

WHAT LIES BEHIND DOMESTIC WATER USE? A REVIEW ESSAY ON THE DRIVERS OF DOMESTIC WATER CONSUMPTION

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ABSTRACT

Water constitutes an essential flow for the reproduction of urban environments. However and differently than other essential flows such as energy, money or materials, water is essentially bounded to local or regional environments for direct uses. Water stressed urban environments (such those in Mediterranean areas) are prone to suffer water scarcity both due to physical variables but also to human and social factors. Thus, understanding which factors lay behind urban water consumption is critical both in theory terms and also in technical and policy related matters. While the economic and technical literature has paid a great deal of attention to the role of price and other socio-economic drivers, the present work reviews other types of research carried out in the field of domestic water consumption drivers, and highlights the potential contributions of studying territorial, demographic and cultural factors, all of them of great interest for Geography.

Key words: domestic water use, socio-demographic and economic factors, statistical models.

RESUMEN

El agua constituye un elemento fundamental para la reproducción de las áreas urbanas. Sin embargo y al contrario que otros flujos esenciales (energía, materiales, dinero, etc.), el agua se halla directamente unida a los entornos locales y regionales por los usos directos que genera. Muchas áreas urbanas mediterráneas se hallan expuestas a situaciones de escasez debido a causas físicas pero también y muy especialmente humanas y sociales con lo cual se puede afirmar que al menos en parte, la sequía es un fenómeno socialmente construido.

Fecha de recepción: febrero 2009.

Fecha de aceptación: septiembre 2009.

¹ El primer autor quiere agradecer el soporte del «Comissionat per a Universitats i Recerca» del Departamento de Innovación, Universidades y Empresa de la Generalitat de Catalunya, así como del Fondo Social Europeo.

La comprensión de los factores que se hallan detrás del consumo de agua en las ciudades es muy relevante tanto desde un punto de vista teórico como aplicado. Mientras que la literatura dominante ha prestado una atención especial a los precios y otros factores económicos, en este trabajo se ponen de manifiesto otros factores como los territoriales, demográficos y culturales, todos ellos de gran interés para la Geografía.

Palabras clave: uso doméstico del agua, factores económicos, demográficos y territoriales, modelos estadísticos.

I. INTRODUCTION

In 2008 Barcelona and its metropolitan region suffered one of the worst water crises of the last 50 years. Low precipitation during 2007 caused a dramatic decrease of water stored in the Ter-Llobregat reservoir system supplying Metropolitan Barcelona. However, domestic water use (representing over 65% of total consumption in the area) was not evenly distributed across the Barcelona Metropolitan Region: consumptions per capita ranged from roughly 100 to over 500 litres per person and day (lpd) (Domene and Saurí, 2006; March and Saurí, forthcoming). Lack of rain was undoubtedly a major cause of the drought but water scarcity is rarely the sole product of physical or social factors (see Kallis 2008). Rather scarcity has become a hybrid of these two factors and, therefore, it is very important to consider and understand not simply meteorological factors but also what social drivers lie behind water use.

Our paper aims to review, collect and synthesize the main findings regarding the relationship between domestic water use and population, territorial, social and cultural factors in urban environments. By doing so, we aim to broaden the debate of population-environment relationships (and more concretely on the urban water and population flows), but we also attempt to provide a conceptual and methodological framework to carry out empirical studies. In turn these empirical studies could ratify, challenge or enlarge the theoretical background presented here. In addition, empirical work could result in the development of better water demand forecast, which can inform water policies and planning strategies at different spatial scales and for different agents (regional or national water agencies, water companies or local/metropolitan administration). This review is rooted in the need to understand water use patterns and the uneven geography of water consumption in an era of increasing concerns around the availability of this resource in adequate quantities and qualities. In turn, these claims grounds the proposals to advance towards a sustainable approach to water resources management (Brooks, 2006; Butler and Memon, 2006; Gleick, 2003). The European Union and the United Nations called for the application of the «Integrated Water Resources Management» (IWRM) concept which attempts to combine supply and, especially, demand measures (European Commission, 2000; ICWE, 1992). Other experts (Corral-Verdugo et al., 2002; Guy, 1996; Postel, 1992) call for the application of new mechanism and paradigms of water management against the backdrop of the growing difficulties in the provision of water which will become probably exacerbated by climate change.

Domestic water demand management and conservation may help to reduce water deficits and improve the reliability of supplies; may make less necessary the construction of large

infrastructures, and may lessen existing pressures on the natural environment (Aitken et al, 1994; Brandes and Maas, 2004; Bruvold and Smith, 1988; Cantó, 2007; Maddaus et al 1996). In addition it could improve utility management and decrease economic costs. Thus, conservation and domestic demand management may contribute to: 1) the reduction in operation and maintenance costs; 2) the downsizing of infrastructures, and 3) the decrease in purchases from wholesale suppliers (Burn et al 2002; Inman and Jeffrey, 2006). The characteristics and trends of domestic water demand should represent a basic axis of the public and private company's strategies (Beecher, 1996).

Domestic water demand management requires, among other matters, a deep knowledge of the behavior of users in relation to consumption (Dziegielewsky, 1999; Mazzanti and Montini, 2006; Stephenson, 1999). Households appear to be the key unit to analyze the relationships between population and domestic water consumption (De Sherbin et al. 2007).

We will see how the literature has progressed from a dominant economic perspective centred on the Anglo-Saxon world (especially the Western United States and Australia) to a richer focus that not only considers other urban environments but also and more importantly considers a myriad of other factors, including some very important for geographers. Since the late 1960s and through the 1970s, North-American economic literature grew interested in the characterization of residential water demand (Gottlieb, 1963; Howe and Linaweaver, 1967; Hanke, S. H. 1968, Sewell, 1974). Most of the attention was directed to seek for the best price mechanisms to regulate demand (Campbell et al 2004; Green 2003; Nauges and Thomas, 2000; Young, 2005; Winpenny, 1994). To ascertain the main drivers behind domestic water consumption or to make forecast for the short/medium term, econometric models have been widely proposed (Agthe and Billings, 1980; Campbell et al 1999; Dalhuisen et al 2002) using different sets of data, in time series, cross-sectional or panel data formats (Arbués et al. 2003; Arbués et al. 2004; Dalhuisen et al. 2003; Martínez-Espiñeira, 2002). Water demand equations generally take a form where the quantity of water consumed is expressed as a function of price, income and a set of other factors. In the recent years, more and more variables have been incorporated into the models to the point that currently, the drivers of domestic water demand may be very varied (Nauges and Thomas, 2002).

Most of the studies deal with suburban Anglo-American environments, mostly the (Western) United States and Australia, and to lesser extent Canada and the United Kingdom (see among others Agthe 1986; Billings and Agthe 1980, Billings 1982; Billings, R.B 1982; Billings and Day 1989; Chicoine and Ramamurthy 1986; Dalhuisen et al. 2003; Foster and Beattie 1979; Foster and Beattie 1981; Gibbs 1978; Gottlieb 1963; Hoffmann et al. 2006; Howe and Linaweaver 1967; Opaluch 1982; Renzetti 2002; Wentz and Gober. 2007). With time, other scholars have focused on non-Anglo-American case studies. Many studies dealt with European case studies: France (Nauges and Thomas 2000; Nauges and Reynaud; Reynaud 2003), Cyprus (Hajispyrou et al. 2002), Italy (Mazzanti and Montini 2006), Spain (Arbués et al. 2000; Arbués and Villanúa 2006; Domene and Saurí 2006; Martínez-Espiñeira. 2002b; March and Saurí, forthcoming), Sweden (Hanke and De Maré 1982; Höglund 1999), Germany (Hummel and Lux 2007; Lux 2008), Denmark (Hansen 1996) or Poland (Kloss-Trebaczkiwicz and Osuch-Pajdzinska, 2000). Other studies have embraced the Middle East (Mukhopadhyay et al, 2001), Southern Africa (Gumbo, 2004; Jansen and Schulz, 2006) or Asian countries such as Philipinnes (David and Inocencio 1996) and China (Zhang and Brown 2005).

II. THE ECONOMIC DRIVERS OF DOMESTIC WATER CONSUMPTION

As said, before economic instruments, and especially prices, were among the first factors considered in influencing domestic water demand. Interest in pricing and other economic instruments arose as part of a more general approach to water management emphasizing control actions over demand. Thus, demand management has been postulated as an alternative to the 20th century hydraulic paradigm (Kallis and Cocossis 2003; Sauri and Del Moral 2001). Under the ideological construct of the alleged supremacy of the market as the instrument to manage and efficiently allocate natural resources (Anderson 1991; Anderson and Snyder 1997; Andersen and Sprenger 2000), price represents one of the most relevant tools to manage water demand (Arbués et al, 2004; Garcia and Reynaud, 2004; Howe, 1982; Jones and Morris, 1984; Moncur, 1987; Rogers et al 2002; Winpenny, 1994). For example, Lux (2008) links the decreases of water consumption in East Germany after the unification to financial incentives (price increases) and technological changes. At the institutional level, international organizations such as the OECD (OECD, 1999, 2002) or the European Union, through the European Water Framework Directive, concretely article 9 (European Commission 2000; Kaika 2003), champion the application of market instruments to efficiently manage demand. The essential logic is that higher water prices lead to lower consumption (Shaw, 2005), which makes sense if water is treated as a pure economic good. However, as Savenije (2002) notes water is far from behaving as a normal economic good as for most uses water is irreplaceable.

Most of economists working on domestic water generally recognize that domestic water consumption tends to be price-inelastic which means that the decrease in demand is lower than the increase in price. For domestic consumption price-elasticity oscillates between 0 and -1, and also may vary over time (Arbués et al. 2003; Espey et al. 1997; Hoffmann et al. 2006; Martínez-Espiñeira and Nauges, 2004; Mazzanti and Montini 2006; Renwick and Green. 2000; Savenije and Van der Zaag. 2002). Scholars working with domestic water consumption models have proven that, in general, the price elasticity of water demand varies according to the use given (Billings and Aghte, 1980; Conley, 1967; Thomas and Syme, 1988). The more basic and essential the use is, the closer to zero the price-elasticity of this demand will be. As a result, price mechanisms would not make a great difference in the demand for those quantities of water (Dalhuisen et al. 2003; Renwick and Green, 2000). Contrarily, when dealing with water-related leisure activities such as watering the garden or making use of swimming pools, price-elasticity of the demand approaches -1. This information is critical to set pricing schemes in order to balance equity with efficiency and to achieve the greatest conservation potential in outdoor uses while not translating the conservation burden to essential uses.

In addition to the variation of elasticity that follows the use given to water, Martínez-Espiñeira and Nauges (2004) demonstrated that the water demand function presents different elasticities for different levels of consumption in different price ranges. A great deal of economic literature has specifically focused on water pricing schemes and several price mechanism approached has been proposed (Bar-Shira et al, 2006; Billings, 1982; Billings and Aghte, 1980; Dalhuisen and Nijkamp, 2002); García-Valiñas, 2005; Kulshrestha, 1996; Martínez-Espiñeira, 2002a; Nieswiadomy, 1992; Nieswiadomy and Cobb, 1993). Thus, moving from a uniform to an increasing block structure tariff can significantly impact demand (Whittington, 1992). Other authors point out that progressive block structures

may increase revenue instability for the water utility. This may be corrected by introducing some kind of fixed fee in the bill independent of the water consumed (Dandy et al, 1997; Taylor et al. 2004). To enable marginal pricing, metering is critical. Without metering it is impossible to track household water consumption and test the effectiveness of other demand management actions, especially prices. Already in 1968, metering water consumption was seen by economists as a way to reach greater efficiencies in the use of water supplies (Howe and Linawewer, 1967; Hanke et al. 1968). Eventually, as Gaudin (2006) argues, information is also key for the citizen, as the lack of transparency and detail in price information is a possible factor contributing to low price elasticity in water demand

It is widely accepted and empirically demonstrated, that domestic water consumption is positively correlated with income (Agthe and Billings, 1987; Arbués and Villanua, 2006; Arbués et al. 2003; Baumann et al. 1998; Gaudin et al. 2001; Hoffmann et al. 2006; Renzetti 2002). We want to insist in that this variable, being a proxy of affluence, affects water consumption in different ways. On the one hand, higher levels of income may suppose an increase in living standards, which could imply a higher quantity of water-consuming appliances and a higher probability of the presence of high-water demanding outdoor uses such as lawn gardens and swimming pools (Cole, 2004). Domene and Saurí (2006), analyzing domestic water consumption in Barcelona's metropolitan region, argued that the income effect is more evident when outdoor uses exist. Garden watering reflects to a large extent household income and class (Domene, et al. 2005).

On the other hand, income importantly affects the responsiveness to price mechanism. Thus, while low income families may not respond to price because they are using water mostly to fulfill basic needs, well-off individuals or households fail to respond because the price signal is not strong enough to curb their consumption (Renwick and Archibald 1998, Renwick and Green, 2000). The extreme case could be found where piped water supply is not available (slums in Third World cities, rural poor regions, etc) and water vendors sell pricey water to the citizens. This suggests that a conservation campaign based on price mechanisms may probably achieve larger reductions in domestic demand in lower income zones than in higher income communities (Hajispyrou et al 2002). In turn, questions about equity and distribution of the environmental burden among citizens may appear in this process. Moreover household price responsiveness may not only vary depending on income but also it may vary seasonally, for example, increasing the responsiveness during summertime (Renwick and Green 2000).

III. DEMOGRAPHY ALSO MATTERS: HOUSEHOLD SIZE, AGEING, IMMIGRATION AND WATER CONSUMPTION

The addition of other explanatory factors to the models of domestic water consumption is necessary in order to verify both the robustness of price and income elasticity estimates across different specifications and to explore further water demand determinants (Mazzanti and Montini 2006, Nauges and Thomas, 2000, Renzetti 2002). In fact, increases in water price are sometimes associated with increases, rather than reductions, in water use in the following years. According to Baumann et al (1998), such casual observations fail to recognize that water use may increase in response to changing weather, population, housing, etc.

In general terms, the western world has been (and still is) undergoing a second demographic transition (Lesthaeghe 1995; Ogden and Hall 2004; Van de Kaa 1987). For instance, a general phenomenon occurring throughout urban regions of the developed world is the decrease in the number of people in the household (Ogden and Schnoebelen 2005), and more specifically the increase in the number of people who live alone (Chandler et al. 2004), especially non-retired people. The causes of this reduction are: lower fertility rates, higher per capita income, ageing processes, a decline in the frequency of multi-generational families living together, or higher divorce rates (Liu et al. 2003; Mukhopadhyay et al 2001).

The household is increasingly seen as a key unit of inquiry to analyze changing sociodemographic structures (Buzar el al. 2005) and may become also a key scale in environmental and resource analyses. Household dynamics are therefore basic to understand resource use and environmental impacts (Liu et al 2003). In that sense, household size, i.e. the number of people living in a household, influences water consumption in different ways (Arbués et al. 2003; Hamilton, 1983; Höglund 1999; Nauges and Thomas 2000, Renwick and Green, 2000; Zhang and Brown, 2004). The changing structures and ways of living have two main and interrelated implications as Lux points out (Lux 2008): a) the decrease in the numbers of members living in the household, and b) the increase in the number of households.

In principle, the higher the number of people living in a household is, the larger the aggregate demand is supposed to be. Nonetheless, economies of scale regarding the optimization of water use could not be generally achieved in small households (Arbués et al. 2000). In addition, Arbués et al. (2003) argue that there is an optimum household size, and that beyond this threshold these economies of scale tend to vanish. On the other hand, the increasing number of small households intensifies the effect of «inefficient» water use in small households (Hummel and Lux 2007; Lux 2008).

The age structure of a given population is another relevant driver of domestic water consumption (Murdock et al. 1991). Though there are not many studies on ageing and resource consumption, it seems that older people tend to spend less water per capita than the young. Moreover, families with children or teenagers can be expected to use more water, principally related to outdoor uses, as elements of the built environment such as swimming pools are largely targeted for them. Nauges and Thomas (2000) suggest that older people may show more saving attitudes and the young might use water less carefully, have more showers, and demand more frequent laundering. Shove (2003) and Binet et al. 2006), similarly argue that the elderly are not generally used to the comfort conditions of 21st century. Finally, due to the generally lower incomes of elderly, Nauges and Reynaud (2001) argue that they are more vulnerable to water price mechanisms.

Probably the relationship between gender and domestic water use is the variable less studied in the developed world, although this may not be the case in the developing world). For example, Zwartveen (1997) reviews the relationships between gender, water rights and water access in developing countries (see also Crow 2001). Elsewhere, Van Koppen (2001) highlights the importance of gender analysis when developing and implementing water policies due to the important variation of water use along gender lines. An important report that provides a great deal of references regarding water and gender in the global south is that of the Gender and Water Alliance and the United Nations Development Program titled «Mainstreaming Gender in Water Management» (Gender and Water Alliance 2006).

Migratory processes and multiculturalism are changing the composition of western societies. Thus, they could temporally rejuvenate aging populations and compensate the loss of population in urban cores. Regarding water, Nauges and Reynaud (2001) argue that immigrants from developing countries (and also the local elderly) may present more frugal water consumption patterns than the population in general. In the study in some neighborhoods in the United Kingdom, Smith and Ali (2006) combined domestic water consumption data with ethnicity and religion data from the 2001 UK census. The research identified important differences in water use patterns directly linked to religious practices (rather than linked to ethnicity). In addition, the study disclosed that the effect on household demand may be enhanced when cultural differences coincide with larger households. Furthermore, Smith and Ali (2006) observed more prudent attitudes towards the use of the resource, probably because immigrants tend to come from a context where water is scarcer. Pfeffer and Mayone (2002), referring to the case of New York City, found that immigrant could obtain water savings 20 percent higher than the local population. They also argued that this fact could be linked and explained with regard to water scarcity and shortages in their countries of origin. In turn, as Bullock (2003) argues, lifestyles, themselves influenced by other variables such as income, age or residential model, may also influence consumption in important ways.

Education is argued to be related to environmental consciousness and awareness (Syme et al, 1991; Syme et al, 2000). In what concerns water, this could be translated in the purchase of water conserving appliances or the planting of drought-tolerant garden species (Geller et al, 1983). However, few studies deal with the influence of people's education in water use (see Howarth and Butler, 2004). Water conservation in the context of attitudes towards environmental issues in general has also been examined (Gilg and Barr 2006).

IV. THE URBAN MODEL AND WATER USE

Population, as Schutte and Pretorius (1997) note, is a relevant driver of domestic water consumption in aggregate terms. However, as Cubillo et al. (2001) and Pedregal (2005) argue, population growth is more indicative than population size per se to predict the likely paths that domestic water consumption will follow. Knowing how people will settle across space is key to understand their subsequent metabolization of 'nature'. In other words, the urban model is argued to have an important influence on the urban landscape and on the consumption of natural resources (Johnson 2001; Kahn, 2000; Liu et al., 2003), such as water (Haase and Nuiss, 2007; March and Saurí, forthcoming, Saurí 2003) or energy (Lavière and Lafrance, 1999).

Europe, and especially Southern Europe is currently experiencing a process leading towards urban sprawl (Catalán et al. 2007; European Environment Agency (EEA) 2006), rooted in the increasing preference of citizens for suburban environments. These spatial shifts of population produce increasing land occupations per capita (Lux 2008). The presence of gardens is said to be an element significantly related to higher household demands (Fox et al. 2009), especially if the human-made landscape is formed by non-local and water demanding species, such as turf grass or tropical plants (Askew and McQuirk 2004; Larsen and Harlan, 2005; Martin 2001; Robbins and Birkenholz, 2004). The presence of swimming pools is another outdoor element that creates differences in domestic water consumption (Vidal 2007).

Data from the Barcelona Metropolitan Area (Domene et al 2005; Domene and Saurí 2006) indicates that a garden may represent, in a Mediterranean urban environment, up to a 30 per cent of all domestic water consumed in a home, and over 50 percent during summertime. Suburbanization in the periphery of many cities, therefore, could be an important driver of higher water use as newcomers use to bring attitudes and behaviors associated with high water consumption (such as having a turf grass garden) and may be less aware of conservation measures (Ferguson, 1987; Hurd, 2006; Hurd et al 2006; Spinti, 2004; Syme et al, 2004).

Nowadays there is still a strong disparity of domestic water consumption between Australia and the United States and Australia (400 and up lpd, on the average), and, Europe (around 170 lpd). This difference is strongly attributed to the wider presence of outdoor uses (gardens and swimming pools) in Anglo-American contexts. In turn these uses are made possible by the low density, disperse urban form characteristic of Australia and North America as opposed to the higher densities found in Europe. To the extent that low density housing is gaining terrain in countries such as France, Portugal or Spain, one may expect an increase in outdoor uses in these countries and therefore of water consumption as well (EEA 2001; 2003).

Even for regions, metropolitan areas or cities that are experiencing drops in population, these reductions do not automatically translate into a decrease in the total consumption of domestic water. Thus it is worth considering several spill-over effects (Lux 2008) of population decrease that in turn may have an effect on water: lower population density and urban sprawl, changes in households and increasing ageing. In order to provide water planners with valuable information for forecasting future domestic demand, Fox, McIntosh and Jeffrey (2009) classify housing developments depending on their physical characteristics. Property size and property type are observed to be significantly correlated with household water demand. Whether housing is the main or the secondary unit of residence or whether apartments or houses are occupied or not are also important issues to take into account in the explanation also variations in consumption.

V. CLIMATE AND DOMESTIC WATER DEMAND

Climate is one of the most explicative drivers of domestic water consumption (Cubillo and Ibáñez 2003). In other words, domestic water consumption is supposed to vary depending on climate variables, especially temperature and rainfall (Griffin and Chang, 1991; Gato et al 2007), though one could argue that other variables such as moisture and irradiation may be relevant as well.

Rainfall is expected to have an effect on outdoor activities, principally water gardening. In an urban environment, the precipitation regime will determine the water needs of the plants and the lawn that will have to be covered by network water. Due to the importance of rainfall patterns in the water needs of vegetal species some municipalities/water companies/agencies are informing in real time about the need or not to water the garden. A pioneering system of information in Spain is that of the Canal de Isabel II that facilitates online the daily recommendations for watering the garden. Policies such as the latter one could have a psychological effect as well as the regime of precipitations is the first element that citizens look in order to identify periods of drought, despite the fact that they are not the best indicator to identify droughts in urban environment (Cubillo and Ibáñez 2003).

Temperature has also been shown to impact on water consumption. The rationale is that hotter days bring about increased garden watering, swimming pool use, and personal hygiene (Hoffmann et al. 2006). In other words, high temperatures imply on the one hand more evapotranspiration both from humans and plants, and this fact increases garden needs and human need to be hydrated. In addition, high temperatures could mean a higher degree of evaporation of water in swimming pools, with the subsequent need to fill them up more frequently.

Each climatic factors reviewed has been approached differently by the scholars dealing with models of domestic water consumption and climatic variables. Both precipitation and temperature could be expressed in different manners. For example, precipitation has been expressed as summer rainfall (Griffin and Chang, 1990), , precipitation during the growing season (Foster et al. 1981), number of rainy days (Hoffmann et al. 2006; Martínez-Espiñeira 2002b, Nauges and Reynad 2001), annual rainfall (Agthe and Billings, 1997), cumulative monthly precipitation (Renwick and Green 2000), and weekly rainfall (Jain et al. 2001). In turn, temperature has been approached through average monthly temperatures, degrees by which average temperature exceeded 58°F (Griffin and Chang, 1990), evapotranspiration of grass (Agthe et al. 1986; Hewitt and Hanemann, 1995; Nieswiadomy and Molina, 1988), number of warm days (meaning temperature above 28.5°) (Hoffmann et al 2006; Nauges and Reynaud 2001), maximum daily air temperature (Renwick and Green 2000), or weekly average maximum air temperature (Jain et al. 2001). In addition some scholars have included in their models variables to differentiate between seasons (e.g. a dummy variable that takes the value of 1 for summer and 0 for the rest of the seasons, Hoffmann et al. 2006) or other climatic variables in order to isolate the seasonal variations (Martin and Wilder, 1992). Along these lines, Agthe and Billings (2002) explored the most influential drivers of domestic water consumption for each season of the year. Arbués et al. (2003) analyzed the psychological effect of rain on consumers, disclosing that sometimes it is more important the occurrence of rainfall episode rather than its amount. Similarly Jain et al. (2001) and Martínez-Espiñeira (2002) pointed out the importance of recurrence rather than total amount of rain. Miaou (1990) suggested that rainfall may have a dynamic and nonlinear effect: reducing first water demand but these effects diminishing over time.

VI. CONCLUSIONS: THE ROLE OF GEOGRAPHY IN ANALYZING WATER CONSUMPTION PATTERNS

The relationships between population and the environment (in this case, water flows), far from being monocausal, linear and static, are complex and dynamic. Thus, changes in a given variable may produce changes in other variables that in turn may affect the metabolism rate of a given society (in terms of water, energy, materials or emissions).

This paper aimed to review the existing literature on domestic water demand drivers or factors. Water price and income were the first and most studied of such factors in the literature. In the paper, we complement this literature with other variables such as household size, housing typology or climate. Models comprising all these variables could explain to an important degree what determines the temporal and spatial uneven use of water in urban environments.

Domestic water use may vary according to economic matters (especially water price and income) but also according to sociodemographic variables (population and population growth; size and characteristics of households; age composition of household members; gender),

cultural variables or even religious variables (nationality of residents in the household), educational levels and responsiveness to conservation campaigns, physical capital in the home (especially the presence of water efficient technologies), the predominant territorial urban form (compact or disperse), and climatic variables (the latter ones especially important if suburbanization is present). All these factors produce a very complex picture with several possible interpretations as to which variables are more relevant. All these factors also prove the importance of geographically-based factors. After decades where economics reined supreme in the study of the variations of domestic water consumption, Geography and other sister disciplines such as Demography may add valuable findings to these previous studies. Geographers are able to amass a vast body of knowledge regarding urban, socio-demographic and economic processes. This comprehension is critical to understand the unevenness of water use in urban environments, especially where scarcity problems could emerge.

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