Evaluation of Water Footprint for table olive groves of *Olea europaea* L. – cv. Conservolea

K. Fotia, I.L. Tsirogiannis, P. Baltzoi, P. Barouchas, N. Malamos, N. Mantzos, K. Zisis, G.D. Nanos

Interreg Greece-Italy IR2MA
European Regional Development Fund
EUROPEAN UNION

Water Footprint

“The Water Footprint quantifies the amount of water that we consume and pollute for making a product over the full supply chain”

Three Components:

- Green WF: volume of rainwater consumed (evaporated)

+

- Blue WF: volume of surface or groundwater consumed (evaporated)

  *that does not return to the same catchment

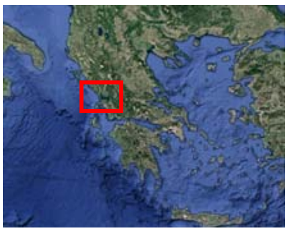
+

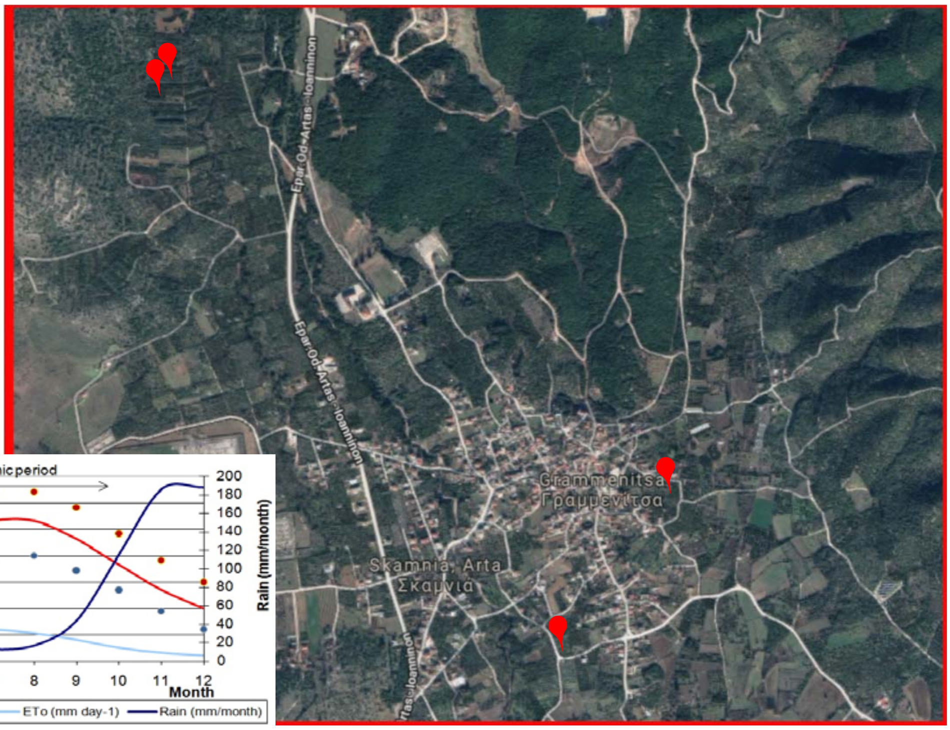
- Grey WF: volume of surface or groundwater polluted

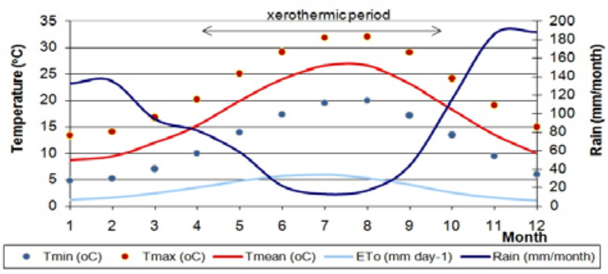
  *water needed to assimilate the water pollution caused by production activities

Olea europaea L. – cv. Conservolea

Study area







Olive groves

Field ID	Area (ha)	trees	Planting Distance (m x m)	Density (trees ha^{-1})	Soil type
Field 1	0.25	60	6 x 6.5	240	clay loam
Field 2	0.20	54	7 x 7.2	270	clay loam
Field 3	0.18	40	7 x 7	222	clay loam
Field 4 raifed	0.28	65	7 x 7.2	232	clay loam

mean density

241 trees ha^{-1}

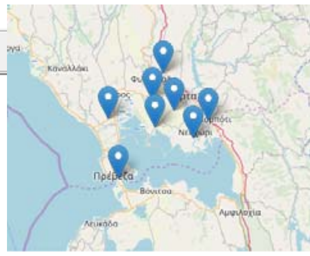
Water Footprint accounting Methodology

- Hoekstra et al., 2011 "The Water Footprint Assessment Manual: *Setting the Global Standard*"
- CROPWAT Model: 'irrigation schedule option'
  - → estimation of ETgreen & ETblue
  - field measured data

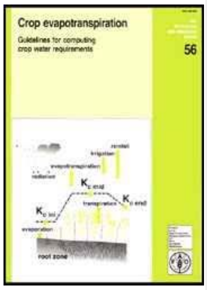
- Computing farmers' data input
  - (cropping practices & yield)

input DATA

Public network of agro-metereological stations



FAO, PAPER 56
Soil analysis (soil type)
Saxton & Rawls, 2006 (properties)



Water meters

Grey Water Footprint data

$$WFproc,grey = \frac{\dfrac{a \times AR}{Cmax - Cnat}}{Y}$$

AR → farmers' input
**Application rate of N-Fertiliser*

α = 0.1 (10%)
**nitrate leaching fraction*

Cmax = 50mg NO_3 L^{-1}, (EU Nitrates Directive, 91/676/EEC)
**maximum acceptable concentration of nitrate*

Cnat = 0
**natural occurring N concentration of the receiving water bodies*

Y → farmers' input
**Yield*

Field ID	N application (kg ha^{-1})	Ieff (m^3 ha^{-1})	Yield (tn ha^{-1})	WFgreen (m^3 tn^{-1})	WFblue (m^3 tn^{-1})	WFgrey (m^3 tn^{-1})	WFtotal (m^3 tn^{-1})
Field 1	220.80			356,06		**212.31**	705.58
Field 2	248.40			336.72		**176.01**	593.29
Field 3	117.78			174.32		**66.25**	326.93
Field 4 rainfed	257.68			653.16		**327.95**	981.12

- WFgreen greatest contribution to WFtotal (49-67%)

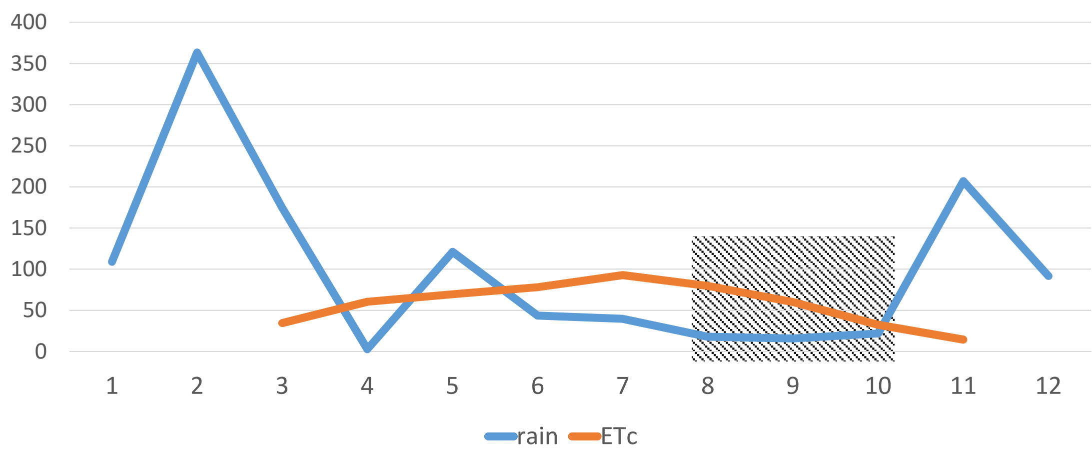
Field ID	N application (kg ha^{-1})	Ieff (m^3 ha^{-1})	Yield (tn ha^{-1})	WFgreen (m^3 tn^{-1})	WFblue (m^3 tn^{-1})	WFgrey (m^3 tn^{-1})	WFtotal (m^3 tn^{-1})
Field 1	220.80			356,06		**212.31**	705.58
Field 2	248.40			336.72		**176.01**	593.29
Field 3	117.78			174.32		**66.25**	326.93
Field 4 rainfed	257.68			653.16		**327.95**	981.12

- WFgreen greatest contribution to WFtotal
- Higher WFgrey : higher N application rate
  - 150 kg ha^{-1}

Field ID	N application (kg ha^{-1})	Ieff (m^3 ha^{-1})	Yield (tn ha^{-1})	WFgreen (m^3 tn^{-1})	WFblue (m^3 tn^{-1})	WFgrey (m^3 tn^{-1})	WFtotal (m^3 tn^{-1})
Field 1	220.80		10.40	356,06		**212.31**	705.58
Field 2	248.40		12.50	336.72		**176.01**	593.29
Field 3	117.78		17.80	174.32		**66.25**	326.93
Field 4 rainfed	257.68		7.85	653.16		**327.95**	981.12

- WFgreen greatest contribution to WFtotal
- Higher WFgrey: higher N application rate
- Rainfed max WF: low yield

Discussion: rainfed



Intervention with irrigation at critical stages of crops not only compensates for unfavorable weather conditions but also rationalises preceding agronomic practices (eg fertilization, plant protection) which leave larger footprint if not "capitalised" accordingly in the end product (yield)

Field ID	N application (kg ha^{-1})	Ieff (m^3 ha^{-1})	Yield (tn ha^{-1})	WFgreen (m^3 tn^{-1})	WFblue (m^3 tn^{-1})	WFgrey (m^3 tn^{-1})	WFtotal (m^3 tn^{-1})
Field 1	220.80	1641.90	10.40	356,06	137,21	212.31	705.58
Field 2	248.40	1522.50	12.50	336.72	80.56	176.01	593.29
Field 3	117.78	3517.80	17.80	174.32	113.23	66.25	326.93
Field 4	257.68	0	7.85	653.16	0.00	327.95	981.12

- WFgreen greatest contribution to WFtotal
- Higher WFgrey (literature): high amounts of N fertilizer
- Rainfed max WF: low yield
- Field with highest water consumption: lowest WF
  – high yield
  – ↓ WFgrey

Water productivity

Accounting limitations & points to take into consideration

- Blue and Green ET:
  - Cultivar tailored Kc
- Grey water: more detailed calculation
- Linking WF to the quality of end product

Conclusions

- WF valuable tool for efficiency water management
  - Points out the weak points (“hot spots”)
- action towards
  - Minimisation of WF
    - ➢ Increase Green water productivity
    - ➢ Increase Blue water productivity
    - ➢ Zero Grey water
- Enrichment of data basis
- Improvements in the calculation methodology: more accurate WF

Thank you

Interreg
Greece-Italy
IR2MA
European Regional Development Fund
EUROPEAN UNION

Evaluation of Water Footprint for table olive groves of *Olea europaea* L. 'Konservolea'

K. Fotia[1], I.L. Tsirogiannis[2], P. Baltzoi[2], P. Barouchas[3], N. Malamos[3], N. Mantzos[3], K. Zisis[2], G.D. Nanos[1]

[1]University of Thessaly, School of Agricultural Sciences, Laboratory of Pomology, Fitoko Str., 38446 Volos; [2]University of Ioannina, Dept. of Agriculture, Kostakii Campus, 47100 Arta, Greece; [3] University of Patras, Dept. of Agriculture, Theodoropoulou Terma, 27200 Amaliada, Greece

Abstract

As agriculture appears to be globally the greatest water user and water scarcity, due to fresh water shortages or deterioration of fresh water quality, is listed among the major global risks, efficient use of water resources is closely linked to sustainable agricultural practices. Water Footprint (WF) has been largely employed during the last decade as a useful tool for planning efficient water management strategies at global, national, regional or even water basin level. WF is an indicator that is based on methods and tools that calculate the amount of water used along the full supply chain of a product. 'Konservolea' is a local table olive cultivar assigned as a Protected Geographical Indication (PGI) product of Arta, Greece. It is the main table olive cultivar in the area, it has a significant impact on local economy and it exhibits favorable economic and market prospects. In this study the WF of 'Konservolea' was calculated based on actual data from four olive groves and the results are presented and discussed. All four groves were conventionally treated according to the local practices regarding pruning, fertilisation, plant protection, etc. Three of the olive groves were irrigated, while the fourth was rainfed. The WF of the four olive groves ranged from 354 to 961 m^3 t^{-1} of olive fruit. The results provide a first yet solid assessment of the WF of table olive crop in the area and underline the effect of different agronomic practices on WF. Practical difficulties regarding the calculation of WF that need to be further investigated and resolved are pointed out.

Keywords: table olive yield, water requirements, efficient irrigation management, micro-sprinkler, Blue Water