Land Use Policy 44 (2015) 10–18

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Golf course irrigation and self-sufficiency water in Southern Spain

Armando Ortuño*, María Hernández, Sergio Civera

University of Alicante, Spain

ARTICLE INFO

Article history:
Received 16 October 2013
Received in revised form
17 November 2014
Accepted 23 November 2014

Keywords:
Golf
Irrigation
Real estate
Competition
Reuse
Spain

ABSTRACT

During the first decade of the 21st century, many golf courses were developed in the Southeast of Spain, which greatly increased the number of these facilities. Almost all of these golf courses have been accompanied by large residential developments composed of thousands of dwelling units. This article seeks to identify the factors that influence golf courses' water consumption and estimate the number of dwelling units that an associated residential development needs to have to provide the effluent necessary to fully meet the irrigation needs of a golf course. The study indicates that private golf courses achieve greater levels of irrigation efficiency than public golf courses and that the golf courses associated with residential developments subject the irrigation needs of the grassland to the sale requirements of the real estate properties. The study also estimates that a golf course requires approximately 3000 dwelling units with an average annual occupancy of 33% to achieve self-sufficiency for irrigation.

Introduction

At the beginning of the 21st century many studies (Burriel, 2008; Gaja, 2008; Romero et al., 2012) warned about the problems caused by the many low-density urban developments that were being built in different regions of Europe. These residential developments have often been built in the coastal areas, as is the case in Ireland, Portugal and particularly the Spanish Mediterranean coast, where the urbanised area is expected to increase from 55% to 73% from 1995 to 2025 (EEA, 2006).

These low-density residential developments have often been accompanied by golf course developments, which alludes to the complementarities between traditional "sun and sea" tourism (Rico et al., 2009) and water amenities, such as swimming pools, golf courses, water and amusement parks, gardens, spas, leisure and sport developments, that are needed to assure the viability of the tourism industry (Gössling and Hall, 2006); Developers' interest in golf course developments is aroused by the important purchasing power of the market segment interested in using these types of facilities and the multiplying effects that they generate. However, it is the so-called "golf urbanization" (Vera, 1991) which has registered the highest growth in recent years, not only in the coastal municipalities but also in inland areas. As with marinas, golf courses will be used by the real estate business to add value to the new buildings. The Alicante and Murcia provinces (in the Southeast of Spain) are where these developments are taking place with the greatest intensity. This is clearly reflected in the increased number of golf courses; there were only 23 golf courses in 2006, but there were 120 planned golf courses with the capacity to accommodate approximately 500,000 homes over an area with a total residential population of about three million people (INE, 2012). This process has occurred elsewhere on the Spanish Mediterranean coast, for example Costa del Sol (Province of Málaga), where several studies have detected a similar dynamic (Grindlay et al., 2011).

The expansion of tourism and residential settlement in the coastal municipalities, encouraged for decades by different administrations, has resulted in a strong competition for soil and water with other economic functions (e.g., agriculture) and the environment (e.g., wetlands). One of the determinants of use competition between irrigated agriculture and urban demands is water scarcity, especially during droughts. The unequal spatial distribution of water resources and consumption has accentuated this problem. The second ones are located in the coastal areas facing inland mountain areas that concentrate major guarantees and quality resources.

A controversial issue that is often linked to this residential expansion is the relation between water demands and available resources (Hernández, 2013). New demands and conflicts that are associated with the spread of new residential uses and golf courses have received attention in the new Basin Management Plans that have been developed by the Hydrographic Confederations, agencies that develop water policy in Spain, and by laws that affect land management and its impact on water resources. Although Spanish Water Law does not adequately specify the participation of land-use planning in water policy, it assumes that water policy should result from hydrological planning, which takes as one of

* Corresponding author. Tel.: +34 600948797

http://dx.doi.org/10.1016/j.landusepol.2014.11.020
0264-8377/

its main objectives (art. 40.1), "*to achieve a good ecological status of the public water domain, satisfy the demands of water, and balance and harmonise regional and sectorial development*". Basin Hydrological Plans, for example the Jucar and Segura Basin Management Plans, are the instruments that Water Law provides to attain these aims.

Another crucial issue arising from the great importance of water management is that water resources deserve consideration in soil and land management laws. In the case of the Valencian Region, law 4/2004, *Land management and landscape protection of the Valencian Region*, contains a specific chapter on sustainable development with several articles devoted to the water resource as a fundamental criterion for planning. Thus, water resources must be considered in the different instruments of territorial and urban planning to achieve an efficient and sustainable use (articles 17 and 19) that preserves the quality of water bodies (art. 18). However, the most noticeable qualitative leap involved in this law lies in the introduction of new land uses that involve an increase of water consumption and that require a favourable report of the basin or a collaborating authority to ensure water availability and that other water use rights are not affected (art. 19.2). This same requirement has been included in the national soil law (8/2007), which requires mandatory reporting by the hydrological administration that enough water resources exist to meet new demands (art. 15). The territorial impact of these laws is evident, although the various planning instruments should not allow the expansion of new demands that exploit precarious supply systems while leaving open the possibility of ensuring the availability of water through non-conventional sources such as desalination and water reuse. The application of these two controversial regulations has resulted in large and contentious Court cases contesting the implementation of new urban planning programmes (Rico and Hernández, 2008).

The construction of new exempt golf courses associated with urban development reflects clashes to the implementation of these regulations and to access and use of water. Water consumption in golf courses varies substantially depending on variables such as climate, topography, soil, drainage, wind, sun exposure, type of turfgrass in use, and the size and design of the golf course (Pira, 1997; Barrett et al., 2003; Graves and Cornish, 1998; Witteveen and Bavier, 1998). A study covering 15% of all US golf courses (almost 17,000) found that the average irrigation needs of an 18-hole golf course ranged from 52,000 m^3 in the northeast to 566,000 m^3 in the desert states of the southwest (Throssell et al., 2009). Golf course research in Europe has shown that the annual consumption of a standard golf course in France ranges from 80,000 to 100,000 m^3 in the north and from 150,000 to 200,000 m^3 in the south. Much higher values can be found in dry and warm climates (Gössling et al., 2012). In the case of the Mediterranean countries, Stefano (2004) estimated that the annual water consumption was between 500,000 and 750,000 m^3, which is similar to the consumption of a rice pond.

Competition between the different land uses for access to water is as varied as the water consumption of golf courses. In water-stressed locations, golf courses have to compete for water resources against rising domestic demand and existing uses, which are predominantly agricultural (EEA, 2009). This is why golf course developments have frequently been controversial, especially in countries where water resources are under stress because there is a public perception that golf course irrigation significantly reduces water resources and has major impacts on the environment (Markwick, 2000). In fact, in the high season, conflicts can arise between the different sectors that use the water resource, such as agriculture, hydro-electricity production and household consumption. Tourist facilities often are given priority in the supply of water, while agriculture and households see their access reduced (water cuts, controlled volumes/rationing) (EEA, 2009).

Spain provides a good example of the conflict between agriculture and golf for water resources. The transfer of water from agriculture to golf is widely criticised and is a highly contentious political issue (Rodríguez et al., 2007, 2011). However, when considering the competition of land uses for access to water resources we must take into account that the irrigation needs of golf courses can be met by the use of treated wastewater, which can come even from the annexed residential development. In this context, 12% of golf courses in the US reuse water for irrigation, while this figure reaches 37% in the Southwest, where water needs are higher (Throssell et al., 2009). On the other hand, in Europe the reuse of treated wastewater is currently not widely practiced, although it is becoming a popular measure, particularly for the irrigation of crops and golf courses (EEA, 2009). This is the case for the Mediterranean countries, where the main problem may not be scarcity of water in terms of average use per capita but the high cost of making water available at the right place, at the right time and with the required quality (Angelakis et al., 1999). That is why wastewater is becoming an important asset to increase water supply and its use is increasing in agriculture and golf courses irrigation (Candela et al., 2007).

Study area, objectives and methods

The residential expansion that occurred on the Spanish Mediterranean coast from the late 1990s until 2008 has produced visible changes in the landscape and land use. The total number of dwelling units in Spain increased by almost five million between 2001 and 2011 (Ministerio de Fomento, 2012), which increased the total number of homes from 21.03 to 26.01 million, an increase of 23% in this decade. This level of growth had not occurred since the development of the 1960s that took place after the Stabilisation Plan (1959). This process has been most intense in the Southeast of Spain (which includes the regions of Andalusia, Catalonia, Valencia, Murcia and the Balearic Islands), where 55% of the new housing units (approximately 3 million) were built. From 1997 to 2008, the Valencian Community was the third autonomous community with the highest number of new housing units. During this stage, approximately 790,000 housing units were built, which constituted an increase of 36% over the number of housing units that existed in 1996 (Burriel, 2008). The case of Alicante province is relevant and illustrative; from 2001 to 2011 a total of 2,487,262 new homes were registered in the Province, which represented 44% of all new homes in the country. Alicante province became the third most intensive region for building new homes, only surpassed by Madrid and Barcelona and outpacing provinces with larger populations such as Valencia, Malaga (which are part of Spanish Mediterranean coast) and Seville.

This intense urbanisation process has been associated with, among other factors, good climate conditions that have favoured the development of tourism since 1960 (Vera, 1987). Latitudinal development, in combination with the configuration of the topography and the shape of the coast, allow the territories of Valencia and Murcia to provide a remarkable climatic and hydrographic diversity, which translates into noticeable differences of temperature, rainfall and water availability (Piqueras, 2012). The combination of natural factors produces a natural geographical feature that defines the climate of these regions: aridity, i.e., the lack of humidity and rainfall resources. On the other hand, the heat and light conditions of this territory, with an annual average temperature of 18 °C in Alicante and Murcia, and very mild winters above 10 °C, are conducive to the development of fruit and vegetable agriculture and activities associated with tourism.

The intensity of the urbanisation process and the promotion of golf courses, together with the climate features that define this territory, explain the interest in analysing the relations that exist