



Water consumption related to different diets in Mediterranean cities



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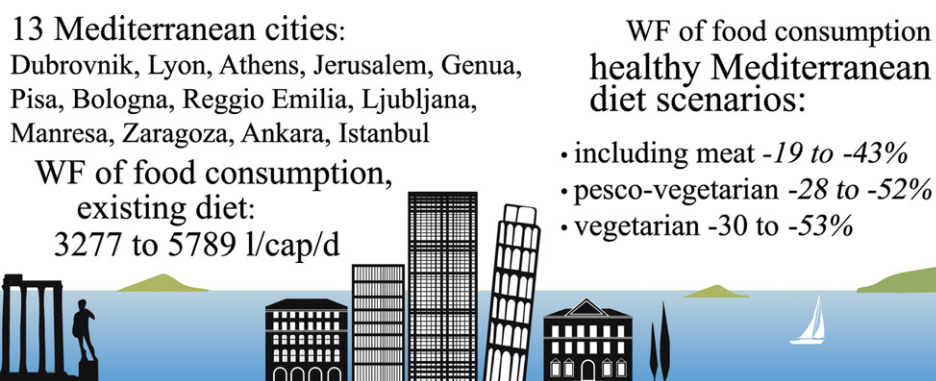
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HIGHLIGHTS

- Modern cities score well regarding water management in international city rankings.
- They are however dependent on external water resources for the food they consume.
- Mediterranean urban citizens eat too many animal products and sugar.
- They can save a lot of water by shifting to a healthy diet.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:

Received 18 July 2016

Received in revised form 16 August 2016

Accepted 16 August 2016

Available online xxxx

Editor: D. Barcelo

Keywords:

Urban
City
Water
Mediterranean
Diet
Footprint

ABSTRACT

Providing the sustainable development goals (SDGs) water, food and energy security to cities relies strongly on resource use outside city borders. Many modern cities have recently invested in a sustainable urban water system, and score high in international city rankings regarding water management and direct urban water use. However, these rankings generally neglect external resource use for cities. Here we quantify the water resources related to food consumption in thirteen cities located in Mediterranean countries, by means of the water footprint (WF) concept. These WFs amount from 3277 l per capita per day (l/cap/d) to 5789 l/cap/d. These amounts are about thirty times higher than their direct urban water use. We additionally analyse the WF of three diet scenarios, based upon a Mediterranean dietary pattern. Many authors identify the Mediterranean diet as cultural heritage, being beneficial for human health and a model for a sustainable food system. The first diet scenario, a healthy Mediterranean diet including meat, leads to WF reductions of –19% to –43%. The second diet scenario (pesco-vegetarian), leads to WF reductions of –28% to –52%. The third diet scenario (vegetarian), leads to WF reductions of –30% to –53%. In other words, if urban citizens want to save water, they need to look at their diets.

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1. Introduction

Providing the sustainable development goals (SDGs) water, food and energy security to a rapidly increasing and urbanising global

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Fig. 1. Location of the 13 cities in the Mediterranean countries.

population in a sustainable way, is one of the largest challenges humanity faces (UN, 2014; Vanham, 2016). How many and which resources urban citizens consume, is key to achieve this goal. It is however unlikely that cities can ever be fully self-sufficient to provide its populations with water, food and energy security (Elmqvist, 2014). They import most of the resources they consume. This fact is generally ignored in current international sustainability rankings for cities, like the Green City Index (Economist Intelligence Unit, Siemens, 2012) or the City

Blueprint (Koop and van Leeuwen, 2015; Koop and van Leeuwen, 2016; van Leeuwen et al., 2012), where many European cities tend to receive high scores. Such indices are generally based only on – though very important – direct urban best practices such as waste collection, energy efficiency of city buildings or efficiency in water management. They generally neglect the dependency of cities on resources outside city borders. To communicate the full picture of resource consumption to citizens, stakeholders and policy makers, indicators on external

Table 1
Mediterranean cities assessed in this study, with population statistics and data on direct urban water use.

| Country | City | Population | | | Comment | Urban direct water use |
|----------|----------------------|------------|---------|-------|--|---|
| | | Total | % women | % men | | |
| Croatia | Dubrovnik | 42,615 | 52.7 | 47.3 | Year 2011 statistics, source (DZS, 2016) | |
| France | Lyon | 1,584,738 | 52.1 | 47.9 | Year 2012 statistics on the “urban unity” (<i>l’unité urbaine</i>) of Lyon, source (INSEE, 2016). The municipality of Lyon has a population of 496,343. | Water use of 173 l/cap/d (Koop and Van Leeuwen, 2015) |
| Greece | Athens | 3,090,508 | 52.3 | 47.7 | Year 2011 for the metropolitan area of Athens (Greater Athens and Greater Piraeus), part of the Attica administrative region (population of 3,828,434), source (Hellenic Statistical Authority, 2016). The municipality of Athens has a population of 664,046. | Water use of 293 l/cap/d (Economist Intelligence Unit, Siemens, 2012), domestic water use 125 l/cap/d (Koutiva and Makropoulos, 2016) |
| Israel | Jerusalem | 914,500 | 50.3 | 49.7 | Year 2009 statistics, source (CBS, 2016) | Water use of 160 l/cap/d (Koop and Van Leeuwen, 2015) |
| Italy | Genova | 592,507 | 53.0 | 47.0 | Year 2015, source (ISTAT, 2016a). Genova is located in the Italian zone “North-West”, Pisa in “Center”, Bologna and Reggio Emilia in “North-East”. These zones are also identified in the third Italian national nutrition survey INRAN-SCAI 2005–06 (Leclercq et al., 2009) | Water input to a municipal distribution system in 2012 = 384 l/cap/d; domestic water use 163 l/cap/d (ISTAT, 2016b) |
| Italy | Pisa | 89,523 | 52.8 | 47.2 | | Water input to a municipal distribution system in 2012 = 410 l/cap/d; domestic water use 180 l/cap/d (ISTAT, 2016b) |
| Italy | Bologna | 386,181 | 53.0 | 47.0 | | Water input to a municipal distribution system in 2012 = 308 l/cap/d; domestic water use 161 l/cap/d (ISTAT, 2016b) |
| Italy | Reggio (nell’)Emilia | 171,655 | 51.5 | 48.5 | | Water input to a municipal distribution system in 2012 = 241 l/cap/d; domestic water use 132 l/cap/d (ISTAT, 2016b) |
| Slovenia | Ljubljana | 287,283 | 52.0 | 48.0 | Year 2015, source (SURs, 2016) | Municipal water use 198 l/cap/d in 2011, of which 157 l/cap/d domestic water use (City of Ljubljana, 2013) |
| Spain | Manresa | 74,655 | 51.2 | 48.8 | Year 2015, source (INE, 2016) | Water use of 341 l/cap/d (Koop and Van Leeuwen, 2015) |
| Spain | Zaragoza | 664,953 | 51.9 | 48.1 | | Water use of 227 l/cap/d (Koop and Van Leeuwen, 2015) |
| Turkey | Ankara | 5,270,575 | 50.3 | 49.7 | Year 2015, source (TURKSTAT, 2016) | Water use of 205 l/cap/d (Koop and Van Leeuwen, 2015) |
| Turkey | Istanbul | 14,657,434 | 49.8 | 50.2 | | Drinking water supply in 2010 of 188 l/cap/d (van Leeuwen and Sjerps, 2016) |

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