

EXPLANATORY FACTORS OF DOMESTIC WATER CONSUMPTION IN THE COSTA BLANCA (2000-2014)

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1. INTRODUCTION

The province of Alicante is in one of the driest climatic regions of Spain and the European continent. In this territory, water scarcity has generated a strong development of hydraulic infrastructures, transfers, unconventional sources of supply and special agreements of between the agricultural sector and the tourist sector to guarantee urban water demand (RICO *et al.*, 2014). However, urban water supply may be affected by the intensification of extreme events, such as sequences and floods, produced by the climate change (IPCC, 2014). For this, it is necessary to implement water policies for demand management that improve efficiency and promote policies aimed at a more rational use of water resources (DEL MORAL *et al.*, 2014).

These include technical measures such as the installation of household saving devices and the creation of awareness campaigns to promote more sustainable use of water, among many others measures (GIL *et al.*, 2015). But the implementation of demand management measures imposes new information requirements (VILLARÍN, 2016), so that the identification and knowledge of the variables that influence urban water demand is essential to make policies aimed at the reduction of water consumption for urban and tourist uses. This research identifies the variables that best explain the functioning of the domestic demand for water on the coastline of Alicante in the 21st century.

2. INFLUENCING FACTORS IN DOMESTIC WATER CONSUMPTION

In Spain the first studies on the determinants of domestic water consumption focused on the influence of economic variables and on the search for effective tax structures to reduce urban water demand (ARBUÉS *et al.*, 2003; MARTÍNEZ-ESPIÑEIRA y NAUGES 2004). These studies generally show that water behaves as an inelastic good insensitive to price changes, especially for indoor uses that satisfy the basic needs regardless of the price of water (ARBUÉS *et al.*, 2003). However, some studies show that the price of water does influence the consumption of those users who consume higher volumes of water due to the existence of external uses such as irrigation of gardens and the filling of swimming pools (GRIFFIN y CHANG, 1990; DANDY *et al.*, 1997).

A second economic variable that affects water consumption is the income level of households. Studies have shown that water consumption is positively correlated with income level (DANDY *et al.*, 1997; HÖGLUND, 1999; ARBUÉS *et al.*, 2003).

The urban factors have been another group of factors analyzed widely in the Spanish Mediterranean coastline (DOMENE y SAURÍ, 2006; MARCH y SAURÍ, 2010; HOF y SCHMITT, 2011; MOROTE y HERNÁNDEZ, 2014; 2016; MOROTE, 2015; MOROTE *et al.*, 2016a, 2016b). The urban model adopted by a municipality has an important influence on the domestic consumption of water. Areas of high urban density are associated with lower per capita consumption, while low density urban areas tend to have higher levels of consumption due to the greater presence of single family homes with gardens and swimming pools. Thus, urban water consumption depends on the type of housing and the physical characteristics

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associated with it, such as the size, number of bathrooms or the presence or absence of external uses (DOMENE y SAURÍ, 2006; RICO, 2007; RICO *et al.*, 2009; FOX *et al.*, 2009).

In addition to these variables, the impact on domestic water consumption of tourism activity must be considered in the Mediterranean coast. The number of tourists, the type of accommodation in which they are staying and the length of their stay are key factors in understanding the functioning of the demand. In the coast of Alicante, there is a great development of the residential tourism model, characterized by the profusion of secondary houses occupied mainly during the summer months. Most of these houses are single-family dwellings, which entails water consumptions of twice the consumption of the permanent population (RICO, 2007).

Regarding demographic variables, the factor with the greatest incidence on domestic water consumption is the size of the household, understood as the number of people living in it (HÖGLUND, 1999; NAUGES Y THOMAS, 2000). Although domestic demand is higher as the number of members in a household increases, per capita consumption is reduced by the generation of economies of scale in relation to water consumption.

Other relevant factors in domestic water consumption are related to the presence of population in retirement age and foreign population. Some studies have shown that these groups have lower consumption patterns than those of the rest of the population, since they tend to have a low average economic level (NAUGES y REYNAUD, 2001; MARCH *et al.*, 2012; GIL *et al.*, 2015).

3. OBJECTIVES AND METHODOLOGY

The main objective of this research is to identify the factors that can explain the trends and spatial differentiation of domestic water consumption in the municipalities of the Costa Blanca for the period 2000-2014. In this coastal sector, practically 80% of urban consumption is made up of domestic uses, due to the residential tourism nature of most municipalities, so that commercial, industrial or municipal consumption will not be analysed. A second objective will be the analysis of the limitations and problems associated with the choice of this scale and certain statistical data for this study area.

For this analysis, information extracted from a municipal database on urban water consumption in the Spanish Mediterranean coastline has been used, as well as data on various urban-tourist, demographic and economic variables. From the municipal water consumption per capita of the years 2006 and 2014, a descriptive spatial analysis of the variables analysed was carried out.

4. EXPLANATORY FACTORS OF DOMESTIC CONSUMPTION IN THE COSTA BLANCA: CERTAINTIES AND LIMITATIONS

The trend in domestic water consumption on the coastline of the province of Alicante has followed two major stages. Firstly, a stage of increased consumption, which occurs simultaneously with the residential expansion produced on the Mediterranean coast since the late 1990s (MOROTE *et al.*, 2016a). At this stage, there is a strong demographic and urban growth, with a great development of typologies of low and medium density housing, which led to an increase in urban water consumption until 2005 in absolute terms (MOROTE, 2015). In a second stage, for the period 2005-2013, the Costa Blanca undergoes a long stage of reduction of consumption, approximately 15%. During these years, this regressive trend also occurred at the national and regional levels, partly because of the end of the urban expansion, the bursting of the real estate bubble and the repercussions on the population of the economic crisis (MOROTE *et al.*, 2016a).

Some studies in the city of Alicante have identified the interaction of various structural factors that explain this decline, such as an increase in environmental awareness, the modification of some consumption habits related to personal hygiene or the introduction of saving devices in taps and showers at homes (GIL *et al.*, 2015, MOROTE *et al.*, 2016a). In addition, the reduction in consumption is also explained by the impact that the economic crisis

has had on middle-class households, the increase in water prices specially for high consumption segments, a large decrease in foreign population in some coastal municipalities or the use of regenerated water for urban uses (GIL *et al.*, 2015, MOROTE *et al.*, 2016a, VILLAR, 2017). However, except for Alicante and Elche, which have maintained a downward trend since 2005, in some regions of Alicante, this decline has stagnated since 2010, as in the coastal municipalities of the regions of Vega Baja, Marina Baja or Marina Alta, where there is even a slight increase in domestic water consumption (VILLAR, 2017). The explanation of the spatial differentiation of domestic water consumption and the different trends observed will be approached from the analysis of the different groups of variables.

4.1 URBAN-TOURISTIC FACTORS

On one hand, the existence of the largest consumption modules in the municipalities of the north coast is related to a lower urban density, given the greater proportion of single-family houses, and the larger size of plots, gardens and swimming pools compared to other sectors of the Costa Blanca. On the other hand, in the southern littoral, the most numerous types of housing are medium density, such as terraced houses and tourist apartments, where there is a greater presence of external community uses and paved exterior surface, which produces less consumption of water per capita (MOROTE and HERNÁNDEZ, 2014).

In addition to urban factors, it should be noted the influence that the seasonal population residing in secondary housing has on the domestic water consumption on the coastline of Alicante. In nine municipalities of the Costa Blanca for every five inhabitants registered is added at least another inhabitant equivalent to annual scale. This population generates intense seasonal fluctuations in water consumption, however if we consider this temporary population in the calculation of per capita consumption does not substantially change the distribution of domestic water consumption of the coastline, since the municipalities of the north continue to show the highest values.

4.2 DEMOGRAPHIC FACTORS

For the Costa Blanca, as well as in other areas of the Mediterranean coastline, the most characteristic demographic feature is the high presence of retired foreigners from Western and Northern Europe. This population usually lives in municipalities on the north and south coast of Alicante, where the residential tourism sector associated with low density urban models is more developed. This means that the municipalities of the central coastal sector are the ones with the lowest percentage of foreign population, consequently the presence of retirees and immigrants in this area is related to a lower level of income and, therefore, a lower domestic consumption of water (MARCH *et al.*, 2012).

In the Costa Blanca, the percentage of foreign population and population over 65 are variables that are interrelated. The greatest presence of population in retirement age is recorded, again, in the Marina Alta region. These characteristics translate into a smaller household size, which results in a higher consumption of water for not taking advantage of economies of scale, as discussed above.

4.3 ECONOMIC FACTORS

The possible influence on domestic water consumption of two economic variables has been analysed: household income available per inhabitant and water price. For the case of available family income, there is a marked difference between the incomes of the municipalities of the north coast and the south coast. The municipalities located north of Benidorm, along with Alicante and El Campello, have a higher level of income than those of the rest of the coastline. However, although there seems to be a relationship between disposable family income and domestic water consumption, this is not decisive. Of the five municipalities with the highest purchasing power, Alfaz del Pí, Finestrat, El Campello, Altea and Jávea, only the latter is in the group of municipalities with the highest consumption per capita.

Regarding water price values, have been considered the price associated with the supply for an average consumption between the different municipalities, and the price of supply for the largest segment of domestic consumption. For the first case, in almost all municipalities there has been an increase in rates since the beginning of the economic crisis, although each municipality has undergone a specific evolution. With respect to the absolute values of the price paid for supply, the municipalities that in 2014 had a larger consumption module are, in general, the ones that pay the most. Secondly, in the municipalities of the regions of Marina Alta and Marina Baja, a higher price of water is observed in the larger consumption segments. However, this strategy has failed to contain or reduce the high levels of domestic consumption in the municipalities of Marina Alta.

5. CONCLUSIONS

The factors analysed are a first approximation to the study of the determinants of domestic demand for water on the coastline of Alicante. This analysis reveals the influence of urban density and the residential tourism sector on household consumption. However, the municipal scale of study makes it difficult to understand how certain factors influence this consumption.

Conducting detailed studies at household level will allow a better understanding of the interactions between the analysed variables and domestic water consumption (DOMENE and SAURÍ, 2006). This exercise will also provide data related to the seasonal population, such as the type of housing where they live, the length of their stay, the size of the home and its composition by age, among many other variables. Also, in future detailed studies, it will be possible to analyze the impact on the consumption of other variables that could not be analyzed in this research, such as the technical characteristics of the dwellings or climatic variables such as temperature and precipitation. These studies become more interesting after the end of the regressive trend of urban consumption in some municipalities and the intensification of tourism activity since 2010. Finally, the lack of revision of the supply rates in the municipalities of the north coast and, in general, the disparity of criteria regarding the establishment of tariffs on water supply will in turn require future studies on the influence of urban water governance on domestic consumption.

6. REFERENCES

- ARBUÉS, F.; GARCÍA-VALIÑAS M.A. y MARTÍNEZ-ESPIÑEIRA R. (2003). *The Journal of Socio-Economics*. "Estimation of residential water demand: a state-of-the-art review", nº 32 (1), pp. 81-102.
- DANDY, G.; NGUYEN, T. y DAVIES, C. (1997). *Land Economics*. "Estimating residential water demand in the presence of free allowances", nº 73(1), pp. 125-139.
- DEL MORAL, L.; PITA, M.^a F.; PEDREGAL, B.; HERNÁNDEZ-MORA, N. y LIMONES, N. (2014). *Progress in water geography. Pan-European discourses, methods and practices of spatial water research*. "Current paradigms in the management of water: resulting information needs" University of Tartu, pp. 19-29.
- DOMENE, E. y SAURÍ, D. (2006). *Urban Studies*. «Urbanization and water consumption: Influencing factors in the Metropolitan Region of Barcelona», nº 43, pp. 1605-1623.
- FOX, C.; MCINTOSH, B. y JEFFREY, P. (2009). *Land Use Policy*. «Classifying households for water demand forecasting using physical property characteristics», nº 26, pp. 558-568.
- GIL, A.; HERNÁNDEZ, M.; MOROTE, A.F.; RICO, A.M.; SAURÍ, D. y MARCH, H. (2015). *Tendencias del consumo de agua potable en la ciudad de Alicante y Área Metropolitana de Barcelona, 2007-2013*. Hidraqua, Gestión Integral de Aguas de Levante S.A. y la Universidad de Alicante.
- GRIFFIN, R. C. y CHANG, C. (1990). *Water Resources Research*. "Pretest analysis of water demand in thirty communities", nº 26, pp. 2251-2255.
- HOF, A. y SCHMITT, T. (2011). *Land Use Policy*. "Urban and tourist land use patterns and water consumption: Evidence from Mallorca, Balearic Islands", 28(4), pp. 792-804.

- HÖGLUND, L. (1999). *Water Resources Research*. "Households demand for water in Sweden with implications of a potential tax on water use", nº 12, pp. 3853-3864.
- INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2014). *Climate Change 2013 and Climate Change 2014* (3 vols.). Disponible en: <http://www.ipcc.ch/> (fecha de consulta 03.09.2016).
- MARCH, H. y SAURÍ, D. (2010). *The Professional Geographer*. "The suburbanization of water scarcity in the Barcelona Metropolitan Region: Sociodemographic and urban changes influencing domestic water consumption", nº 61(1), pp. 32-45.
- MARCH, H.; PERARNAU J. y SAURÍ, D. (2012). *Regional Studies*. "Exploring the Links between Immigration, Ageing and Domestic Water Consumption: The Case of the Metropolitan Area of Barcelona", nº 46(2), pp. 229-244.
- MARTÍNEZ-ESPIÑEIRA, R. y NAUGES, C. (2004). *Applied Economics*. "Is all domestic water consumption sensitive to price control?", nº 36, pp. 1697-1704.
- MOROTE SEGUIDO, A.F. (2015). *Transformaciones territoriales e intensificación de la demanda de agua urbano-turística en la provincia de Alicante*. Tesis Doctoral. Instituto Interuniversitario de Geografía, Universidad de Alicante.
- MOROTE, A.F. y HERNÁNDEZ, M. (2014). *Documents d'Anàlisi Geogràfica*. "Jardines y urbanizaciones, nuevas naturalezas urbanas en el litoral de la provincia de Alicante", nº 60/3, pp. 483-504.
- MOROTE, A.F. y HERNÁNDEZ, M. (2016). *Land Use Policy*. "Urban sprawl and its effects on water demand: A case study of Alicante, Spain", nº50, pp. 352-362.
- MOROTE, A.F.; SAURÍ, D. y HERNÁNDEZ, M. (2016a). *The Professional Geographer* "Residential tourism, swimming pools, and water demand in the western Mediterranean", nº 69(1), pp. 1-11.
- MOROTE, A.F.; HERNÁNDEZ, M. y RICO, A.M. (2016b). *Water*. "Causes of Domestic Water Consumption Trends in the City of Alicante: Exploring the Links between the Housing Bubble, the Types of Housing and the Socio-Economic Factors", nº8, pp. 374, 1-18.
- NAUGES, C. y THOMAS, A. (2000). *Land Economics*. "Privately Operated Water Utilities, Municipal Price Negotiation, and Estimation of Residential Water Demand: The Case of France", nº 76 (1), pp. 68-85.
- NAUGES, C. y REYNAUD, A. (2001). *Revue économique*. "Estimation de la demande domestique d'eau potable en France", nº52, pp. 167-185.
- RICO, A.M. (2007). "Tipologías de consumo de agua en abastecimientos urbano-turísticos de la Comunidad Valenciana". *Investigaciones Geográficas*, nº 42, pp. 5-34.
- RICO, A.M.; OLCINA, J. y SAURÍ, D. (2009): "Tourist land use patterns and water demand: evidence from the Western Mediterranean". *Land Use Policy* 26, 493-501.
- RICO, A.M.; OLCINA, J. y BAÑOS, C.J. (2014). "Competencias por el uso del agua en la provincia de Alicante: experiencias de gestión en la armonización de usos urbano-turísticos y agrícolas. *Documents d'Anàlisi Geogràfica*, nº 60/3, pp. 523-548.
- VILLAR, R.A. (2017). *Nuevas Aportaciones en la Investigación en humanidades. VI Jornadas de Investigación de la Facultad de Filosofía y Letras de la Universidad de Alicante (Alicante 28 y 29 de abril de 2016)*. "Tendencias en el consumo de agua en el litoral alicantino (2000-2014)". En Cutillas Orgilés, E. (Coord.), pp. 237-248.
- VILLARÍN, M.C. (2016). *Factores explicativos de la demanda doméstica de agua. Estudio a microescala del municipio de Sevilla*. Tesis Doctoral. Universidad de Sevilla, Sevilla, España