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Economic Impact and Water Use Trade-Offs and Synergies: A Case Study of the Cyprus Tourism Sector

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Abstract

Water issues have been gaining importance on the global political agenda in recent years. Nevertheless, water scarcity issues are inherently local. The impact of tourism activities on local water resources remains an understudied issue. Tourism is highly heterogeneous and offers a plethora of different products which cater for different tastes and budgets at different times of the year. Tourism products differ in terms of their economic impact but also in terms of their demand for water and other resources. Direct use of water by the tourism industry, which includes water used in hotels, golf courses, water parks and other tourism establishments, is relatively well understood. In addition to this volume of water, substantially more is required indirectly to produce food and other products which cater for tourism demand. Quantifying both the direct and indirect components is essential to understanding total water demand and productivity in the tourism sector.

The common perception in Cyprus and other tourism economies is that high-spending tourists represent the most desirable market segment. However, this assertion is rarely based on economic yield assessments and ignores environmental impacts. The present research uses Environmental Input-Output (EIO) analysis along with detailed tourism expenditure data in order to quantify economic and water use synergies and trade-offs, for different tourism markets in Cyprus. The results suggest that different market segments vary significantly in terms of their economic return in relation to total water use. Consequently, there are important sustainability implications for policymakers and destination managers in water scarce destinations.

1. Introduction

All economic activity requires the input of environmental resources, either directly or indirectly. Water is one such input, and a scarce resource that has been receiving increasing academic, political, and press attention in recent years – largely because there are already parts of the globe where water has become or is fast-becoming (UN-Water, 2006; Vorosmarty, Green, Salisbury, & Lammers, 2000) a limiting factor for human life and economic development. As water remains a vital input in the production of goods and services, it is essential that focus shifts towards increasing water efficiency and water productivity (Gleick, 2003). Each use of water must be able to generate the maximum amount of utility using the least quantity.

Tourism is not an economic activity that has traditionally been associated with pressure on water resources (Gössling, 2005). This is mainly because, on a global level, direct water use from tourism only represents a very small percentage of water use (Gössling et al., 2012) compared to other users such as agriculture, industry and household sectors (FAO, 2011). The tourism industry's focus on minimising carbon emissions from travel and accommodation has also perhaps detracted attention away from tourism's use of other resources, including water (Hadjikakou, Chenoweth, & Miller, 2013). Nevertheless, due to its seasonal and spatial concentration, tourism can significantly impact water resources in certain places (De Stefano, 2004; Kent, Newnham, & Essex, 2002). The Mediterranean is a prime example, as it is an area where most tourists arrive in the summer, when precipitation and natural flows tend to be at a minimum. Furthermore, as a service sector with a very large supply chain and interlinkages, tourism draws water through its supply chain, thus exponentially increasing its total demand for water (Hadjikakou, Miller, & Chenoweth, 2012). Tourism tends to be a highly 'extravagant' form of consumption, as a holiday often represents a well-earned break (Miller et al. 2010), with destinations commonly encouraging spending and consumption in order to maximise revenue.

It is well understood that tourist facilities such as golf course and swimming pools directly use large amounts of water (Hof & Schmitt, 2011; Tortella & Tirado, 2011). Increasingly, there has also been acknowledgement and understanding of the indirect water use component of tourism (Gössling et al., 2012; Hadjikakou et al., 2012; Lundie, Dwyer, & Forsyth, 2007), even though this is still to be comprehensively or consistently quantified. The concepts of virtual water (Allan, 1996) and the water footprint (Hoekstra, 2003) have succeeded in raising awareness of the fact that the majority of water consumption takes place in the agricultural and industrial stages of production (i.e in the supply chain). Approximately one-third of all tourist expenditure is used to buy food (Gössling et al. 2010), which suggests that tourism may have a much more substantial impact on water consumption, particularly in agriculture, than previously thought.

It is becoming clear that it is in the long term interests of not only the environment but also the tourism industry itself to be able to accomplish more with less. However, important questions remain with respect to the trade-offs between water use and economic impact of different kinds of tourists. Tourism is highly heterogeneous and offers a plethora of different products which cater for different tastes and budgets at different times of the year. This implies that there is no 'one-size-fits-all' management approach for reducing water use impacts and that different groups should be targeted in specific ways to ensure that economic yield is maximised and water use minimised. This is the issue that this paper seeks to address, by firstly developing a suitable methodology to estimate the total economic and water use impact of tourism on the island of Cyprus, and then breaking this down into more relevant tourism sub-sectors whose relative performance can, subsequently, be compared.

The paper is structured as follows. The next section sets the scene by briefly discussing tourism and water scarcity issues in Cyprus – the case study for the present paper. A subsequent section provides a general overview of the methodology, along with a brief description of the environmental input-output (EIO) model and the datasets used to perform the analysis. The ensuing results and discussion sections present the key findings of the modelling exercise, such as total water use as well as water productivity for different kinds of tourists, with a concluding section which discusses some of the key implications for water scarce destinations and tourism management.

2. Tourism and water scarcity in Cyprus

Cyprus is an island nation in the eastern Mediterranean region (Fig. 1). Similarly to other islands in the Mediterranean, a favourable climate, natural beauty and rich history have made the island an attractive tourism destination. The island first became a tourism destination in the 1960s. Since then, the development of tourism has been a remarkable success story, with the establishment of tourism as the dominant economic sector since the early 1980s (Sharpley, 2001). In 2012, according to the Cyprus Statistical Service (CyStat), the tourism sector made a total contribution of 19.4% to GDP and supported 20.8% of total employment (CyStat 2013). Cyprus belongs to a group of countries known as Small Island Tourist Economies (SITEs), owing to its small size, its nature as an island and its economic dependence on tourism (Shareef, Hoti, & McAleer, 2008).

Cyprus has a climate typical to the region, characterised by mild rainy winters and long, hot and dry summers (Hadjinicolaou et al., 2010). With an annual average precipitation of around 460mm, the climate regime is classified as semi-arid – making Cyprus one of the EU member states experiencing the highest levels of water shortage (Cyprus WDD, 2009). The water scarcity problem is further compounded by the extremely unequal spatial distribution of water resources as well as the fact that around two-thirds of the annual rainfall total typically falls during the winter months (Kampanellas et al. 2003). As in other Mediterranean islands, water demand can often surpass natural water availability during the summer months (Gikas & Angelakis, 2009). As a result, the island has become highly reliant on reservoirs and desalination.

Desalination plants presently supply around 50% of the water used in the residential sector, which includes tourism establishments (Kaimaki, 2010).

Tourism is directly responsible for around 16.9% of domestic water use in Cyprus, which corresponds to 5% of the total annual water use (Kaimaki, 2010). As the most prominent environmental issue on the island is water scarcity, it is commonly accepted that tourism has exacerbated the problem (Sharpley, 2003). This is especially the case during the summer months where peak tourism demand coincides with full irrigation requirements in agriculture (Iacovides, 2011). In recent years, attempts have been made by the government and the tourism sector alike to diversify the tourism product in order to attract higher-spending clientele (Adamou & Clerides, 2009; Clerides & Pashourtidou, 2007). With the current economic downturn in the EU and the recent collapse of Cyprus as an offshore banking centre, tourism is likely to become an even more important main source of national revenue (Hadjikakou et al., in press). Nevertheless, even though diversifying the existing tourism product represents a proven way to increase the economic yield of the sector, it is likely to increase water demand. Evidence from other mature destinations in the Mediterranean suggests that water resources tend to become increasingly stressed from diversification and upgrading of the tourism product, especially at a time when the challenges posed by climate change are becoming apparent (Hof & Schmitt, 2011; Tortella & Tirado, 2011).

Figure 1. Map of the eastern Mediterranean region showing the location of Cyprus (source: drawn by author using freely available GIS shapefiles available at http://www.diva-gis.org/Data).

Future water availability on the island is expected to be severely affected by climate change. The eastern Mediterranean region is considered to be an extremely sensitive 'hotspot' for climate change (Giorgi, 2006; Giorgi & Lionello, 2008; Ludwig et al., 2011). Projections show that the area is likely to face an increase in annual mean temperature of well above the average global temperature increase, whereas annual precipitation is very likely to decrease. Specifically for Cyprus, recent studies using regional climate models suggest that, by mid-century, average temperature is likely to increase in the range of 1.3°C to 1.9°C (Giannakopoulos et al., 2010) and precipitation will decrease by 20% (Chenoweth et al., 2011).

The present study therefore represents a timely attempt to comprehensively quantify and compare the total (direct and indirect) water demand and water productivity of the tourism sector, in addition to performing a necessary comparison of different tourism types currently present on the island.

3. Methods

Overview of methodology

Fig. 3 below provides an overview of the methodology. Subsequent sub-sections describe each of the three stages in more detail.

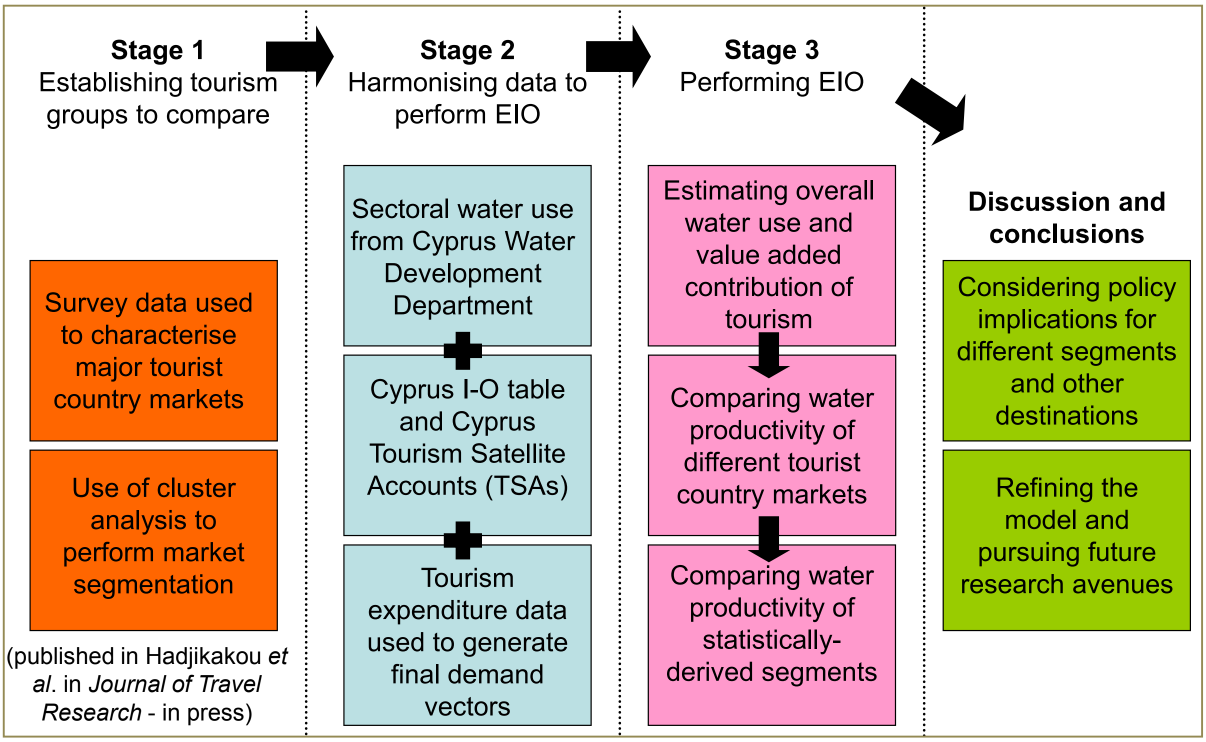

Figure 2. Brief outline of the three-stage methodology followed in the current study.

Stage 1 (establishing tourism groups to compare)

The first necessary objective of the study was to determine what kinds of tourist groups are currently present on the island. As an established mature tourism destination, Cyprus offers a plethora of holiday choices which are likely to have different economic impacts as well as exert different amounts of water use pressure. The Cyprus Tourism Organisation (CTO) distinguishes tourists based on their country of origin (COO), which traditionally serves as the basis for collecting and interpreting tourism data (Andriotis, Agiomirgianakis, & Mihiotis, 2008; Reid & Reid, 1997). Nevertheless, Hadjikakou et al. (in press) argue that existing COO segmentation needs to be supplemented with tourist typologies based on other tourist characteristics and consumption patterns besides nationality. In the aforementioned study we employed cluster analysis to segment the largest COO market in Cyprus (tourists from the United Kingdom), and showed that spending behaviour can vary enormously between tourists belonging to the same COO segment.

Stage 2 (EIO and data harmonisation)

EIO analysis is a top-down economic technique that allows the association of economic accounts with environmental accounts of resource use or pollution. It is based on the input-output (IO) model, an analytical framework developed by Leontief in the 1930s that makes use of sectoral monetary transactions to account for interdependencies between industries in modern economies (Munksgaard et al. 2005). The fundamental starting point in performing an IO analysis is having information on the flows of products from each economic sector to each of the other sectors (R. E. Miller & Blair, 2009). This is typically available in the form of an input-output table (IOT) of the economy (see Table 1). Today, most statistical agencies worldwide regularly produce IOTs as part of their National Account framework. In the inter-sectoral transactions matrix (shaded area in Table 1), rows represent the distribution of a producer's output throughout the economy whereas columns describe the composition of inputs required by a particular industry.

Table 1. Basic input-output table for a hypothetical two-sector economy.

	Sector 1	Sector 2	**Final demand (y)**	**Total output (x)**
Sector 1	z_{11}	z_{12}	y_1	x_1
Sector 2	z_{21}	z_{22}	y_2	x_2
Imports	m_1	m_2		
Value added	VA_1	VA_2		
Total inputs	x_1	x_2		

The next step in the Leontief input-output model is to replace the inter-sectoral sale terms (denoted by *z*) with technical coefficients (R. E. Miller & Blair, 2009), interpreted as the monetary input value per one monetary unit of output for each sector, described using the ratio:

$$a_{ij} = \frac{z_{ij}}{x_j} \quad \textbf{(1)}$$

The basic Leontief model is then based on the principle that total output is equal to intermediate demand plus final demand, given by:

$$Ax + y = x \quad \textbf{(2)}$$

where A is the 'direct requirements matrix' whose elements are all the technical coefficients (a in equation 1) for a given economy, y is the vector of sectoral final demand (as shown in column 3 of Table 1 – y can correspond to final demand from any chosen group of consumers such as households, exports or, as performed in the present study, tourists) and x is the vector of sectoral total outputs (as shown in column 4 of Table 1). Equation (2) can be rearranged in terms of x to give the Leontief equation:

$$(I - A)^{-1}y = x \quad \textbf{(3)}$$

where I is an identity matrix (a matrix with the same dimensions as A with ones on the main diagonal and zeros elsewhere). $(I - A)^{-1}$ is the 'Leontief inverse' matrix. It captures the total sum of an infinite series of round-by-round effects, thus representing the total production generated by each economic sector in order to satisfy final demand in the economy (Velazquez, 2006).

The extension of the IO model to include links between economic and environmental data was first undertaken in the late 1960s by Leontief himself, who developed a method to incorporate environmental externalities such as pollution into the conventional IO structure (Leontief, 1970). Environmental input-output (EIO) makes use of the Leontief matrix that contains monetary inter-sectoral transactions, allowing both direct and indirect environmental pressures (resource use or pollution) for any given consumption pattern to be estimated. This is based on the premise that all monetary flows in the supply chain of a product or service are correlated with the use of resources. Common applications of EIO in the literature include carbon emissions (Druckman & Jackson, 2008; Druckman & Jackson, 2009; Druckman & Jackson, 2010; Minx et al., 2009; Munksgaard et al., 2005; Weber & Matthews, 2008), ecological footprint considerations (Turner, et al. 2007; Wiedmann et al. 2006) and water use/water footprinting (I. Cazcarro, Duarte, & Sánchez-Chóliz, 2012; Duarte, Sanchez-Choliz, & Bielsa, 2002; Wang, Xiao, & Lu, 2009; Zhang et al. 2011; Zhao et al. & Qin, 2010). Tourism-related EIO studies (Collins, Munday, & Roberts, 2012; Jones & Munday, 2007; Lundie et al., 2007; Munday, Turner, & Jones, 2013) are also prominent in the literature. The model setup used in this study is akin to Munday et al. (2013).

The generalised EIO approach involves the calculation of direct impact coefficients (denoted by the vector w_i for water use in this case). This is a vector of resource use per unit of currency of output for each sector within the IO framework, calculated as:

$$w_i = \frac{e_i}{x_i} \quad \textbf{(4)}$$

where e_i is a vector of water use by each economic sector or commodity and x_i is the previously defined vector of total sector output. The generalised expression for calculating the total water use for any given final demand vector is given by:

$$W_T = w_i(I - A)^{-1}y + W_d \quad \textbf{(5)}$$

where W_T stands for total water use, and W_d corresponds to direct onsite water use (in the case of tourism, this refers to water use at hotels or other accommodation) which needs to be added separately since it cannot be included in the IO model. Although EIO is an approach that belongs to the family of life cycle assessment (LCA) methodologies, unlike conventional process-based LCA, it does not require micro-scaled production details and also captures entire supply chains (Murray, Wood, & Lenzen, 2010). Through the addition of imports into the IOT (see m_1 and m_2 in Table 1), EIO can also distinguish between water that originates from domestic sources and that which is imported from abroad.

As shown in Fig.2, the study uses three main kinds of data to perform EIO: (a) water use data supplied by the Cyprus Water Development Department (WDD), (b) economic data in the form of an IOT for Cyprus along with Tourism Satellite Accounts (TSAs) provided by CyStat, and (c) tourism expenditure data which originated from the survey data previously used in Stage 1, also supplied by Cystat. The data are for the year 2007, which corresponds to the latest edition of the Cyprus TSAs. Even though the 2007 data is slightly dated now, this ensures that all data are from the same year. Below is a brief description of the datasets.

(a) Water use data

The WDD (Cyprus WDD, 2011) and the Cyprus Statistical Abstract (CYSTAT, 2011a) provide the most reliable information on annual water withdrawals and estimated water demand for different sectors of the economy for any given year. This provides the vector *e* which then allows the calculation of *w*, as seen in equation (4). Furthermore, the WDD provides information on domestic water use, taken as W_d in equation (5), for households and tourists, respectively. The figures used in this study are 217 litres per capita per day for the local population (l/c/d) and 450 l/c/d for the average tourist (with adjustments made across different tourist groups in relation to accommodation types).

(b) Economic data

As CyStat does not currently release IOTs, the study uses IOTs for Cyprus from the World Input-Output Database (WIOD). Funded by the European Commission's 7th Framework Programme (EC, 2012) , the WIOD was developed in order to help in the analysis of the impacts of globalisation on trade patterns, environmental pressures and socio-economic development (Timmer et al., 2012). THE WIOD IOTs are used to estimate $(I - A)^{-1}$, the 'Leontief inverse' matrix, as shown in equation (5). In addition, TSAs were obtained from CyStat. TSAs are satellite accounts of the core national accounts compiled from visitor expenditure data, industry data, and supply and use relationships in the System of National Accounts (Dwyer, Forsyth, & Dwyer, 2010). They essentially provide an estimate of tourism-specific expenditure, thus complementing information on inter-sectoral transactions contained in the IOTs.

(c) Tourism expenditure data

Passenger survey data that includes expenditure is typically collected through exit surveys in which tourists are asked to provide an estimate of total and detailed expenditure during their visit (Wilton & Nickerson, 2006). The expenditure data used in this study were obtained from exit surveys administered through questionnaires at the island's two major airports during 2007 (CYSTAT, 2011b). The data is used in conjunction with TSAs in order to estimate final demand from tourism, which corresponds to y in equation (5).

Stage 2 involved considerable pre-processing and aggregation or disaggregation of data in order to ensure that all data were in the same sectoral classification, as required in order to perform EIO.

Stage 3 (Comparisons between tourist groups)

Stage 3 involved the estimation of total water use by tourism in Cyprus, subsequently converted into per capita averages, which then allows a comparison to that of residents. The comparison proceeded by producing final demand vectors for the major nationalities of tourist on the island, as well as the clusters belonging to the UK country market. The objective of this stage was to produce a wealth of comparison data that allows an understanding of water use differences and subsequently water productivity and trade-offs between different tourist groups.

4. Results and analysis

Total water use

Fig. 3 displays total daily water use for the main country markets in comparison to the average tourist and the average resident (households). The figure also shows what percentage of the water use is direct or indirect and further divides supply-chain water use into domestic water and imported water, thus accounting for trade in food and other commodities.

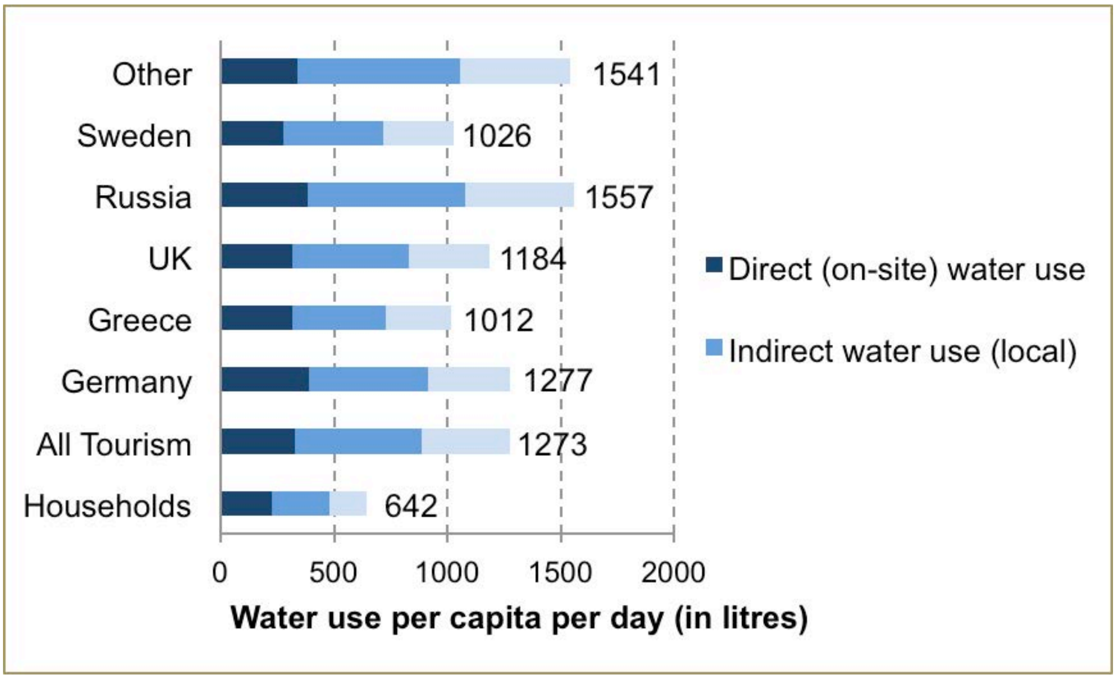

Figure 3. Daily direct and indirect water for the main country markets, the average tourist and households.

The results (Fig. 3) show a considerable range in daily total water use between tourists and households, with the average tourist using almost twice as much water (1273 l) as the average Cypriot (642 l), with some tourists groups (Russia and Other) using considerably more. This supports the findings from previous studies which show that tourists tend to use significantly more water than residents (Essex, Kent, & Newnham, 2004); (Gössling, 2005); (Emmanuel & Spence, 2009). In this instance, the ratio of direct to indirect water does not appear to vary significantly between different nationalities, which suggests that the average spending behaviour within large tourist groups of the same nationality is fairly homogeneous.

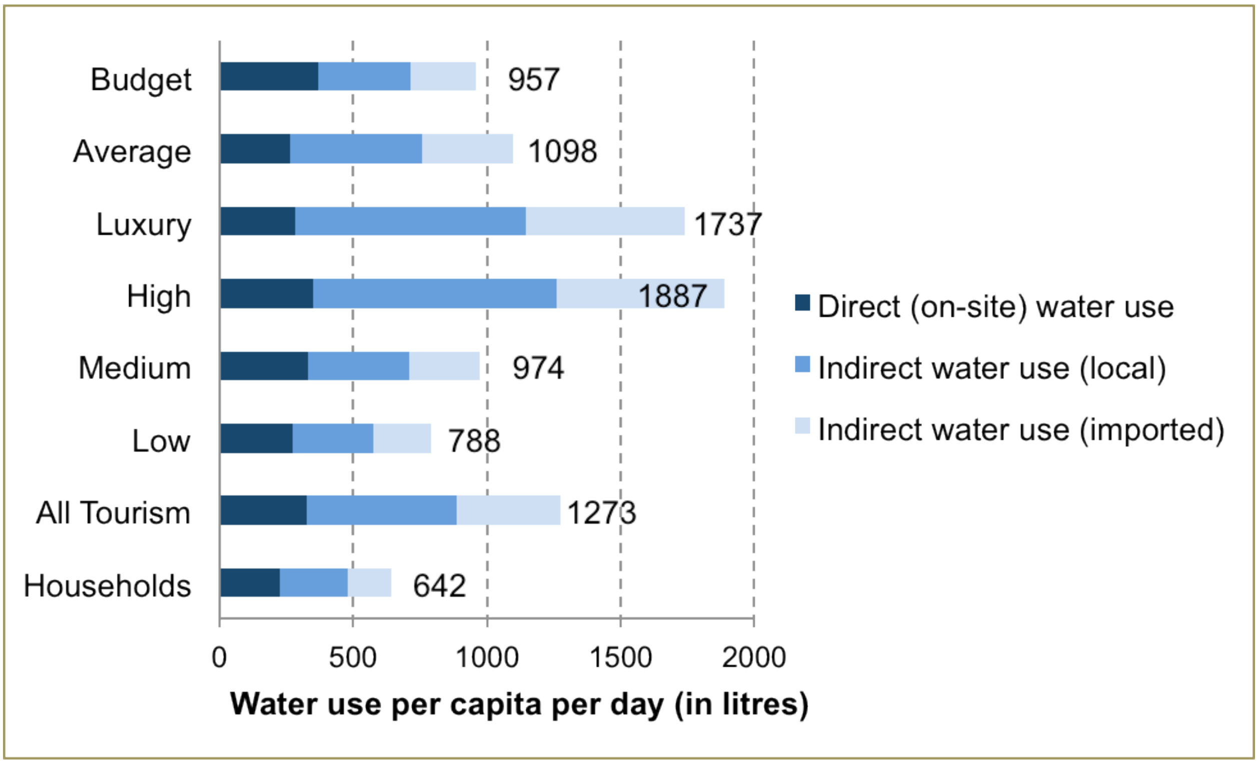

Figure 4. Daily direct and indirect water for different segments of the UK market.

Fig. 4 shows that, within the UK tourism segment, there is considerably more range in daily per capita water use than between the different country segments. This highlights the argument made elsewhere (Hadjikakou et al. in press) that there is actually considerable heterogeneity within different country segments that has to be explored further using statistical techniques. Again, it appears that those segments that spend the most money ('luxury' and 'high') are the ones associated with the highest overall water use, with both of these segments consuming around three times as much water as an average Cypriot. Fig. 5 shows that there is indeed a strong linear correlation (with an R^2 value of 0.95) between expenditure and water use.

Nevertheless, the percentages of direct and indirect (local or imported) in Fig.4 show considerably more variation than in Fig. 3. A comparison between the two extremes within the UK market exemplifies this observation very well. In the 'high-spending' segment, 81% of total water use comes from the supply chain (48% of which is local and 33% of which is imported), with only 19% of the total water use being directly used on-site. In contrast, in the 'budget' segment, only 61% of total water use comes from the supply chain (36% of which is local and 25% of which is imported), with 38% of the total water use taking place on-site. Therefore, even though on-site water use in absolute terms does not differ widely between the two segments, overall water use is almost around double in the 'high-spending' segment, owing largely to higher spending to buy food and other goods which require significant inputs of water in their production.

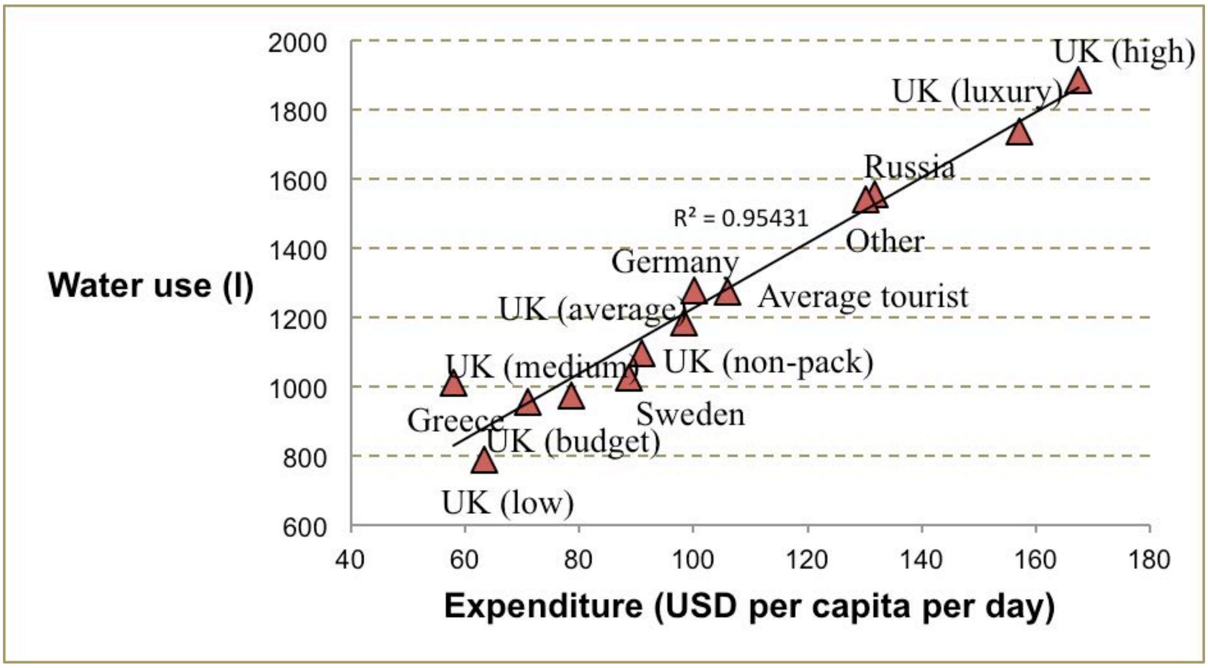

Figure 5. Linear correlation between expenditure and water use.

The above figures already point to potentially important trade-offs or synergies that should be taken into account in water demand assessments of the tourism sector. For the more budget end of the market, it appears that on-site water use can represent almost 40% of the total water use associated with a tourist's consumption activities. This implies that ensuring water-efficient accommodation facilities becomes an important priority for budget hotels and other accommodation, as it may ensure higher water productivity for the lower-spending tourist segments. On the other hand, in the higher-spending end of the market, indirect water use typically accounts for around 80% of total water use, emphasising the need to consider where agricultural products used in hotels and restaurants originate from and how much water was required to produce them. Even though this issue is important for all types of tourist, it is particularly so for the higher-spending segments, who are typically interested in consuming local delicacies and generally consume more food products.

Water productivity

Fig. 6 considers water productivity, using a simple indicator of water use divided by value added (VA), in an attempt to relate water use impacts to economic benefits. According to the overall results, an average tourist uses 10.6 litres for every USD VA contributed. This is significantly less than the average Cypriot resident that requires 17 litres in order to generate one USD of VA. This appears to suggest that, even though tourists use significantly more water than local residents, they do contribute considerably more to the economy. It therefore becomes more important to explore the range of values for different tourist types. Once again, taking two extremes as an example, the 'budget' segment requires 12.1 litres (14% more than the average tourist) for every USD VA generated whereas the 'luxury' segment requires only 9.7 litres (8% less than the average tourist) for every USD VA. It is evident that the higher-spending tourism segments tend to compensate for their higher water use by generating more VA and hence contributing more to GDP. It should be noted, however, that VA is only one indicator of economic contribution: it is likely that other indicators of economic contribution such as employee numbers or labour compensation may result in a different ranking of the segments (Dwyer & Forsyth, 2008). For this reason, the results presented here should only be considered as one of many possible measures of water productivity indicators.

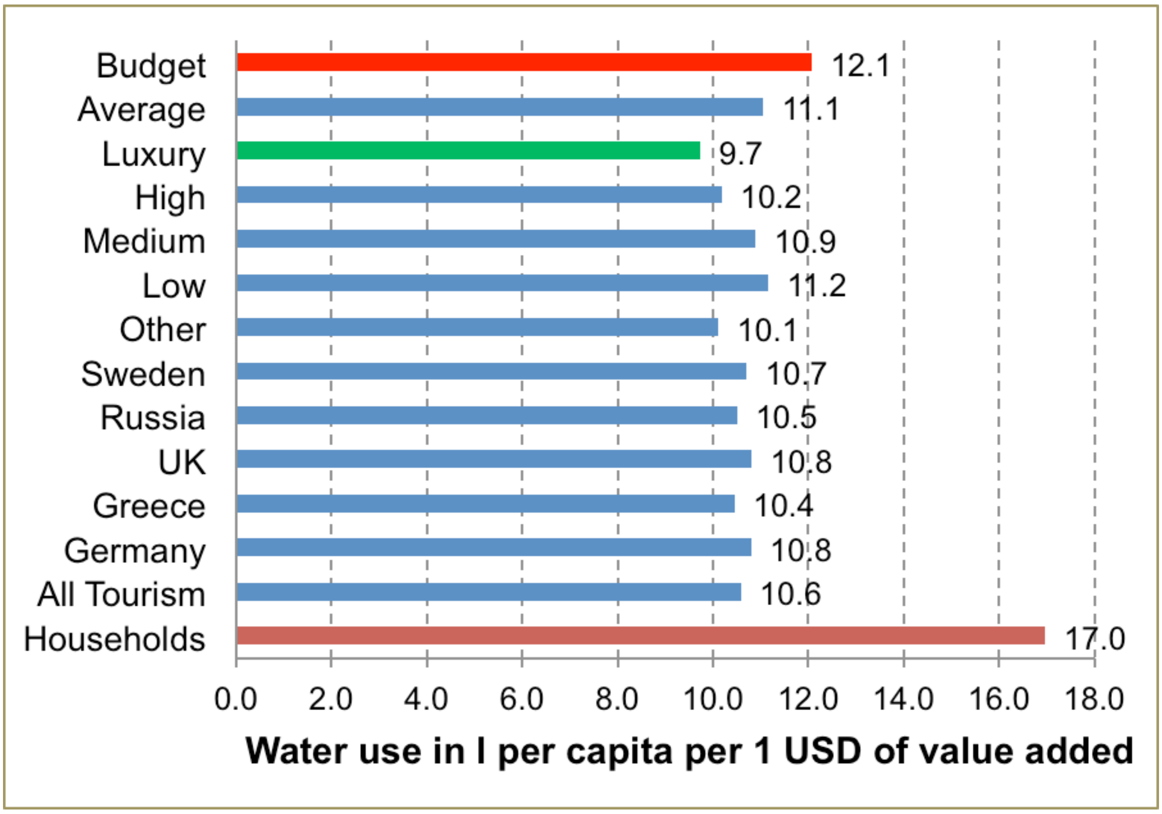

Figure 6. Water productivity shown for all tourist segments considered in the study.

5. Discussion and conclusions

Implications and limitations

The results suggest that indirect water use dominates over direct water use for all kinds of tourism consumption. Expenditure on food is the category that accounts for most of the water use associated with each tourist segment. This suggests that whereas traditionally tourism and agriculture are seen as competing water users (Holden, 2008; Iglesias et al. 2007), they may in fact be correlated in the sense that more tourism spending also results in more food production and hence more agricultural water use.

Even though reference of this phenomenon, known as a 'water demand multiplier effect', can be found in previous literature (Emmanuel & Spence, 2009), it is only in the past few years that researchers are beginning to explore the water use associated with the tourism supply chain (Cazcarro, Hoekstra, & Sánchez-Chóliz, 2014; Gössling et al., 2012; Hadjikakou et al., 2013). The results of the present study reinforce the need for more rigorous quantification of the indirect water use component of tourism consumption, as well as for comparisons between different tourist types. One of the key implications is that there is substantial variation in water use needs between different tourist types. Whereas the benefits of saving water used directly in hotels and accommodation are well understood (Bohdanowicz & Martinac, 2007; Deng & Burnett, 2002) and relatively straightforward to address, indirect water use is likely to prove a much more complex issue.

It is important to acknowledge that the approach outlined in this paper is only a brief demonstration of the potential uses of EIO for establishing water use needs for different tourism types. The approach outlined here requires further refinement in order to provide meaningful management advice and policy guidelines. Firstly, there is need to use more disaggregated data (IOTs, tourism expenditure and water use) in order to explore the role of different dietary preferences. As indirect water use is clearly associated with food consumption, and especially animal products which have considerably higher water footprints (Hoekstra & Mekonnen, 2012; Vanham, Mekonnen, & Hoekstra, 2013), it is imperative that the analysis is carried out at a level of disaggregation that allows capturing the impact of different food choices. This could then allow more specific recommendations to be drawn for hotel buffets or restaurant menus in order to maximise water productivity for different kinds of tourist consumption. A second research priority is to add a seasonal component to the model, which can provide information on how direct and indirect water is used throughout the year by different tourist types, and the associated water demand pressures which arise.

Another important research avenue is to obtain a more qualitative understanding of tourist behaviour. Through the use of in-depth surveys, working closely with tourists and hotel and restaurant managers, research needs to explore why different tourist types have different preferences – and what are the factors that tend to promote consumption patterns associated with higher water use intensity. Ultimately, studies will also need to be conducted in order to test the impact of different water-saving measures as well as their likely effects on tourist satisfaction. Ensuring adequate revenues, high tourist satisfaction and sustainable water use is a highly challenging proposition, but the methodological framework described here has the potential to contribute towards achieving this.

Concluding remarks

For regions already suffering from some form of water scarcity, the additional consumption of water from tourism development can lead to severe water stress.

However, the extent of this stress is rarely apparent from official water use statistics, because they generally only consider direct water use in tourist accommodation. The use of LCA-type methodologies, such as EIO, ensures that impacts throughout the supply chain of tourism are captured, otherwise the picture remains incomplete. Maximising the economic impact of tourism is certainly desirable, but this must not be pursued at the expense of environmental resources. The present research has used the island of Cyprus as a case study – however, the proposed framework is potentially relevant for any tourism destination where water is scarce, such as many islands and most countries of the Mediterranean. It is envisaged that further data collection and modelling refinements should allow a multi-indicator approach that can handle water alongside other environmental pressures such as carbon emissions, land use and threats to biodiversity. This would provide a more complete appreciation of trade-offs and synergies between different kinds of consumption, and help to maximise policy interventions.

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