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Hotel water consumption at a seasonal mass tourist destination. The case of the island of Mallorca

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A B S T R A C T

While it is true that tourism is one of the main driving forces behind economic growth in several world regions, it is also true that tourism can have serious negative environmental impacts, especially with regard to water resources. The tourist water demand can generate big problems of sustainability, mainly in those regions where water is scarce, as occurs in most coastal and small island destinations where a large part of world tourism is concentrated. Given the shortage of literature on the subject, further research into the tourist water demand is required, with particular attention to the hotel sector, since hotels are the most popular option for tourists, displaying higher levels of water consumption. The main purpose of this study is to develop a model to analyse hotel water consumption at a mature sun and sand destination with a strong seasonal pattern and scarcity of water; characteristics shared by some of the world's main tourist destinations. Our model includes a set of different hotel variables associated with physical, seasonal and management-related factors and it improves on the capacity to explain water consumption at such destinations. Following a hierarchical regression methodology, the model is empirically tested through a survey distributed to managers of a representative sample of hotels on the island of Mallorca. From the obtained results, interesting recommendations can be made for both hotel managers and policy makers. Among these, it should be highlighted that the strategic move contemplated by many mature destinations towards a higher quality, low-season model could have significant negative effects in terms of the sustainability of water resources. Our results also conclude that managerial decisions, like the system of accommodation that is offered (i.e. the proliferation of the "all-inclusive" formula, both at mature and new destinations), could give rise to the same negative effect. Development of water saving initiatives (usually introduced in response to demand-based factors), also reveals significant effects over water consumption. Finally, other key factor in explaining hotel water consumption is the management system under which the hotel is run.

1. Introduction

Tourism is one of the main driving forces behind economic growth in several countries and world regions (Capo Parrilla et al., 2007; Hyun Jeong et al., 2006; Neves-Sequeira and Campos, 2005). Some of the world's leading economies owe their high levels of income to the tourist industry while other less developed countries rely on this sector to achieve a higher level of economic development. While it is true that the economic benefits of tourism, in terms of income and employment, are very high, probably due to the multiplier effects on the whole economy (Fletcher and Archer, 1991; Payeras and Sastre, 1994), it is also true that tourism can generate several negative impacts, that usually concludes in the emergence of negative attitudes among the resident population (Bujosa and Rosselló, 2007; Kousis, 2000; Kuvan and Akan, 2005). As a consequence, in recent decades there has been growing recognition of the need to achieve long-term sustainable tourism development, and public institutions are being forced to develop initiatives that will reconcile tourism growth with the sustainable management of environmental resources (i.e., Ecologic, 2007; Hamele and Eckardt, 2006; WTO, 2002a, 2002b; 2002c; WTO, 2004; WTO, 2005). As noted by the United Nations Environment Programme (UNEP, 2009), like any production sector, tourism has negative impacts and positive effects for the environment, society and the economy at local, national and global levels. In the case of environmental impacts, although the beneficial effects tourism can

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have by contributing to environment protection and conservation, most literature and several international organizations alert us to the possible negative impacts of tourism activity (Briassoulis, 2002; Davies and Cahill, 2000; Gunn, 1973; Healy, 1994; Huybers and Bennett, 2003; Kousis, 2000; Sasidharan et al., 2002; Tisdell, 2001).

Among the different environmental impacts of tourism, the effects on water resources are one of the most relevant impacts. As we discuss below, the tourist water demand can generate serious problems of overexploitation or depletion in places where water resources are in scarce, as occurs at most coastal and small island destinations (Ecologic, 2007; Essex et al., 2004; García and Servera, 2003; Gikas and Tchobanoglous, 2009b; Gössling, 2001; Kent et al., 2002; Pigram, 2001; Rico-Amoros et al., 2009; UNEP, 2009). These destinations are normally characterized by warm weather, cyclical droughts and a limited number of rainy days, especially during the tourism high season.

While there is extensive literature on water demands in other uses (public consumption, irrigation, and industry), this is not the case with the tourist consumption. In the little literature that can be found in this field, several calls are made for further research into the tourist water demand, particularly analyses of the factors that influence different uses of water by this sector (Ecologic, 2007; Lehmann, 2009; Gössling, 2001), especially at tourist destinations with water supply problems, such as arid and coastal destinations.

Our paper contributes towards finding new evidence of the factors that influence hotel water consumption at tourist destinations with a strong emphasis on traditional sun and sand holidays, and marked seasonal pattern (characteristics shared by most of the world's top tourist destinations). In the limited literature on the subject, a set of variables is proposed for determining hotel water consumption tied in with hotels' physical characteristics (i.e. the hotel size, existence of swimming pools, existence of golf courses) and with occupancy factors (i.e. the number of guests and overnight stays) (Bohdanowicz and Martinac, 2007; Deng and Burnett, 2002; Gopalakrishnan and Cox, 2003; Gössling, 2001).

Our model incorporates a set of variables that improves on the explanatory capacity of hotel water consumption at the said destinations. First, we believe that the seasonal component requires the consideration of specific factors not considered in previous literature (i.e. the number of months that the hotel is open) which might also affect water consumption. Taking into account that seasonality is a characteristic shared by several of the world's leading tourist destinations (i.e., Greek Islands, French coast, etc), and that major efforts are being made by local governments to reduce it, an analysis of its potential effects on water consumption is fundamental. Secondly, we also consider that the hotel management system might have a significant impact on hotel water consumption. In our opinion, key management issues, such as the strategy followed by hotels, the system of accommodation on offer, the development of water saving initiatives (usually introduced in response to demand-based reasons), and chain affiliation, might all play a relevant role in explaining hotel water consumption.

This paper is structured as follows. First, we outline the complex relationship between tourism and water at coastal destinations. In Section 3, we analyse and describe the hydrological situation of the Balearic Islands and their tourism model, with particular reference to the island of Mallorca. Section 4 presents the main body of our research, that is, it specifies a hotel water consumption function and the methodology used to test our research hypothesis. In Section 5 we describe the prime characteristics of the sample, while Section 6 presents and interprets the main results. Finally, we outline the main conclusions of the study, addressing several recommendations both for policy makers and hotel managers.

2. Water resources and tourism in coastal zones

Several studies demonstrate that the viability and sustainability of any tourist destination is ultimately dependent upon an adequate water supply (both in quantity and quality) and constitutes a determining factor in the tourism lifecycle model (Essex et al., 2004; Kent et al., 2002; Rico-Amoros et al., 2009 [1]). Whatever the complexity of quantifying water consumption by the tourist sector (water consumed by tourists is accounted for and incorporated in urban consumption), several studies quantify per capita tourist water consumption between two and three times the local water demand in developed countries (Garcia and Servera, 2003; UNEP, 2009; WTO, 2004), and up to 15 times in developing countries (Gössling, 2001). In the case of Spain, for example, tourist water consumption is estimated at around 440 L per day, more than double the average local demand, due to the fact that tourists usually consume more water when they are on holiday than when they are at home (UNEP, 2009). Additionally, we have to take into account the problem of seasonality, which exacerbates this problem. For example, in the Balearic Islands in July 1999 (a peak tourist month), water consumption by the tourist sector represented 20% of one year's total consumption by the local population (Ecologic, 2007).

From a review of literature on water consumption, significant differences can be observed depending on the type of lodging (hotels of different categories, campsites, holiday lets, bed & breakfast guesthouses, resort hotels etc), and tourist activities during the stay (yachting, golf, swimming etc) (Ecologic, 2007). Hotels and holiday houses consume far more water (394 L per overnight stay – hereinafter l/os), than campsites (174 l/os), and usually this consumption is directly related to the category. For example, according to Hamele and Eckardt (2006), an analysis of 349 European accommodation centres showed that five-star hotels are the ones that consume most water (594 l/os), compared with the average hotel consumption figure. Hotel facilities were also observed to play a relevant role. Thus, the presence of swimming pools pushes up consumption by 60 l/os, while the existence of café or bar facilities leads to a 35 l/os rise (Hamele and Eckardt, 2006). From these figures, we can deduce that the average consumption of a hotel with a swimming pool and bar would be situated at around 489 l/os. These results are similar to those obtained in Plan Bleu (2004), which estimates average water consumption at luxury hotels in the Mediterranean as representing between 500 and 800 L per day per tourist, and to others obtained in other worldwide regions. The study conducted by the International Hotels Environment Initiative (IHEI, 1996), observes an average consumption level range between 666 and 977 l/os. In this same line, we have the results observed by Chan et al. (2009) in a sample of hotels in Hong Kong. The study observes a significant reduction in consumption between the periods 1994–1996 and 2001–2002 (from 572.5 l/os up to 452 l/os), probably driven by the introduction of water-saving technologies and a greater water-saving awareness among staff and guests.

These problems are more serious when coastal tourist destinations[2] have limited water resources, usually giving rise to conflicts in different uses of water, like traditional agricultural uses versus

[1] Rico-Amoros et al. (2009) notes that international tour operators require adequate water supplies, both in terms of quantity and quality, through compliance with strict standards. If a tourist destination fails to live up to these standards, it may no longer be offered by the tour operator.

[2] For example, the west of the United States, the Mediterranean area and Australia.

urban ones.[3] This is accentuated when the seasonality of tourism and the agricultural sector coincide in increasing the demand during the dry season.[4] The central problem that most of these destinations come to face is one of economic scarcity, generated socially. This, in turn, can lead to the deterioration of water supplies,[5] together with greater social conflict when other sectors of the population become worse off due to water prices and the resource's allocation and quality standards.[6]

The geological features of many coastal zones make underground water one of the main natural sources of raw water. In this context, the risk of overexploitation and its consequences appears, like groundwater salinization, land subsidence, lowering of the groundwater table and pollution. However, technological advances in hydraulics can reduce pressures on this water source through increased use of non-conventional water resources. Gikas and Angelakis (2009) identifies some measures such as using recycled water from wastewater to recharge groundwater or to irrigate crops and gardens, rainwater catchment excess or seawater desalination. Furthermore, the tourism model at coastal destinations influences the quality of water resources (including both continental and coastal water bodies) due to pollution from sewage, groundwater salinization, water pollution from pesticides and fertilizers used to maintain golf courses, lawns and gardens, and the degradation of water ecosystems as a result of water tourism activities (i.e. anchoring, snorkelling, yachting etc).

Thus, management of water resources at coastal tourist destinations has become a difficult but crucial task to ensure the long-term viability and sustainability of any tourist industry.[7] Traditional water policies have focused mainly on increasing water supplies in order to meet increasing demands, with big social, economic and environmental costs. In contrast, new trends in water management are moving towards an efficient system of management based on demand-led policies, the conservation of water as a resource and the integrated water resources management. Efforts should be directed towards water saving programs, pricing policies, water markets, water recycling and re-use and the more efficient use and allocation of water. The main objective of many international water management institutions (the OCDE, World Bank, European Union etc.) is the coordination of water management policies in order to find an adequate balance between ecological targets and the provision of water services for consumption and production activities. In this sense, Gikas and Angelakis (2009) indicate the need (especially in insular water-short areas), to develop integrated water resources management by combining the management of water demand and the exploitation of non-conventional water resources. A good example is the use of reclaimed water from wastewater, in conjunction with satellite and decentralized wastewater management (Gikas and Tchobanoglous, 2009a).

These new policies mostly focus on residential, industrial and agricultural uses, in most cases assimilating tourism-related water uses into residential ones. Methodological developments in tourism-related water management lag behind research into water management field. As Gössling (2001) noted, in scientific literature there are few studies that assess the amount of freshwater consumed by the tourist sector. This, in conjunction with the high level of tourism activity in some areas (i.e., Mallorca Island), only serves to emphasize the need (i.e., for policy makers) to develop models aimed at explaining and understanding patterns in water consumption by the tourist sector.

3. A case study in the Balearic Islands: Mallorca Island

The Balearic Islands form an archipelago in the western Mediterranean Sea, off the east coast of the Iberian Peninsula. The archipelago is composed of four main islands (Mallorca, Minorca, Ibiza and Formentera), as well as a number of practically uninhabited smaller islands. The archipelago covers a total area of about 5000 km^2, with a resident population (in 2009) of 1.1 million people. The following sections briefly describe the water situation in the Balearic Islands and the main features of the local tourist industry, with particular attention to Mallorca's hotel sector. The island of Mallorca is not only the archipelago's largest (3600 km^2), and the most heavily populated island (78.7% of the archipelago's total population), but it also receives the most tourism, accounting for 75.3% of all tourists and 70.2% of all accommodation rooms in Balearic Islands. As a result, Mallorca has the highest water consumption level (82.5% of Balearic's total water use – see Table 1).

3.1. Water resources

The Balearic Islands have a typically Mediterranean climate, with mild winters and hot dry summers. This weather leads to irregular rainwater supplies that vary considerably throughout the year. The geology and topography are also responsible for a lack of permanent rivers and any other relevant source of surface water (GIB, 2008; IGME and GIB, 2009; Tirado, 2003). Under these conditions, as shown in Table 1, underground water is the main natural source of raw water (80% of the total water supply), and reservoirs represent only a small fraction (2.6% of the total water supply). However, the availability of underground water is conditioned by the highly irregular rainfall, and during dry hydrological years reserves may fall to 30% or 50% in relation to average years. A last important reason for water stress on the Balearic economy is the time difference between the availability of natural water supplies, with 60% of all rainfall concentrated between October and January and less than 10% during the summer months when the demand peaks.

For obvious reasons, physical scarcity is one of the main potential sources of conflict among water uses. In the case of the Balearic Islands, this conflict mainly involves the tourism and agricultural sectors. While the former represents around 48% of the total GDP and consumes about 12% of total water consumption, the agricultural sector represents just 1.2% of the total GDP, but accounts for the 41% of the total water consumption[8] (CRE, 2009b; GIB, 2006; GIB, 2007).

Until the late '90s, solutions by the local authorities to deal with conflicts generated by water scarcity usually consisted of initiatives to increase water supplies, leading to the well-documented overexploitation and salinization of groundwater resources[9] (GIB, 2008; IGME and GIB, 2009; Plan Bleu, 2004; Tirado, 2003). Furthermore, these solutions only partly mitigated the problem and, in periods of severe drought, additional measures were required, including

[3] For example, negative social reactions on the islands of Hawaii to the development and expansion of golf courses and resorts (Pigram, 2001).

[4] As in Mediterranean climate regions, Plan Bleu (2004).

[5] Some interesting examples of the situation of water resources at island tourist destinations like the Balearic Islands, Malta and Sardinia etc. can be found in Sa Nostra (2001).

[6] See Tirado et al. (2006) for a specific case study of the Balearic Islands.

[7] It is particularly important in small developing islands that consider tourism as an opportunity to achieve greater economic development (Pigram, 2001).

[8] As noted in Plan Bleu (2004), between 1980 and 1995 the demand for agricultural water in the Balearic Islands decreased by 22%, while the tourism demand rose by 156%.

[9] Given the saltiness of water supplies in the Bay of Palma (that represents about 50% of the Balearic drinking water demand), in 1994 it was necessary to build a desalination plant to treat brackish water from aquifers.

Table 1
Raw water use and water sources per sector and island (Hm^3/year).[a]

		Mallorca	Minorca	Ibiza	Formentera	Balearic Islands	Consumption Share(%)
Public Consumption	Underground	79.3	12.9	7.9	0	100.1	
	Water Reservoirs	7.2	0	0	0	7.2	
	Desalinization	20.2	0	4.7	0.5	25.4	
	Total	106.7	12.9	12.6	0.5	132.7	*47.3*
Agro-Gardening[b]	Underground	19.3	1.8	3.3	0.5	24.9	
	Total	19.3	1.8	3.3	0.5	24.9	*9*
Industry	Underground	0.8	0.1	0.1	0	1	
	Total	0.8	0.1	0.1	0	1	*0.3*
Irrigation and livestock	Underground	81.2	5.6	10.1	0.1	97	
	Wastewater Treated	16.9	1	0.1	0.1	18.1	
	Total	98.1	6.6	10.2	0.2	115.1	*41*
Golf irrigation	Underground	0.3	0	0	0	0.3	
	Wastewater Treated	4.3	0.2	0.2	0	4.7	
	Total	4.6	0.2	0.2	0	5	*1.8*
Others[c]	Wastewater Treated	1.8	0	0	0	1.8	*0.6*
Total		*231.3*	*21.6*	*26.4*	*1.2*	*280.5*	*100*
Island Share (%)		*82.3*	*7.7*	*9.4*	*0.4*	*100*	

[a] Elaborated from data of the draft Hydrological Plan of the Balearic Islands (GIB, 2008).
[b] Public consumption not connected to the public water network.
[c] Public gardens/parks irrigation.

water restrictions in many areas and towns and temporary water imports from the Ebro river basin (on the Spanish mainland). Since 1994, one of the main public authority strategies has consisted in the desalination of sea water that currently accounting for almost 17% of the urban water supply.

Fortunately, since the late '90s we have observed a significant shift towards demand-side policies. These policies include measures aimed at saving and re-using water,[10] improved efficiency in its use and allocation, and conservation, protection and integrated water management policies. Within this context, it is important to highlight significant efforts by the local authorities to adapt the Balearic Islands' water policies to the Water Framework Directive (2000) [11] (hereinafter the WFD).

The WFD aims to achieve good water status for European surface waters[12] and groundwater by 2015, both in terms of environmental quality and availability for human uses. The WFD proposes a new approach, where the resource is conceived as being part of the whole water cycle and is inseparable from the ecosystems that contain it. To achieve these objectives, the WFD recommends the use of economic instruments and pricing schemes that allow to recover the costs of water-related services as well as encouraging a more efficient use of the resource.

To meet the WFD objective, the Balearic Hydrological Plan[13] incorporates a programme of initiatives (see GIB, 2008) aimed at ensuring sustainable water use, and a deadline of 2015 has been set to restore the ecological status of aquatic ecosystems in the Balearic Islands. For example, to restore overexploited aquifers to their former condition and reduce the supplies taken from them, several initiatives have been proposed (some currently in progress), such as artificially replenishing aquifers, the interconnection of water-producing areas, an increase in the use of wastewater,[14] and the construction of four new desalination plants for sea water in different tourist resorts.[15]

3.2. Tourism

The Balearic Islands are characterized by an economic model that is heavily dependent on tourism. Like in other regions, this model brings wealth, business and a high standard of living to the islands (Brau et al., 2003; Hyun Jeong et al., 2006; Lanza and Pigliaru, 2000; Neves-Sequeira and Campos, 2005). During periods when tourism has seen higher growth rates (1980–1995), the Balearic Islands' growth rate has systematically exceeded the Spanish average, and in some years, the European average (CRE, 2009b).

In 2009, the Balearic Islands ranked second (after Catalonia) in the number of tourists received (8.9 million international tourists and 2.629 million domestic tourists), representing a total of 11.6 million tourists (Conselleria de Turisme, 2010) and generating a total of 8748 million euros in tourism receipts (IET, 2010). Visitors to the Balearic Islands mainly stay at hotels (71% of the total), with an average length of stay of 10.8 nights. Within the Balearic Islands, Mallorca constitutes the most important destination, receiving 74.2% of all visitors (8.6 million tourists). The Balearic tourism model – and thus Mallorca's tourism model – is mainly based on mass tourism, in search of the traditional combination of sun and sand (Aguilo et al., 2005). Little data is needed to prove this. As we can observe in Fig. 1, Mallorca receives 76.3% of all tourist arrivals during a 6-month period (from May to October - the high and mid seasons) and 56.4% over a period of four months (from June to September – the high season), while just 23.7% of its arrivals come in the autumn and winter months (January, February, March, April, November, and December – the low-season).

The accommodation sector comprises a total of 2623 accommodation establishments, representing a total of 195,177 rooms and 422,918 beds (Conselleria de Turisme, 2010). These establishments include hotels, rural and agro-tourism centres, apartments, and campsites. Among these, hotels head the ranks, accounting for 75.3% of all rooms (146,892 rooms), and 69% of all beds (292,308

[10] The Balearic Hydrological Plan (GIB, 1999) had already established the need to reduce the amount of water taken from aquifers so as to ensure their sustainability.
[11] Directive, 2000/60/CE of the European Parliament and Council of 23rd October 2000, which is binding upon member states of the European Union.
[12] Which includes inland surface waters, transitional waters and coastal waters.
[13] Pending approval by the National Water Council.
[14] Although treated water is used for 16% of all agricultural water and Balearic legislation requires it to be used to irrigate golf courses, there is scope for further re-use in agriculture and other sectors (the irrigation of parks, cleaning streets and cars etc) because only 30% of all wastewater is currently re-used.
[15] Two in Mallorca, one in Ibiza and one in Minorca. They are expected to become operational in 2010 and provide 15.6 hm^3/year in Mallorca, 3.6 hm^3/year in Minorca and 10.4 hm^3/year in Ibiza.

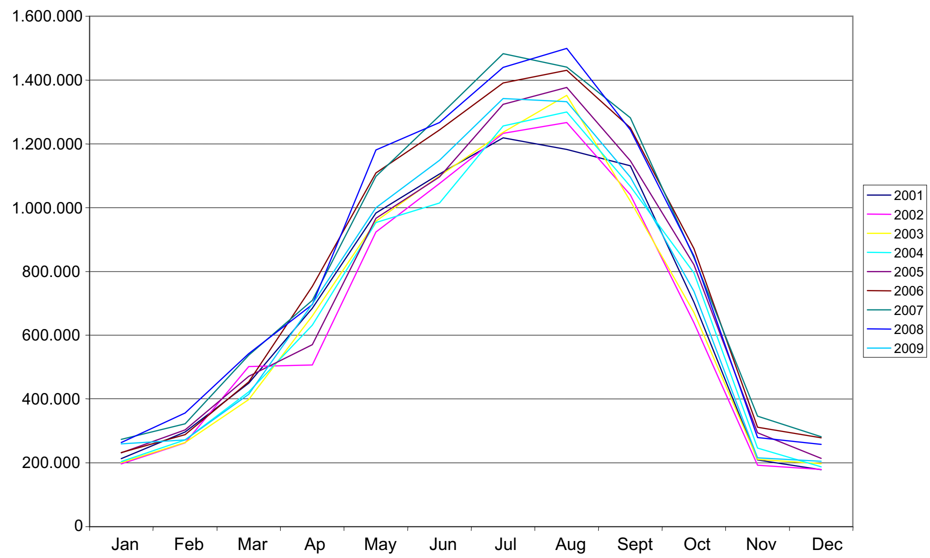

Fig. 1. Tourism arrivals distribution 2001–2009. Elaborated from data of Tourism Annual Reports (Department of Tourism – Balearic Islands Government, 2002 to 2010).

beds). In this case too, Mallorca is the most important island, both in terms of the number of rooms (136,956 rooms, representing 70.2% of the total) and number of beds (285,065 beds, representing 67.4% of the total). Above all, Mallorca leads the field in the case of hotel accommodation, accounting for 81% of all rooms and 78.3% of all beds.

Three-star hotels constitute the most important category (representing 54% of all beds), followed by four-star ones (36.4%), while one (1.6%), two (5.2%) and five-star (2.7%) hotels are minority categories. The average three or four-star hotel have 162 and 171 rooms respectively, usually with two beds per room. This pattern might be due to the structure of the tourism market, specializing mainly in mass tourism in search of a traditional sun and sand holiday that require large-size medium-category hotels. The consequence of the strong seasonal component is a tourist industry with a high level of seasonality, also extending to the whole economy. In recent years, this effect has become more exacerbated and the percentage of accommodation establishments opening during the low-season has fallen significantly. From Table 2 we can observe that the average percentage of hotels opening during the winter months (from November to January) fell from 17.5% (in 2005) to 8.3% (in 2009). Similarly, the percentage of hotels opening during February and March dropped from 29% and 38.2% to 20.6% and 27.1% respectively. As for the remaining months, during the high season (from June to September) the percentages are usually around the 100% mark (Conselleria de Turisme, 2010).

In Table 2 we can observe two interesting facts of Mallorca hotel industry. First, in the summer months hotels are virtually fully-booked, and adapt their opening month (usually between March and May) and closing month (between September and October). Second, while the average number of months that hotel stays open decreases across time, occupancy rates remain practically constant. Thus, we can conclude that hotels adapt the number of months they open to fit in with occupancy forecasts (based on anticipated sales and tour operator agreements) in order to reach a certain break-even occupancy level (that is, an occupancy level at which the business starts making profits and below which it makes a loss). At destinations with a strong seasonal component, when a hotel's occupancy level is expected to be below the break-even point for a prolonged period of time, hotels usually decide to close its doors temporarily, only reopening when occupancy forecasts surpass the break-even point. The reopening of the hotel usually involves a significant amount of sunk costs (i.e. getting gardens and pools ready, hiring staff,[16] cleaning the hotel, starting up the kitchen etc), meaning that once it is open, it will not close again until the end of the tourist season.

4. Methodology

As previously noted, the purpose of this study is to develop a comprehensive model aimed at specifying factors that determine water consumption by hotels at a mature tourist destination with a strong seasonal component which specializes heavily in the traditional sun and sand segment. Thus, total hotel water consumption[17] (measured in m^3) is the dependent variable analysed in this study. To ensure a normal distribution and facilitate interpretations of the estimated coefficients, we use the log transformation of hotel water consumption as the dependent variable.

The methodology used to test the model proposed in our study is the hierarchical regression model, estimated using ordinary least squares (OLS). A hierarchical regression can be defined as a stepwise regression in which, starting out from an initial model, intermediate regression models are defined through the successive addition of variables and groups of variables (typically grouped into categories), ending with a model that includes all the variables defined. This methodology was mainly chosen for two reasons. First, with hierarchical regression models, the robustness of the estimators can be confirmed. Secondly, it is possible to detect how the inclusion of additional explanatory variables improves on the model's predictive power, thus determining the validity of contributions made during the study (Table 3).

As for the form of the consumption function, two different alternatives have been proposed in previous literature, with significant statistical consequences. Some studies (like Bohdanowicz and Martinac, 2007; Deng and Burnett, 2002) regress hotel consumption functions, introducing a constant term,

[16] One of the features of the current Spanish labour market is its lack of flexibility. This has a significant effect on the tourist sector, given its high seasonality.

[17] Although our initial aim was to differentiate between water consumption in different parts of the hotel (the kitchen, laundry, maintenance of green areas, swimming pool etc), it was not possible because most hotels in the sample only possessed aggregate information for their total water consumption. 1.

Table 2
Months open and occupancy rates (2009).

	% Available hotel beds					% Occupancy rates of available hotel beds				
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
January	19.1	18.8	14.5	13.1	8.6	43.2	43.7	46.6	48.2	43.8
February	29	29.3	22.4	22.3	20.6	53.6	51.9	57.7	54.7	51.5
March	38.2	32.9	30	31.6	27.1	63.2	63.1	67.4	63.8	62.9
April	52.1	48.9	64.4	46.5	60.7	58.8	68.3	59.7	62.7	62.7
May	98.1	96.6	96.4	96.9	99.2	62.9	67.1	67.1	69.1	61.8
June	99.6	99.9	99.9	100	100	78.5	85.9	82.9	82.2	79.8
July	99.8	100	100	99.8	100	88.2	90.4	94.1	91.4	85.1
August	99.8	100	100	99.8	100	92.5	95	95.9	93.9	87.8
September	99.6	99.8	99.7	99.6	100	83.8	86.6	85.8	84.8	74.3
October	90.2	91.3	93.1	92.8	88.3	59.6	63.9	65.3	66.3	55.7
November	18.3	12.9	10.2	12	9.3	58.2	62.9	63.1	56.7	49.6
December	15.2	10.1	8.6	7.8	7.2	42.7	45.9	54.1	47.9	40.8

Elaborated from data of Tourism Annual Report (Department of Tourism – Balearic Islands Government, 2010).

obtaining empirical evidence of their significance. In contrast, Gopalakrishnan and Cox (2003) consider that the hotel water consumption function must not incorporate any constant term, arguing that hotel water consumption must take a zero value if the rest of the explanatory variables also take a zero value. Whatever the case, for statistical reasons, the omission of any relevant variable (such as a constant term) can generate biases in coefficient estimations (Greene, 1998). Thus, based on previous empirical evidence, and taking into account relevant statistical reasons, our regression models incorporate a constant term.

Basing on previous literature, this work develop a model that incorporate a set of reformulated and new variables that might play a key role in helping to analyse hotel water consumption. We estimate a total of three models. Model 1 just includes explanatory variables associated with the hotels' physical characteristics, as commonly proposed in previous literature. Based on Model 1, in Model 2 variables associated with the hotels' seasonal characteristics are incorporated, while Model 3 adds to Model 2 by integrating characteristics associated with the management of the hotel.

Variables related to the hotels' physical characteristics. Hotel water consumption can be related to several hotel characteristics. Hotel size is one of the most common variables proposed in literature, since the amount of water that is consumed seems to have a positive relation with the size of the hotel. Empirical findings, using different measures for the size of the hotels (i.e. the total number of beds, hotel floor area), support this hypothesis (Bohdanowicz and Martinac, 2007; Gopalakrishnan and Cox, 2003; Gössling, 2001). To avoid scale effects and facilitate the interpretation of the estimations, the hotel size variable used in this study is the log transformation of the total number of hotel rooms (Orfila-Sintes and Mattsson, 2009).

Other variables related to hotels' physical characteristics are the existence of swimming pools, spa facilities, and golf courses. To analyse their potential effects on hotel water consumption, our models incorporate three dummy variables (the existence of swimming pools, spa facilities, and golf courses) that take a value of 1 if the hotel offers these services and zero otherwise.

4.1. Model 1

$$Ln(\text{Water Consumption})_i = \beta_1 + \beta_2 \cdot Ln(\text{Rooms})_i + \beta_3 \cdot (\text{Pools})_i + \beta_4 \cdot (\text{SPA})_i + \beta_5 \cdot (\text{Golf})_i + \epsilon_i$$

Variables related to the hotels' degree of seasonality. The hotel occupancy rate seems to be a key explanatory variable in hotel water consumption, since the more guests a hotel has staying in its rooms and using its facilities, the higher the water consumption. Previous studies have tended to incorporate this factor by introducing the "guest night sold" variable (that is, the total number of guests received by the hotel), obtaining robust empirical evidence to support this hypothesis (Bohdanowicz and Martinac, 2007; Deng and Burnett, 2002). In our opinion, tourist destinations with a strong seasonal component (like Mallorca) display some peculiarities that must be analysed more accurately. As pointed out previously, when there is a strong seasonal component in tourist arrivals, hotels usually adapt the number of months they open to fit in with expected occupancy rates. Thus, in order to analyse the potential effect of occupancy and seasonality on hotel water consumption, we split the traditional "guest nights sold" into two variables: the average annual occupancy rate, and number of months the hotel opens. In both cases, positive effects on water consumption are expected.

4.2. Model 2

$$\begin{aligned} Ln(\text{Water Consumption})_i = {} & \beta_1 + \beta_2 \cdot Ln(\text{Rooms})_i + \beta_3 \cdot (\text{Pools})_i \\ & + \beta_4 \cdot (\text{SPA})_i + \beta_5 \cdot (\text{Golf})_i \\ & + \beta_6 \cdot (\text{Occupation})_i \\ & + \beta_7 \cdot (\text{Months Open})_i + \epsilon_i \end{aligned}$$

Variables related to the hotel management system. We also introduce a set of variables related to the hotel management system that might, in our opinion, also constitute key factors in explaining hotel water demand behaviour. Firstly, the strategy followed by the hotel could play a key role. Based on Michael E. Porter's classification, we can differentiate two main contrasting strategic approaches: product differentiation and cost reduction. While in the former case hotels try to differentiate their product from those of their rivals (to achieve monopolistic rents and push up their profit margins), the latter try to increase profit margins by reducing the cost of components. In our opinion, the option chosen by the hotel can have a relevant effect on water consumption. Hotels focussing on the differentiation strategy usually introduce new services (i.e. an indoor swimming pool, sauna, jacuzzi etc) and higher quality standards (i.e. higher cleaning standards), leading to higher water consumption. On the other hand, hotels following a cost-reduction strategy will try to reduce water consumption (like any other cost), while also reducing the number of services they offer and hotel quality standards, which will in turn reduce water consumption levels. In order to determine the potential effects of the hotel strategy on water consumption, we introduce a dummy variable that takes a value of 1 if the hotel follows the differentiation strategy and zero if the hotel follows a cost-reduction strategy.

Table 3
Explanatory variables of water hotel consumption.

Factors Explaining Water Consumption		Variables Introduced in the Model	Predicted Sign over Water Consumption
Variables related to hotel physical characteristics			
Hotel size		Ln(Number of Rooms)	Positive
Existence of Swimming pools		Dummy Variable: 1 if hotel present swimming pool	Positive
Existence of SPA		Dummy Variable: 1 if hotel present spa	Positive/No significant
Existence of golf fields		Dummy Variable: 1 if hotel present golf fields	Positive
Variables related to hotel seasonality level			
Number of months of activity		Number of months opened	Positive
Occupation level		Annual Average Occupation Rate	Positive
Variables related to hotel management system			
Strategy		Dummy Variable: 1 if firms follow differentiation strategy, 0 if firms follow cost-reduction strategy	Positive
Types of board		Type of board offered	Positive
Water saving initiatives		Dummy Variable: 1 if hotel develops water saving initiatives	Negative
Hotel chain affiliation	Small chain	Dummy Variable: 1 if hotel belong a small chain (less than 9 hotels)	Positive/Negative
	Medium chain	Dummy Variable: 1 if hotel belong a medium chain (more than 10 and less than 39 hotels)	Positive/Negative
	Big chain	Dummy Variable: 1 if hotel belong a small chain (more than 40 hotels)	Positive/Negative

Unlike other tourism segments (i.e. city tourism, incentive and events tourism, cultural tourism etc.), hotels specializing in the sun and sand segment usually offer different types of board: accommodation only (no meals included), bed and breakfast, half board (breakfast and lunch or dinner), full board (including breakfast, lunch and dinner) and the “all-inclusive” formula (which includes full-board meals and any other meals or drinks at any time). The type of board has a direct effect on the number of meals served by the hotel and time spent by guests in the hotel facilities. In consequence, the types of board offered by a hotel could constitute an important variable in determining hotel water consumption. To analyse this effect, we incorporate the variable “type of board offered” into our regressions, computed according to the percentage that each type of board represents in relation to the hotel’s total accommodation. We then multiply these percentages by a coefficient corrector factor that captures the average number of meals offered under each type of board (zero in the case of accommodation only, one for bed and breakfast, two for half board, three for full board and four for “all-inclusive” modes).

Sustainability is becoming an increasingly important concept for the tourist sector and many hotels develop and introduce innovations and practices in the field of environmental protection (sometimes due to an environmental awareness on the part of hotel owners or often simply imposed by tour operators to satisfy customer demands). One such example is the introduction of water saving initiatives, such as re-using swimming pool water, the recycling of sewage for irrigation purposes, and the installation of sub metres and flow regulators in rooms, kitchen or laundry (see Chan et al. (2009) for an interesting analysis of introduction of water saving measures in Hong Kong hotels). To analyse the efficiency and impact of these practices on hotel water consumption, our proposed consumption function introduces a control dummy variable that takes a value of 1 when the hotel has introduced water saving initiatives and zero otherwise.

Finally, our model also analyses the potential effects of chain affiliation. Economic literature suggests that hotel chain affiliation allows hotels to take more advantage of economies of scale (Ingram and Baum, 1997). Moreover, membership of a chain facilitates information exchanges among hotel managers, thus facilitating information on the (internal) development or (external) adoption of processes or innovations that can lead to efficient use of resources (Orfila-Sintes et al., 2005; Orfila-Sintes and Mattsson, 2009). Thus, it would seem reasonable to argue that belonging to a chain facilitates and increases the likelihood of highly efficient management processes and hotel facilities, resulting in more efficient use of resources like water.

Unlike other tourist destinations, Mallorca has a high number of hotels that belong to a chain (64.3% of the sample) with a low presence of foreign chains. In contrast, during the last two decades, local hotel chains have undergone an important process of expansion and internationalization, mainly at South American and Caribbean tourist destinations. As a result, at present five of the top 100 international hotel chains (by number of rooms) are based in Mallorca (in order of importance: *Sol Melia*, *Barcelo*, *Riu Iberostar*, and *Fiesta Hotels*). However, hotel chains display big differences in size and in their market approach. To analyse whether chain affiliation affects water consumption, we divided our sample into four categories: independent hotels, hotels belonging to small chains (chains with fewer than 9 hotels, all located in Mallorca), medium chains (chains with more than 10 but fewer than 39 hotels, all located in Spain), and large chains (international chains with more than 40 hotels located worldwide). To capture the chain affiliation effect, we introduced 3 dummy variables, depending on whether the hotel belongs to a small, medium or large chain. The reference group is the independent hotel category.

4.3. Model 3

$$Ln(\text{Water Consumption})_i = \beta_1 + \beta_2 \cdot Ln(\text{Rooms})_i + \beta_3 \cdot (\text{Pools})_i + \beta_4 \cdot (\text{SPA})_i + \beta_5 \cdot (\text{Golf})_i + \beta_6 \cdot (\text{Occupation})_i + \beta_7 \cdot (\text{Months Open})_i + \beta_8 \cdot (\text{Strategy})_i + \beta_9 \cdot (\text{Board Offered})_i + \beta_{10} \cdot (\text{Small Chain})_i + \beta_{11} \cdot (\text{Medium Chain})_i + \beta_{12} \cdot (\text{Big Chain})_i \epsilon_i$$

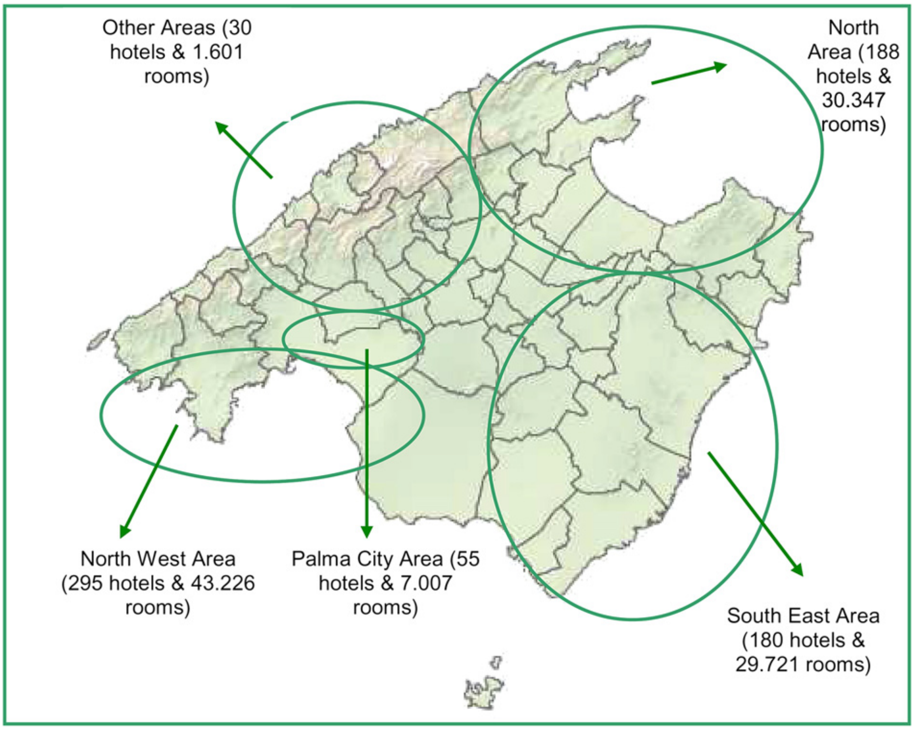

Fig. 2. Mallorca hotel plant geographical areas. Elaborated from the Map of the administrative division of the island of Mallorca (Territory Department of Consell de Mallorca – Balearic Islands Government, 2010).

5. Sample

The sample database was obtained from a survey distributed to a representative sample of 200 hotels in Mallorca. Based on Mallorca's total hotel population (made up of 748 hotels), a sample list was selected, stratified by category and location in order to obtain a representative sample. They were classified by category in accordance with the internationally accepted star system (from 1 to 5 stars) and by location based on local authority tourism criteria, according to which the island is divided into 5 major areas (based on the number of beds). The areas (see their geographical distribution in Fig. 2) comprise the north (including the municipalities of Pollensa, Alcudia, Muro, Santa Margalida, Arta and Capdepera), the south east (including the municipalities of Son Servera, Sant Llorenç, Manacor, Felanitx, Santanyi, Ses Salines, and Campos), the city of Palma area (the municipality of Palma, excluding beach areas), and the north west (including the municipalities of Calvia and Andratx, and Palma beach areas). The rest of the island's hotels (including secondary tourist areas) came under a fifth category called 'other areas'.

The questionnaire was answered directly by the hotel managers during agreed research interviews conducted by professional interviewers. Five hotels were not able to respond the survey (arguing time reasons), and consequently substituted by hotels with the same category and area. Finally 4 surveys present incomplete or wrong data and thus rejected. As we can observe in Table 4, the final sample (composed by 196 hotels) is a representative one under both stratification criteria (location and category), with a confidence level of 97.5%.

Table 5 shows that hotel water consumption ranges from 900 to 99,500 m^3 per year, with a mean value of 24,814. To contrast the values obtained in our survey with those observed in previous studies, we also computed water consumption (in litres) per guest night sold (hereinafter l/gns). These values range from 156 to 2425, with a mean value of 541 l/gns. From a more detailed analysis of the data, we can observe that the average consumption of a three-star hotel is 516 L, while four and five-star ones rise to 548 and 701 l/gns respectively. These results coincide with those observed in several tourist destinations like Jamaica, Thailand, the United States, and Hong Kong (Bohdanowicz and Martinac, 2007; Chan et al., 2009; IHEI, 1996).

Table 4
Population and sample distribution.

	Population	%	Sample	%
Area				
North	188	25.1%	45	23.0%
South-East	180	24.1%	43	21.9%
Palma City	55	7.4%	27	13.8%
North-West	295	39.4%	66	33.7%
Others	30	4.0%	15	7.7%
Total	748	100.0%	196	100.0%
Category				
1Star	38	5.1%	6	3.1%
2Star	72	9.6%	20	10.2%
3Star	374	50.0%	100	51.0%
4Star	237	31.7%	62	31.6%
5Star	27	3.6%	8	4.1%
Total	748	100.0%	196	100.0%

Elaborated from data of Department of Tourism (Balearic Islands Government, 2010).

Table 5
Water consumption in Mallorca Hotels.

	Min.	Max.	Mean	Std. Dev.
Water consumption (m^3)	900	99,500	24,814.4	19,704.3
Log of water consumption	6.8	11.5	9.8	.9
Consumption per guest and night sold (litres)	156.6	2425.3	541.6	362.3

Table 6
Sample descriptive statistics.

Continuous Variables	Min.	Max.	Mean	Std. Dev.
Variables related to hotel physical characteristics				
Number of rooms	6	812	142	123.2
Ln(Number of rooms)	1.8	6.7	4.6	.9
Variables related to hotel seasonal level				
Annual average occupation level	50	100	79.2	9.4
Number of months oppened	4	12	8.2	2.4
Variables related to hotel management system				
Type of board offered	0	4	1.8	.9
Dummy Variables				
	Number of observations takes value 1		%	
Variables related to hotel physical characteristics				
Existence of Swimming pools	167		85.2%	
Existence of SPA	62		31.6%	
Existence of Golf Fields	3		1.5%	
Variables related to hotel management system				
Differentiation Strategy	113		57.6%	
Water saving initiatives	105		53.5%	
Small Chain	61		31.1%	
Medium Chain	44		22.4%	
Big Chain	21		10.7%	

The descriptive statistics for the explanatory variables are shown in Table 6. It is interesting to remark on them at this point. With regard to the hotels' physical characteristics, we can see that most of them (85%) feature swimming pools, while only one third present spa facilities. As for variables related to seasonality, the minimum annual average occupancy rate is 50%, with an average value of 79%, while the number of months the hotels stays open ranges from 4 to 12 months, with an average of 8 months.

Finally, the hotel-management-related variables offer interesting information, such as the fact that 57% of the hotels follow a differentiation strategy while 42% opt for a cost-reduction strategy. Another interesting result is the fact that 53% of the hotels declared that they have introduced water saving initiatives. The type of board offered by the hotels ranges from 0 (hotels with accommodation only) to 4 (hotels that offer the "all-inclusive" formula), with an average value of 1.8 (in the approximate bed and breakfast range). Finally, 64% of the total hotel sample belongs to a chain.

6. Results and discussion

The models defined above were estimated using SPSS 17.0, and the results are outlined in Table 7. From a comparison of the estimated models, we can observe that the inclusion of variables related to seasonal hotel patterns and hotel management factors increases the R^2 from 65.9% to 74.7%. This represents an increase of 8.8 points in the model's explanatory capacity.

As for the diagnosis of multicollinearity, the Variance Inflation Factor (VIF) values indicate that the model's explanatory variables do not display multicollinearity problems. In keeping with previous studies, we observe that the constant term displays a high significance level (at 1%), confirming that its misspecification could generate a significant bias in the estimation of the regressions.

The conclusions drawn from the estimation of Model 1 (which only includes explanatory variables related to the hotels' physical characteristics) are robust, matching conclusions reached in previous literature. The hotel water demand can be seen to be highly dependent on physical characteristics like the hotel size and existence of swimming pools and golf courses (Bohdanowicz and Martinac, 2007; Gopalakrishnan and Cox, 2003). In contrast, spa facilities do not seem to have a significant effect on hotel water consumption, in line with evidence obtained by Bohdanowicz and Martinac (2007).

Table 7
Hierarchical regression results.

Models and variables[a]	Model 1[b]	Model 2[c]	Model 3[d]	FIV[e]
Constant term	6.479***	5.196***	5.627***	
	(.216)	(.577)	(.552)	
Ln(Number of rooms)	.644***	.665***	.602***	2.148
	(.051)	(.050)	(.058)	
Existence swimming pools	.348**	.381**	.345**	1.384
	(.160)	(.155)	(.144)	
Existence of SPA facilities	.011	−.060	−.044	1.248
	(.095)	(.095)	(.090)	
Existence of golf fields	.874***	.837***	.653**	1.155
	(.295)	(.286)	(.273)	
Annual average occupation level	–	.007	.006	1.426
		(.005)	(.005)	
Number of months opened	–	.072***	.051**	1.510
		(.021)	(.020)	
Differentiation strategy	–	–	.197**	1.162
			(.082)	
Type of board offered	–	–	.100*	1.437
			(.053)	
Water saving initiatives	–	–	−.136*	1.044
			(.076)	
Small chain	–	–	−.184*	1.673
			(.103)	
Medium chain	–	–	−.116	1.580
			(.108)	
Big chain	–	–	.344**	1.775
			(.147)	
R^2	.659	.686	.747	
Adj. R^2	.649	.671	.724	
F-test	65.117***	48.345***	31.316***	
Change in Adj. R^2 (respect Model 1)	–	.022	.075	

*significant at 10%.
**significant at 5%.
***significant at 1%.
Standard errors in brackets.
[a] Dependent variable: Log of Water Consumption.
[b] Model 1 only includes variables related to physical characteristics.
[c] Model 2 includes variables related to physical characteristics and to seasonal level.
[d] Model 3 includes variables related to physical, to seasonal level and to management system.
[e] Variance Inflation Factors.

When a specific analysis is made of the estimated coefficients, the highest effect corresponds to the existence of golf courses (which generate an increase of 87% in total hotel water consumption), followed by the effect of the existence of swimming pools (35%). The lowest effect corresponds to the hotel size, where a 1% increase in the total number of rooms generates a 0.6% rise in annual hotel water consumption. Thus, we can conclude that the marginal effect of the number of rooms is practically insignificant compared with the effect of the existence of swimming pools and golf courses. This effect can be due to the atmospheric and weather conditions of Balearic Islands, with a typically Mediterranean climate with hot dry summers that concentrate less than 10% of total annual rainfalls. In this context, the evaporation of pools water, and the evapotranspiration of grass in golf courses is very high, making necessary to refill and irrigate it frequently to keep it in optimal conditions. Furthermore, in the case of swimming pools, hotel water consumption probably also increases as an indirect result of increased use of the showers (for example, in most hotels, the client have to shower before a swim in the pool).

With regard to Model 2 (which includes both physical and seasonal-related variables), the estimated coefficients taken from Model 1 continue to be significant and with the same sign, demonstrating the robustness of our estimations. There is also evidence that seasonal patterns affect hotel water demand. More specifically, we can see that while the occupancy level does not affect total water consumption, the number of months the hotel stays open is significant (at 1%), leading to a 7% increase in total hotel water consumption for each additional month the hotel remains open. A more detailed analysis of the results within the context of the destination can offer a coherent explanation. As seen in Table 2, hotels fit the number of months open depending on the occupancy level that, if it does not exceed a certain level (break-even point, located about 50%), hotel remains closed. Thus, the results of our regressions reveals that the greater the number of months open, greater hotel water consumption, but once the hotel has opened its doors (that is, occupation exceeds the break-even level), the marginal impact of any increase in occupancy level (over the break-even level) is not significant.

Finally, Model 3 incorporates variables related to the hotel management system, obtaining interesting results. First, the results confirm that hotels that follow a differentiation strategy consume 20% more water with respect those hotels that follow a cost-reduction strategy. Probably this is due to the fact that a differentiation strategy requires higher quality standards and a higher number of services and facilities (i.e. in-room jacuzzis, a hotel laundry service, etc), which usually results in higher levels of water consumption. Although this strategy might seem to be reserved for higher category hotels, a more careful analysis of the survey results shows that the differentiation strategy is followed by hotels of all categories but at different levels. More specifically, while all five-star hotels follow a differentiation strategy and 71% of all four-star hotels, this is also the strategy chosen by 51% of all three-star hotels, and 40% and 33% of two and one-star hotels respectively.

These results are particularly important when we consider that some mature destinations (like Mallorca Island) have introduced several measures aimed at changing the prevailing tourism strategy, moving away from the traditional sun and sand mass model to higher-quality models. Hotels directed at the sun and sand market are usually composed of high-rise rather than horizontal low-rise facilities, with a huge number of rooms, and they usually offer a product with a low level of differentiation, instead following a competitive cost strategy. These hotels tend to limit the number of months they stay open to just the high season, resulting in higher occupancy rates. On the other hand, high-quality hotels are usually planned on a horizontal level and they mainly focus on a differentiation strategy, with lower number of rooms, proliferation of golf course and spa facilities, low density of developed land, big gardens and private swimming pools. Usually, these hotels stay open for a higher number of months, with lower occupancy rates than hotels concentrating on the typical sun and sand market.

Thus, from the results of our regressions, this new strategic approach could generate higher levels of water consumption for several reasons. Although empirical evidence reveals that the reduction in the number of rooms, that any move towards a higher-quality hotel requires, probably results in a lower total hotel water consumption, this effect is overcome by the effect of the presence of swimming pools and golf courses. Secondly, since high-quality hotels usually stay open for longer but with lower occupancy rates, we can expect an increase in the effect on water consumption. Finally, since higher category hotels usually adopt a differentiation strategy, a shift towards this strategy by hotels could generate a significant increase in water consumption.

The estimated coefficients for the types of board offered by the hotels confirm significant effects on water consumption. From the estimated values, a one-unit increase in the number of meals included in the type of board offered by the hotel generates a significant increase in annual hotel water consumption of 10%. This coincides with the results observed in some previous empirical studies, (like Bohdanowicz and Martinac, 2007 and Deng and Burnett, 2002) that conclude that the more meals a hotel serves, the higher the water consumption by guests, both directly (drinking water) and indirectly (water use in kitchens for both cooking and washing). Whatever, in our opinion, the high value obtained is also due to the additional idiosyncratic effects of mature sun and sand tourist destinations. At these destinations, the type of board reserved by guests not only affects the number of meals served by the hotel but also the time spent by guests in the hotel rooms and facilities, leading, by extension, to higher water consumption. Additionally, sun and sand destinations are usually characterized by a set of characteristics (i.e. high temperature and humidity level, visits to beaches etc) that encourage guests to use water-intensive hotel facilities (like showers, swimming pools, bars, etc). This result is even more relevant if we take into account the big rise observed in last years in the "all-inclusive" formula, both at mature destinations (18% of sample hotels offering the "all-inclusive" formula, increasing at a rate of 10% per year) and new ones (such as Caribbean areas).

In the case of water saving initiatives, the results highlight their efficacy in reducing hotel water consumption. More specifically, hotels that confirm the introduction of such initiatives reduce their annual average consumption by up to 13.6%. At this point, it is interesting to find out what main determinants compel hotels to introduce these measures. From a more detailed analysis of the survey results, we can see that neither the existence of an Environmental Department, nor recognition of the severity of water regulations, or water costs plays a relevant role. On the other hand, the more importance that is lent to environmental issues in hotel marketing policies (measured from 1 to 7 on a Likert scale), the higher the probability of water saving initiatives being introduced (4.2 vs 3.7). As for the reasons put forward by hotel management to justify the introduction of these initiatives, some of the main ones include attempts to improve the hotel's image (74%), improve the quality of service (46%) and increase customer fidelity (31%). Thus, we can conclude that the main determinants of the introduction of water saving measures are mainly demand-based ones.

With regard to chain affiliation, the results of our regression models conclude that the effect of chain affiliation on water consumption depends on the chain's size. Hotels affiliated to small chains usually have a significantly lower water consumption in relation to non-affiliated hotels (18% lower than independent hotels), confirming our hypothesis that membership of a chain increases the probability of more efficient management processes and hotel facilities being introduced. However, this was not observed in the case of bigger chains. Hotels affiliated to large international chains display a significantly higher level of water consumption (34% higher), while in the case of medium-size chains, a negative but not significant effect was observed. These heterogeneous results can be explained by the fact that incentives to introduce and develop more efficient management processes and hotel facilities mainly depend on their impact on company profit margins. The bigger the chain, the higher the bargaining power with tour operators (who are strongly present at destinations like Mallorca) and suppliers (i.e. for food and beverages etc.) and the bigger the economies of scale (for marketing campaigns etc), leading to higher profit margins. Given the low share of a hotel's total running costs that water costs represent (4% in our sample), we can conclude that incentives to introduce more efficient hotel management processes and facilities will be lower in hotels affiliated to large international chains. Additionally, international hotel chains usually impose a set of standards (i.e. quality standards, concerning cleaning, SPA, in-room jacuzzi, number of services, etc) on affiliated hotels, which might also explain the higher levels of water consumption. In contrast, in the case of hotels belonging to small chains, such incentives will be more predominant.

7. Conclusions

Several conclusions both for policy makers and hotel managers can be drawn from the estimated results of our model. The most relevant is that the strategic move contemplated by many mature destinations (i.e., Mallorca Island) from the traditional low quality and high seasonal sun and sand tourism model, towards a higher quality and low-seasonal model, could have significant negative effects in terms of the sustainability of water resources. Thus, the introduction of measures aimed at changing the prevailing tourism strategy (i.e. tax incentives for hotel upgrades to a high category that reduce the number of rooms, the development of new tourism products with lower seasonality component, etc), despite their positive effects in reducing seasonality and pushing up profit margins, could have significant negative effects on water consumption, and thus, on destination sustainability.

Second, our results also conclude that the proliferation of the "all-inclusive" formula could give rise to the same negative effect over water consumption, both in terms of higher consumption in meals and kitchens, as in a higher use of water-intensive facilities and services.

Third, our study also provides new evidence of the effectiveness of water saving measures in hotels in the line of results observed in other destinations. Additionally, according to our results, the main determinants of the introduction of water saving measures are demand-based ones, like improving the hotel image, improving the quality of service, and increasing customer fidelity.

Finally, the results of our model suggest that chain affiliation plays a significant role in explaining hotel water consumption. We have observed that hotels belonging to small chains usually display significantly lower water consumption levels than independent hotels, while those affiliated to big international ones usually present higher levels.

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