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The impact of municipal budgets and land-use management on the hazardous waste production of Malaga municipalities

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ABSTRACT

Economic development and the search for competitiveness have become key issues in regions' economic success. However, despite the direct relationship between economic and environmental management, few land-use plans consider the latter aspect, and city managers delegate the responsibility for environmental impacts to state legislation and private initiatives. This myopic search for competitiveness has meant that a holistic view of environmental issues is often not integrated into municipal decision-making processes. Therefore, this study's objective was to determine the relevant direct and indirect relationships of land management and budgetary procedures of municipalities with overall production levels of hazardous waste. To this end, a primary tourist region, Málaga, was examined in terms of how this waste's environmental impacts can affect the region's vital tourism sector. This research used principal component analysis, regression by ordinary least squares, cluster analysis in two stages and a means test to compare the data for the Province of Malaga's subregions.

The results confirm a positive relationship between municipal expenditure and waste production and highlight the environmental benefits of land use involving environmentally non-aggressive crops. The results also reveal a negative relationship between waste production and financial assets and a direct relationship between unproductive land and the production of hazardous waste. The findings also highlight the necessity of raising awareness about the need for collaboration between different agents, especially in the development of inter-municipal strategies.

1. Introduction

Economic development and population growth have produced intensive urban expansion over the past century (Kasanko et al., 2006), which has been frequently associated with environmental degradation (Oliveira et al., 2011). This pattern has not been consistent at all times and in all places (Turok and Mykhnenko, 2007). For example, the regulation of land use in the United States during the second half of the twentieth century created many automobile-dependent and low-density residential areas. Along the same lines, Romano and Zullo (2014) found a clear lack of planning over the last 50 years on the Italian Adriatic Coast, which has had important adverse consequences. The economic, social and environmental consequences of past regulations now need to be corrected by efficient and sustainable land-use planning (Göçmen and LaGro, 2016).

Despite these increased negative effects, some authors still see cities as engines of economic dynamism and prosperity (Parkinson et al., 2006). Other researchers report that the environmental protection initiatives of public organisations have significantly increased (Sun et al., 2016). In addition, cities' past links with rural areas with agriculture no longer exist, so these lands can be used to serve a greater number of purposes (Lisec et al., 2014).

In the new global economy, some authors have highlighted opportunities to increase competitiveness through regional economies as well (Fujita et al., 2000; Krugman, 1997; Porter, 2008; Scott, 1998, 2001). Therefore, governments that are mainly responsible for territorial planning, in collaboration with other regional entities, have developed strategies to develop their regions (Innes and Booher, 2010; Sanyal, 2005). These efficient and sustainable territorial development plans focus on residential sectors, through which – as some authors such as Göçmen and LaGro (2016) have demonstrated – the public sector has the potential for embracing sustainability.

This sector can also have a positive influence on both strategic environmental assessment and decision making (Rega and Baldizzone, 2015). Public sector procedures are promoted as an effective way to improve the capacity and legitimacy of environmental assessment and

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regulatory processes (Salomons and Hoberg, 2014). However, while most authors agree that public involvement is key to effective environmental impact assessment (EIA), some authors question this assertion, including, among others, Glucker et al. (2013). If, as the saying goes, there is a will, there is a way, then the public sector can make a difference, although the question remains of whether the political will exists to motivate municipalities to implement environmentally friendly policies.

From an economic point of view, the main objective of regional strategy has necessarily been to promote competitiveness (Despotovic et al., 2016). In this context, the most commonly implemented model is Porter's (1998) economic cluster model, in which regions seek to specialise by grouping similar businesses together in order to obtain benefits from external and local scale economies (Krugman, 1997). These regions, however, have subsequently reverted to emphasising cluster innovation and local development.

In this context, Martin and Sunley (2003) argue that governments (i.e. policymakers) need to avoid joining the fashion of relying on the economic cluster model because this is an extremely diffuse concept that cannot provide a model universally applicable to all regions. Regional governments have to become aware of the need for a more holistic view of regional planning. This holistic perspective should be cultivated using integrated analyses of urban development at regional and local levels (Colantoni et al., 2016).

Martín-López et al. (2011) analysed the confrontation between conservation and development in the Doñana region in southwestern Spain and found that simultaneous conservation and development do not necessarily generate confrontations. It is possible and even necessary to have sustainable development, as this term is understood in its broadest sense (Mebratu, 1998). Land-use plans also need to consider a broader view of competitiveness that seeks to address problems such as inequality in income and environmental pollution (Despotovic et al., 2016). Based on the latter cited authors' results, efforts to resolve these issues have a positive relationship with economic growth, which is due to connections between territorial and environmental planning. These plans present some challenges, as noted by Li and Song (2016), to which must be added the problem that planners usually do not have the necessary technical knowledge to understand fully information about environmental contaminants and their implications for regional planning.

In addition to economic criteria, governments need to take into account the problems associated with uncontrolled urban growth (i.e. sprawl) (Angel et al., 2011; Antrop, 2004; Nijkamp and Kourtit, 2013; Zhang, 2000). Therefore, the present research's primary purpose was to determine the relevant direct and indirect relationships of land management and budgetary procedures of municipalities with overall production levels of hazardous waste. The latter are usually associated with the private sector and applicable state laws. Another related objective of this study was to perform an analysis that would highlight the necessary interrelationships that can contribute to improving the horizontal coordination between different agents involved in environmental plans. Addressing this issue is vital, and it falls well within the urban scope of this research.

To achieve these objectives, a region was chosen that is frequently associated with the tourism sector – Malaga – (Fernández-Morales, 2003). Any research on this province's industrial sector has, thus far, been overshadowed by the tourism sector's importance. The latter sector is also heavily dependent on environmental resources (Bull, 1995), so environmental degradation can directly damage the profits of tourism enterprises (Soler et al., 2016).

2. Materials and methods

2.1. Data

The data refer to 2014, and these were collected from different sources. More specifically, the data on total production of hazardous waste were obtained from the Andalusian government's Ministry of Environment and Planning and Institute of Statistics and Cartography of Andalusia. Farm data were obtained from the Ministry of Agriculture, Food and Environment. Expenditure budget data were obtained from the Ministry of Finance and Public Administration's General Secretariat of Regional and Local Coordination. The variables used are listed in Table 1.

Table 1
Variables used.

Dependent variable
Total production of hazardous waste (tons)[a]
Independent variables
Agricultural area (hectares)[b]
Land occupied by arable crops
Fallow and other unoccupied land
Land occupied by woody crops
Natural grasslands
Grasslands
Timbered mountains
Open mountains
Wasteland pasture
Esparto grasslands
Unproductive land
Nonfarm surface
Rivers and lakes
City expenditure budget[c]
Personnel expenses
Expenditure on current goods and services
Financial expenses
Current transfers
Real investments
Capital transfers
Financial assets
Financial liabilities
Electricity consumption per capita (MWh/inhabitant)[a,d]

[a] Andalusian Ministry of Environment and Planning and Institute of Statistics and Cartography of Andalusia.
[b] Ministry of Agriculture, Food and Environment.
[c] Ministry of Finance and Public Administration's General Department of Regional and Local Coordination.
[d] National Statistics Institute.

2.2. Methods

Principal component analysis (PCA) was conducted to determine the structure of municipal budget spending and eliminate possible multi-correlations among budget items. PCA is a well-known method used to reduce data dimensionality, taking into account the relationships between variables independently from the nature of the data (Bersimis and Georgakellos, 2013). PCA identifies interrelations between variables and transforms them into a smaller set of uncorrelated variables retaining most of the variance of the original variables (Sabio et al., 2012).

This analysis revealed two components, EXPENSE1 and EXPENSE2, that met the Kaiser criterion of an explained variance of 96.270%. When the Kaiser criterion is used, the cut-off criteria consists of using only components with eigenvalues over one (Lasvaux et al., 2016) and rotation to facilitate data interpretation (Hamad et al., 2014). Within the two rotation modes, namely, orthogonal and oblique, oblique rotation is more appropriate in most applied research (Browne, 2001). Therefore, this research used the promin rotation method that, according to Lorenzo-Seva (1999), provides better results than other well-known procedures do. The results of this procedure are presented in Table 2.

The same procedure was performed to determine the structure of land use in each city in the region under study (see Table 3). In this case, PCA resulted in three components – LAND1, LAND2 and LAND3 – with a total explained variance of 79.430%. All these variables were