

Water footprint accounting of green and blue water for the Guadalquivir river basin (Spain).



TIME FOR SOLUTIONS

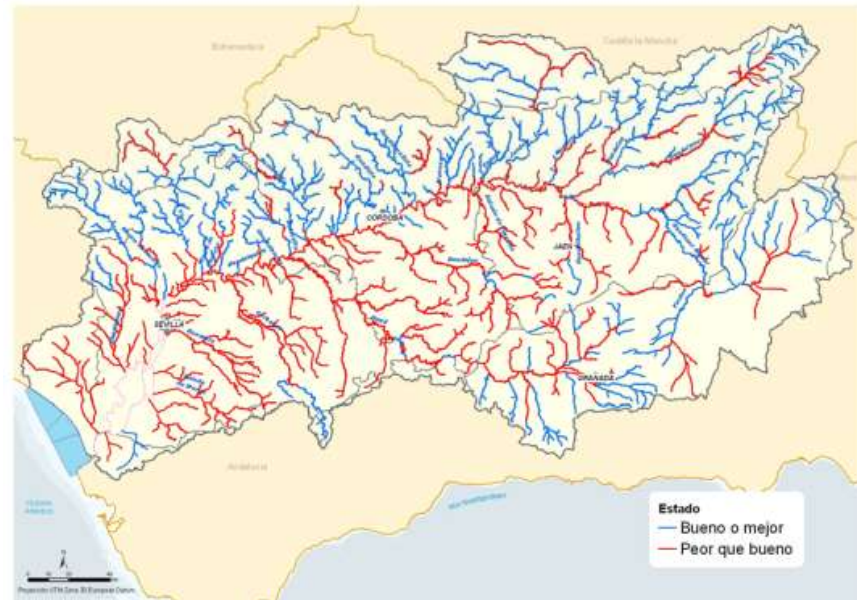
Aurélien Dumont,
Prof. M. Ramón Llamas,
Observatorio del agua,
Fundación M. Botín –
Universidad Complutense,
Madrid

13 March, 2012, Target 2.1.7.

Guadalquivir river basin



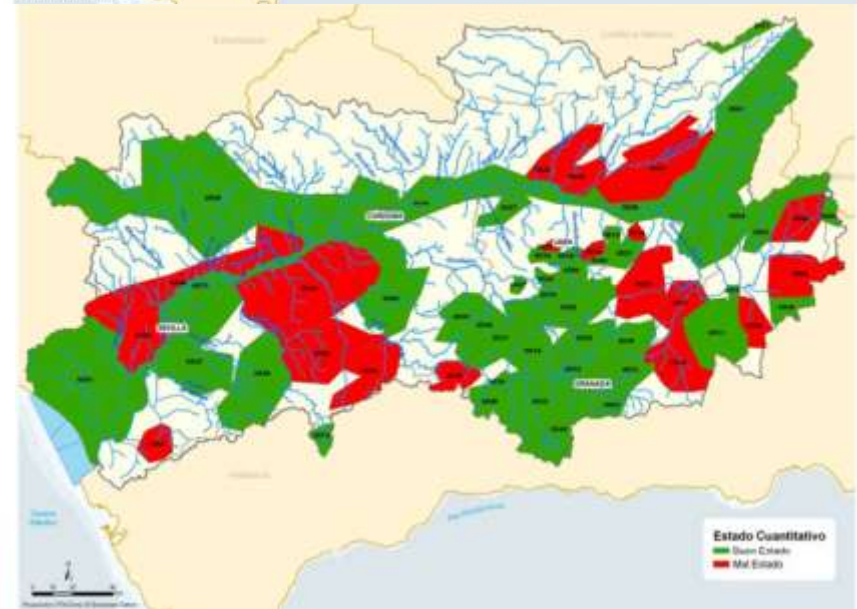
A)



*Status of the
Guadalquivir river basin
Water bodies:
A) Surface water;
B) Groundwater.*



B)



Water footprint as a Water accounting methodology

- WF within a geographically delineated area (River basin)

$$WF\ consumers = WF\ production + WF\ imports - WF\ exports$$

for IRWM

- Green water and Blue water.

- Accounting by sector: ...and for each production:

- Agriculture
- Livestock
- Domestic supply
- Tourism
- Industry
- Dams

- Corn
- Vegetables
- Citrus fruits
- Olive groves
- etc





Water footprint as a Water accounting methodology

BLUE WATER

The WF is a detailed water accounting method, accounting for all the water consumption components:

- 💧 “1. Water evaporates;
- 💧 2. Water is incorporated into the product;
- 💧 3. Water does not return to the same catchment area, for example, it is returned to another catchment area or the sea;
- 💧 4. Water does not return in the same period, for example, it is withdrawn in a scarce period and returned in a wet period.” (Hoekstra et al., 2011)

Return flows are computed only if they are not “re-used” downstream in the river basin.

“Water consumption” is a complementary indicator to water use, withdrawal or demand.



Methodology: WF Agriculture

Green WF (m^3) = EVT = % of precipitations

Period of study
1997-2008

Blue WF(m^3) = Evapotranspiration in the field

-Applied irrigation volume changes depending on the administrative restriction based on the water level in dams.

Livestock

- V_{drink}
- $V_{\text{exp.mgmt}}$

Direct consumption=> WF within the catchment

- V_{feed}

Indirect consumption=> WF within the catchment + Importations

Crop area already included
in the agrarian statistics

Pasture (Green water)



Methodology: WF domestic supply, tourism and industry

Data on withdrawal, CHG(2010)

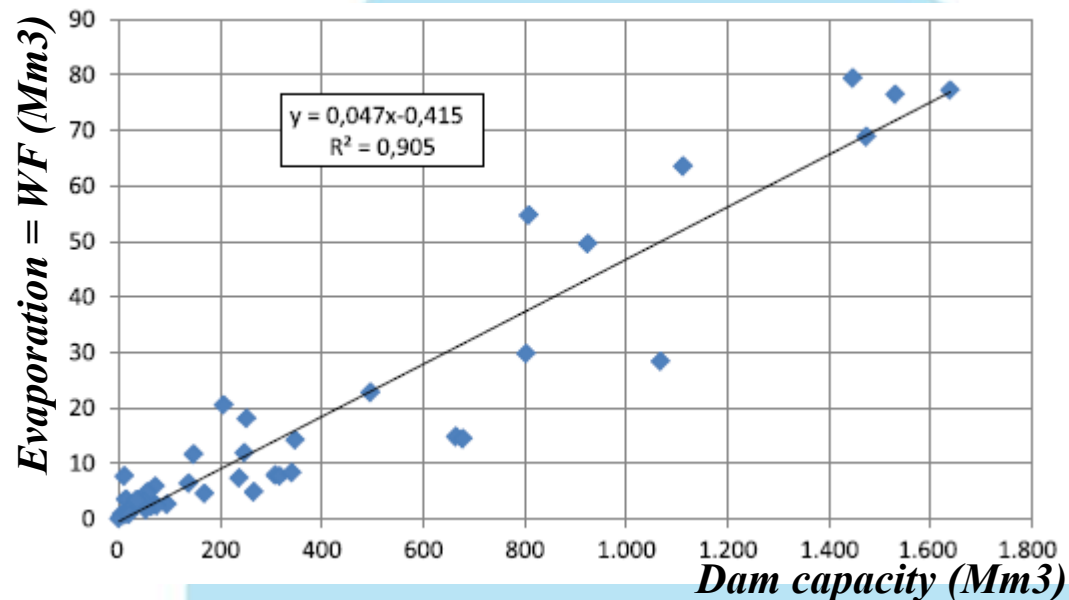


WATER FOOTPRINT

Return flows

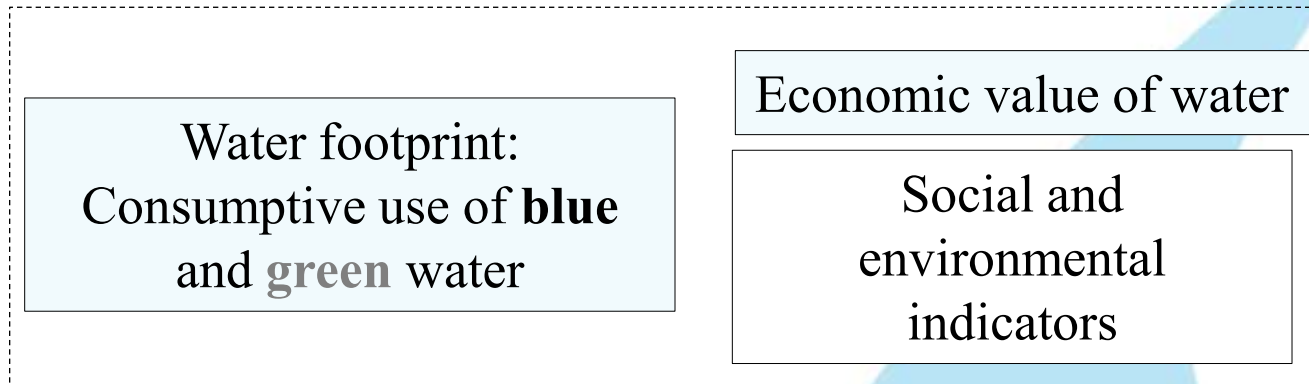
(72% for domestic use– 44% for industrial use)

Dams:



Hardy & Garrido (2010).

Water footprint and other indicators



 Indicators considered in the present study.

**Detailed water accounting within the basin based on the
Water footprint assessment methodology**

+

Indicators of the value of water



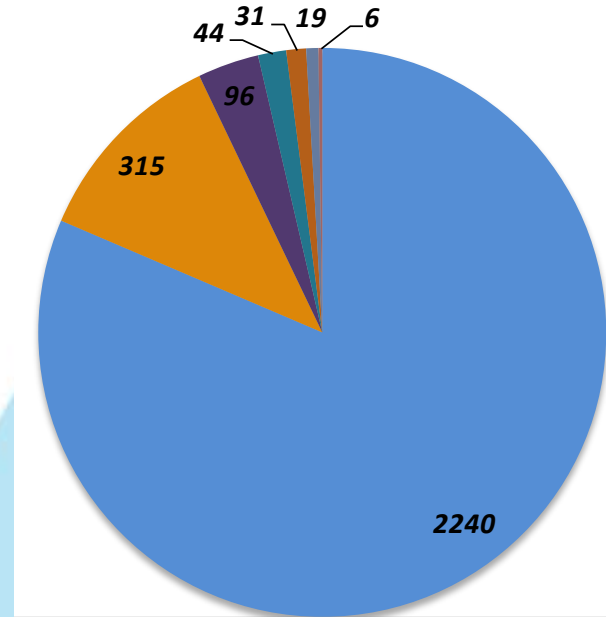
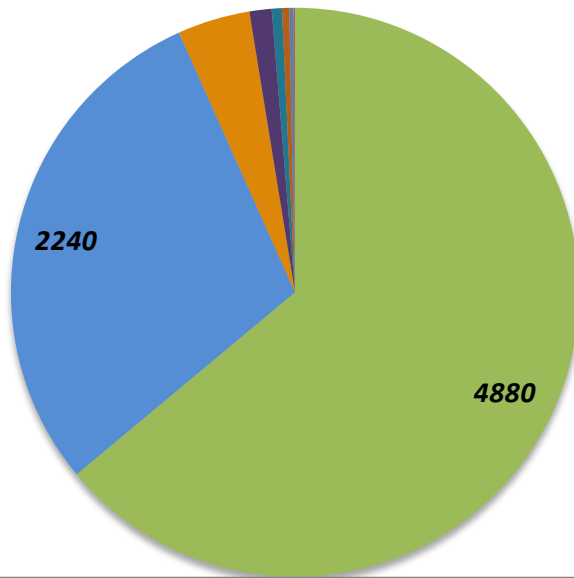
Improved management of water resources

Agriculture:

$$€ (\text{market value})_{\text{crop}} / \text{WF}_{\text{crop}}$$



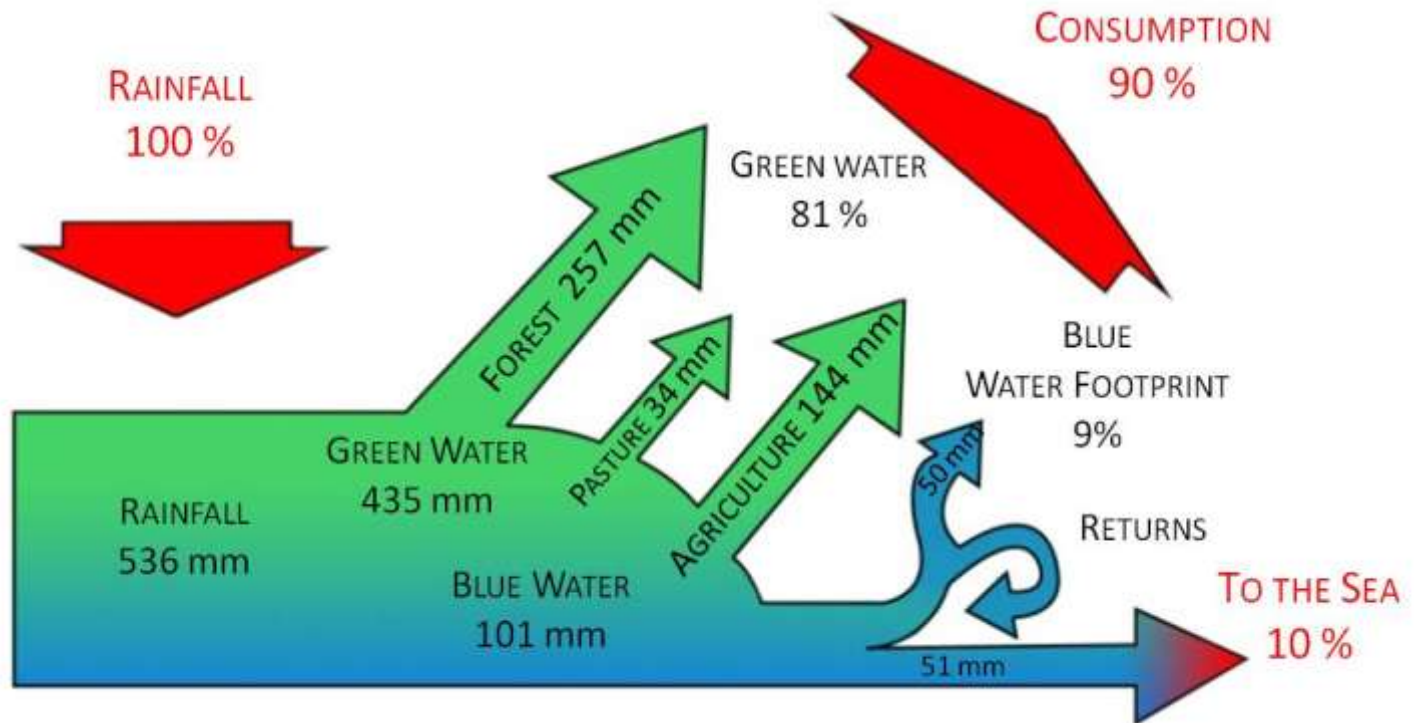
The WF of the Guadalquivir river basin: Results



■ Agriculture green
 ■ Agriculture blue
 ■ Dams
 ■ Urban supply
■ Industry
 ■ Electricity generation
 ■ Livestock
 ■ Golf

Synthesis of the sectoral WF for the Guadalquivir River Basin (Mm³).

The WF of the Guadalquivir river basin: Results



Salmoral et al. (2011) - Adapted from Falkenmark (2009)

***Integration of the Water footprint within
the hydrologic cycle***

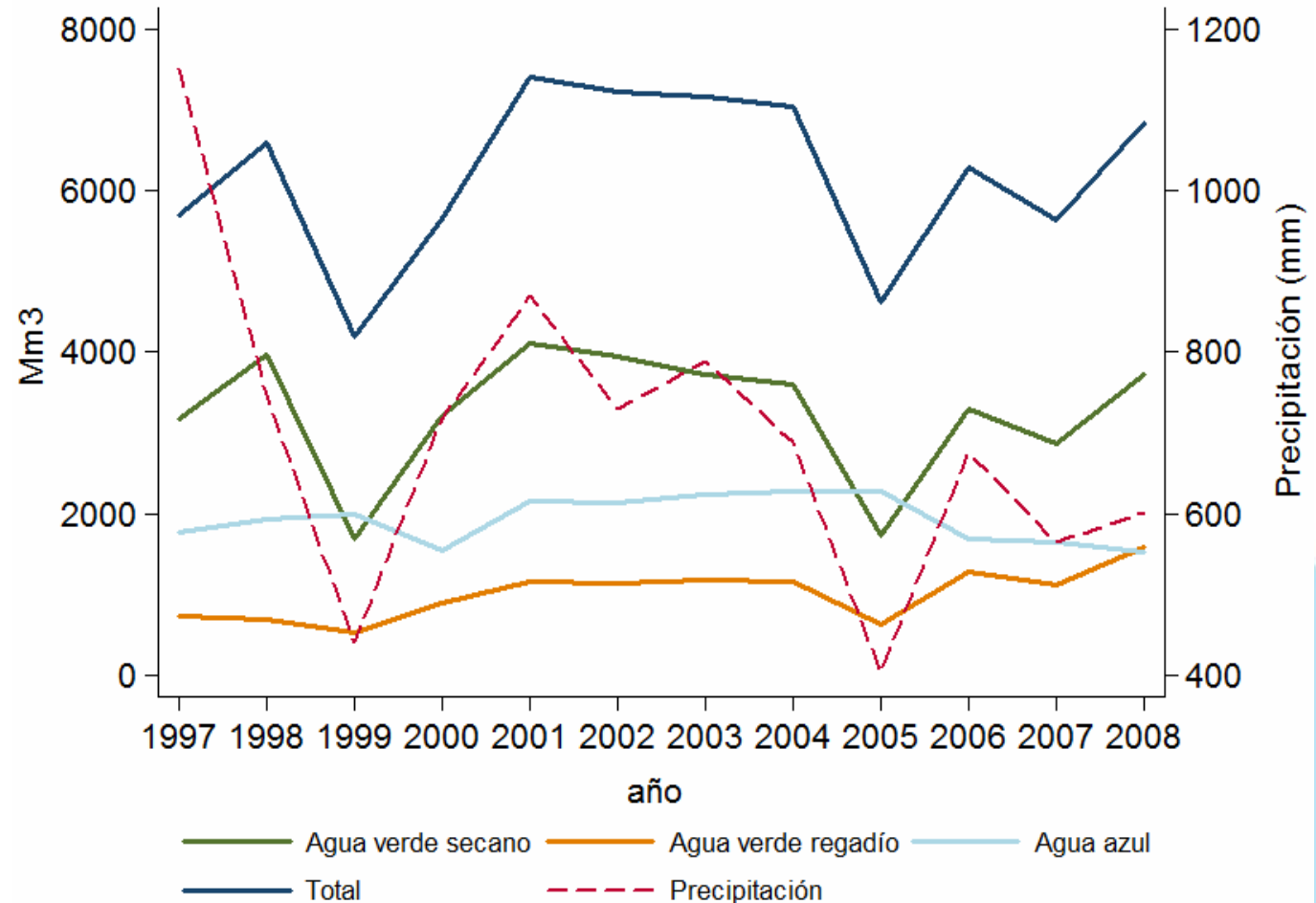
The WF of the Guadalquivir river basin: Results

The WF of Agriculture

• **Total WF:**
4.200-7.400 Mm³

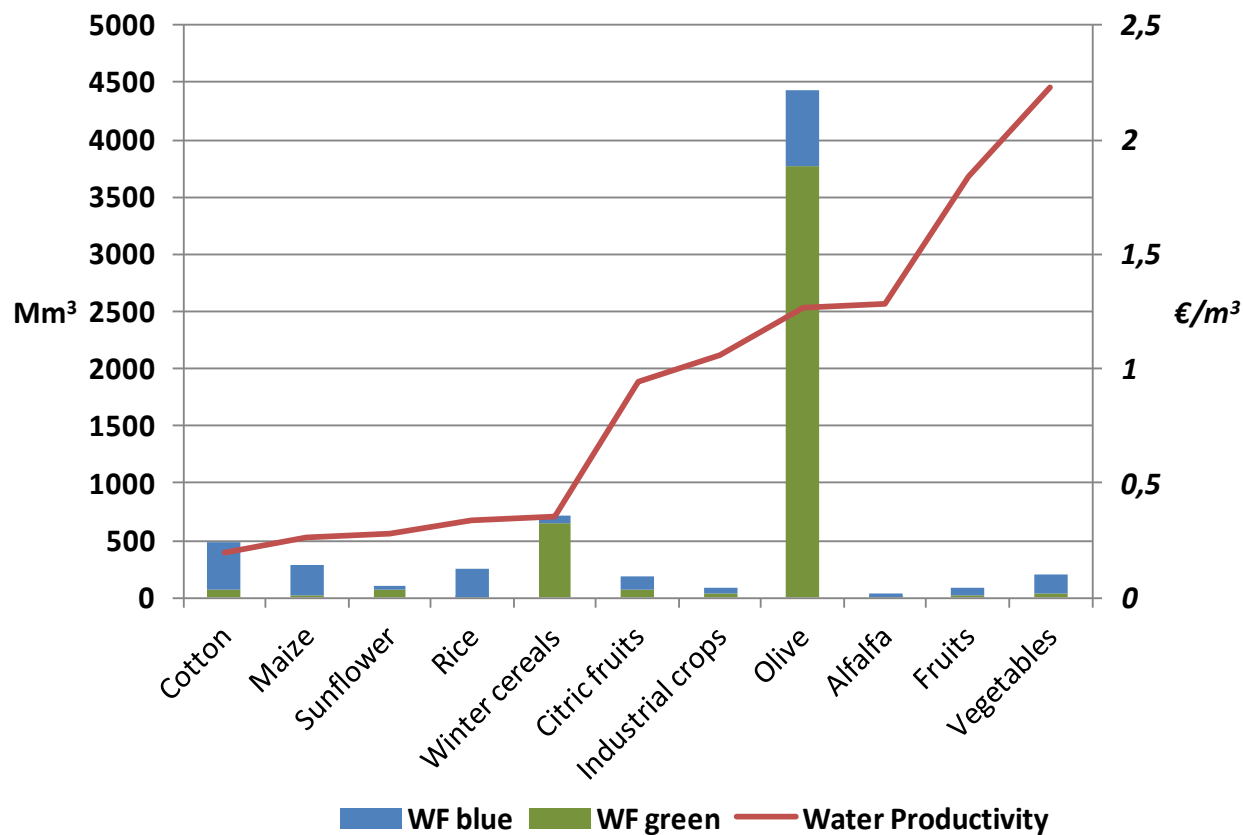
• **Green WF:**
2.200-5.300 Mm³

• **Blue WF:**
1.500-2.300 Mm³



1997-2008: ↑ 29% irrigation area =>250.000 ha

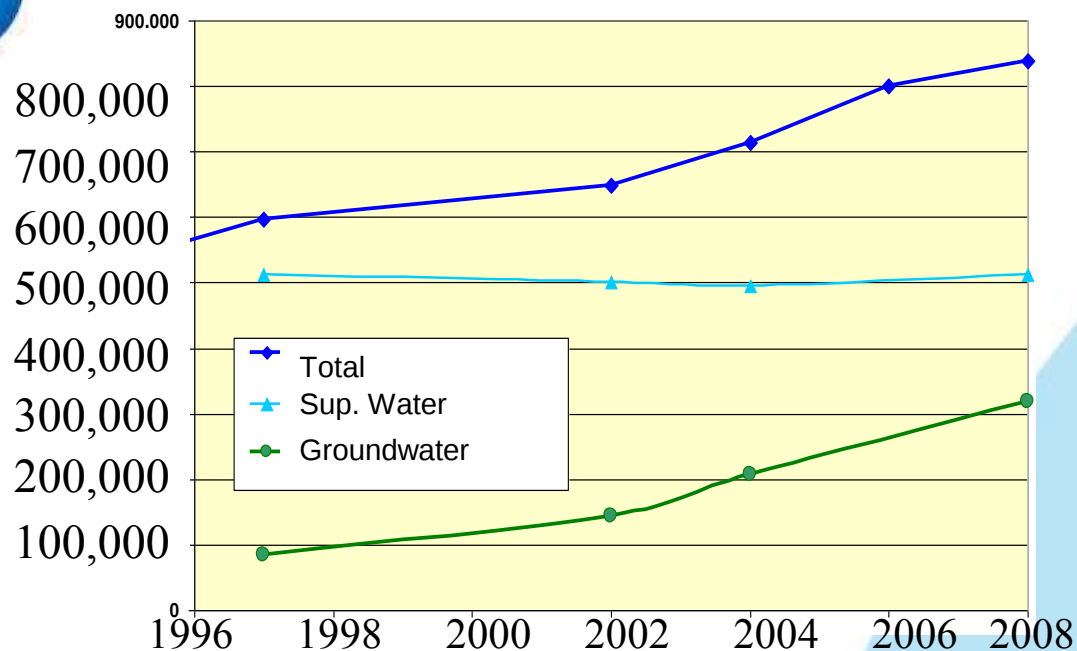
The WF of the Guadalquivir river basin: Results



The WF and “water productivity” by crop (year 2003).



The 'Water bubble' of olive oil production



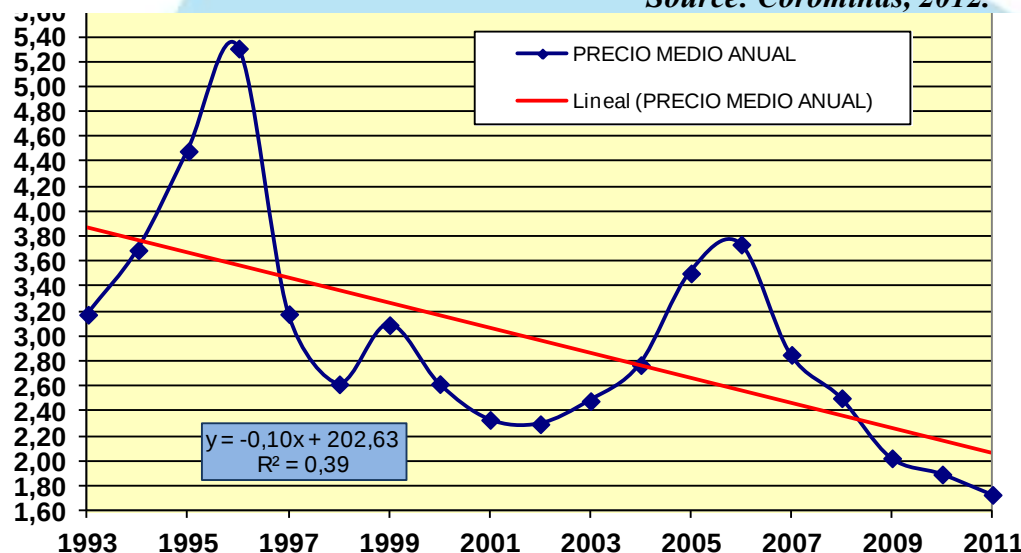
Source: Corominas, 2011.

Evolution of irrigated area (ha) by origin of water.

1997-2008:
Groundwater irrigated olive groves
+ 250.000 ha
+ 300 Mm³

Source: Corominas, 2012.

Evolution of the price of olive oil 1993-2011.





Conclusions and Key points

🔥 Recommendations regarding the Guadalquivir river basin

- 💧 A large fraction of the water used for irrigation generates little economic returns and employment: Reduction of the WF with limited economic and social costs?
- 💧 Reducing the blue WF (groundwater) of olive to alleviate the stressful situation and the current “Water bubble Paradox”.

⟹ Possible solution: Incentive for rain-fed farming or deficit irrigation.

- 💧 New uses: Water should be obtain from existing uses:
 - > Ex: Thermosolar plants: + 16 Mm³ before 2015.

🔥 Key points regarding Water footprint as a Water accounting method

- 💧 The WF integrates only the consumptive fraction of water use / “appropriation of water resources”: return flows are not computed. e.g. essential to assess the effect of possible demand reduction measures.
- 💧 WF is useful for hydrologic balance at basin scale and taking into account green water allows to integrate land use and water policy and to recognize its value for crop production.
- 💧 A detailed accounting of the WF and its value, not only for the big sectors of the economy but also within the sectors (e.g. different crops for agriculture), allows to identify the activities that are more valuable for the area.





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