**5,615,77**	**1,784,38**	**2,138,413**	**578,30**	**1,000,65**	**1,561,32**	**473,815**	**2,623,348**	**8,578,28**	**2,468,92**	**517,66**	**8,658,61**	**878,45**	**3,477,44**	**1,628,823**	**2,963,41**	**4,926,730**
		Blue	**1,638,69**	**648,538**	**464,228**	**189,73**	**330,699**	**597,244**	**174,451**	**655,973**	**2,626,83**	**577,331**	**118,84**	**2,294,37**	**285,39**	**901,629**	**360,266**	**719,885**	**1,444,557**

* Sectors are grouped due to expositive reasons.
** The absence of representation in the table used for Madrid of the sectors of Production and distribution of electricity and gas, and Collection, purification and distribution of water, impede us from deriving results on this.
*** The exceptional case of the negative values for the embodied water contents in the sector of Manufacture of wood and cork (in Aragon, La Rioja and Madrid), are due to the effect of variation of existences, which are superior to the final domestic demand in the year of the chosen tables
Source: Own Elaboration.

Table 4: Water stress and water pressure estimates suffered by each region.

	WF / total uses of domestic water	(Water due to production) / WF	Per capita total WF (m3 per citizen)
Andalusia	2.24	0.46	924
Aragon	2.40	0.47	1,917
Castile-La Mancha	1.66	0.31	1,373
Asturias	4.21	1.49	713
Baleares	3.21	1.89	1,354
Canarias	6.93	5.08	1,097
Cantabria	7.87	1.79	1,153
Castile and León	1.45	0.37	1,306
Catalonia	7.75	2.59	1,602
Galicia	3.76	1.29	1,103
La Rioja	4.32	0.95	2,115
Madrid	19.54	13.32	1,837
Navarre	6.34	0.89	1,963
Basque Country	11.55	6.63	2,061
Extremadura	11.41	0.60	1,842
Murcia CyM	46.86	3.82	2,331
Valencian C.	9.91	2.70	1,358

Source: Own Elaboration.

Appendix

Table A1: Direct water consumption (hm^3/year) by region, in 2005.

Crops	Type	Islas Baleares	Andalucia	Aragon	Cantabria	Castilla-La Mancha	Castilla Y Leon	Cataluna	Madrid	Navarre	Valencian C.na	Extremadura	Galicia	La Rioja	Pais Vasco	Asturias	Murcia	Canarias	**Total**
Cereals	Green	43	1399	1671	3	2184	5759	725	231	663	60	477	148	199	197	2	78	1	13840
	Blue	4	322	357	0	364	342	134	49	53	12	405	6	7	0	0	7	1	2062
Industrial crop	Green	0	1042	72	20	600	504	35	4	18	3	149	0	1	3	0	0	0	2451
	Blue	1	267	89	0	100	250	7	2	6	6	104	0	8	5	0	4	0	849
Pulses	Green	5	203	179	6	343	131	9	14	16	2	51	13	1	6	4	0	0	981
	Blue	0	21	2	0	4	2	3	0	0	3	1	0	4	0	0	1	1	43
Citrics	Green	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	6	193	0	0	0	0	8	0	0	743	0	0	0	0	0	131	5	1086
Dry Fruits	Green	160	1144	1005	0	321	57	469	1	29	671	12	8	100	5	1	247	3	4234
	Blue	1	44	1	0	1	0	23	0	0	35	2	0	0	0	0	25	1	134
Olives	Green	3	9045	82	0	831	19	399	6	7	2	828	0	4	1	0	24	0	11251
	Blue	0	431	6	0	8	0	6	0	1	1	3	0	0	18	0	10	0	482
Fresh Fruit	Green	22	13	14	1	5	7	16	0	1	30	27	5	1	3	15	1	5	165
	Blue	4	121	76	0	10	5	159	1	4	112	54	1	10	0	0	138	77	771
Fodder	Green	271	28	249	142	191	828	478	9	16	24	525	1703	5	22	323	0	5	4818
	Blue	52	189	943	4	327	461	417	20	78	36	182	26	18	3	0	18	3	2780
Tuber	Green	0	2	0	4	1	11	3	1	1	0	0	61	1	3	7	0	1	97
	Blue	5	53	6	0	27	47	7	7	1	15	7	2	12	2	0	6	9	208
Vegetables	Green	0	10	0	1	4	2	1	0	7	1	0	8	0	1	1	0	0	35
	Blue	6	149	12	0	88	19	20	9	13	49	46	3	8	0	0	70	6	498
Vineyard	Green	14	454	157	0	2856	121	529	62	89	109	393	197	263	85	0	68	151	5547
	Blue	0	10	4	0	77	1	3	0	7	41	1	0	2	0	0	29	0	175
Total	Green	**517**	**13339**	**3429**	**176**	**7335**	**7440**	**2664**	**328**	**847**	**902**	**2463**	**2142**	**573**	**326**	**353**	**419**	**167**	**43420**
	Blue	**79**	**1800**	**1496**	**4**	**1006**	**1127**	**788**	**88**	**164**	**1054**	**804**	**38**	**70**	**29**	**0**	**439**	**103**	**9088**
																			52508

Source: Own elaboration from the water data of Mekonnen and Hoekstra (2011) and the production data of the Spanish Statistical Institute.

Table A2: Water availability in the Spanish regions.

	Natural Water Resources (NWR) (hm^3)*	Potential Renewable Water Resources (PRWR) (hm^3)*	Surface (km^2)	NWR/surface (hm^3/km^2)*	(PRWR)/surface (hm^3/km^2)*
Andalusia	9,174	8,825	8,760	1.047	1.007
Aragon	6,641	5,852	4,772	1.392	1.226
Castile-La Mancha	11,926	9,763	7,946	1.501	1.229
Asturias	4,419	3,978	1,060	4.169	3.752
Baleares	652	732	499	1.307	1.466
Canarias	778	959	745	1.044	1.288
Cantabria	4,596	4,120	532	8.640	7.744
Castile and León	20,175	15,287	9,422	2.141	1.623
Catalonia	3,408	3,009	3,211	1.061	0.937
Galicia	31,613	26,318	2,958	10.687	8.897
La Rioja	1,778	1,563	505	3.521	3.095
Madrid	1,648	1,007	803	2.053	1.254
Navarre	2,425	2,132	1,039	2.334	2.052
Basque Country	6,824	6,405	723	9.438	8.859
Extremadura	2,889	2,785	4,163	0.694	0.669
Murcia C&M	934	1,609	1,131	0.826	1.423
Valencian C.	2,718	2,646	2,326	1.169	1.138

* Renewable Water Resources in natural regime

** Natural Water Resources less restrictions (environmental reserve or international transfers), counting transfers and the reuse and desalination capabilities.

Source: Own elaboration from the statistics on water availability per each (of the 24) Spanish basin, from the Spanish Ministry of Environment and Rural Affairs and the National Statistics Institute.