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An exploratory analysis on waste management in Italy: A focus on waste disposed in landfill

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ABSTRACT

The aim of this paper is to analyze the waste management process with a focus on waste disposed in landfills. The results of our analysis provide guidelines for actions geared at improving the waste management. We apply cluster analysis and Exploratory Spatial Data Analysis (ESDA) techniques to 103 Italian provinces for the year 2011. Thus we are allowed to identify spatial correlation processes and spatial clusters. The results of our investigation show a dual structure in the distribution of landfill disposal rate. Moreover, they importantly suggest that institutional quality and pro-environmental behaviour are significant factors in the waste management process.

1. Introduction

In 1999 the European Union has issued the Landfill Directive 1999/31/EC aiming to divert waste from landfilling. In particular, Member States have been forced to introduce national strategies to cut down biodegradable municipal waste (BMW) addressed to landfilling. As a matter of fact, over the years, the growing awareness of damages to the environment and human health has intensified the action of the European policy makers. Therefore, European countries have gradually implemented, following a process still at work, alternative methods to manage waste. These can be categorized as: separate collection of municipal waste fractions, incineration, mechanical-biological treatment (MBT plants), composting. Moreover, in order to implement the Landfill Directive, European countries have also introduced measures to increase landfill costs, as the landfill tax. They have also supported the development of markets for compost and other recycled materials and have strengthened regional responsibilities and cooperation.

According to the European Environment Agency (EEA, henceforth) 2009, the Landfill Directive has notably impacted on areas where the diverting process from landfill was not already working (i.e. Italy and Hungary). To a much lesser extent the Directive has affected areas where the diversion procedure was begun before the Directive's enactment (i.e. Germany and the Flemish region).

As concerns Italy, before the Directive's adoption, precisely in 1995, 82% of its BMW was landfilled. Only in 2003 the European Landfill Directive became law, albeit a landfill tax was been introduced in 1996 (EEA, 2009). Over the years, although there has been a remarkable improvement, Italy has kept on placing oneself above the average percentage of waste disposed in landfill (Fig. 1).

In fact, according to ISPRA 2012, in 2010 only 10 out of 20 Italian regions (Piemonte, Lombardia, Veneto, Friuli-Venezia Giulia, Trentino Alto Adige, Emilia Romagna, Toscana, Campania, Calabria, and Sardegna) turned out to be conform to the 2008 national target (to reduce the amount of BMW landfilled to 75% of the total amount of BMW generated in 1995). Moreover, only 5 regions (Lombardia, Veneto, Friuli-Venezia Giulia, Trentino Alto Adige, and Emilia Romagna) have complied with the 2011 target (to reduce

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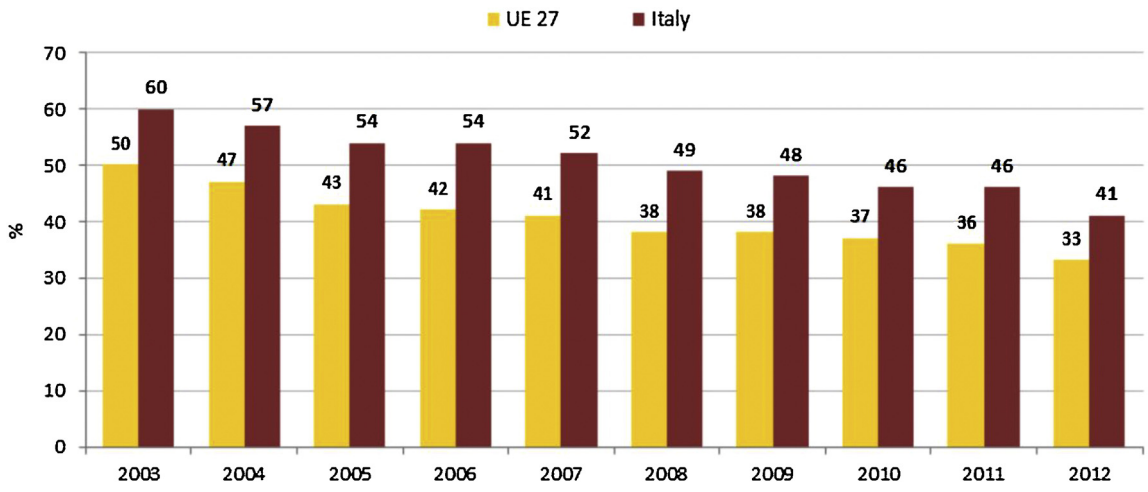

Fig. 1. Percentage of waste disposed in landfill in EU and Italy (*until 2012*). Source: ENI (Ente Nazionale Idrocarburi)[1]

the amount of BMW landfilled to 50% of the total amount of BMW generated in 1995). As a matter of fact, Italian regions have chosen different alternative methods to landfill. According to EEA (2009), composting and incineration are more common strategies in the North because of a greater development and a bigger propensity to invest. In the South, especially in Campania, investments in new incineration have been obstructed by the public because of the availability of old technologies potentially dangerous for the human health. Southern regions prefer to build MBT plants and produce Refuse-Derived Fuel.

In particular, the Campania region case is emblematic. In fact, while data (ISPRA, 2012) confirm that Campania region has already met the 2008 national target, it has recently become the symbol of the one of the most serious waste crises in the world. Not only, as it is highlighted in D'Alisa et al. (2010), Campania region features about 2500 contaminated and polluted areas. Some contributions attribute this mismatching between data and "facts" to the coexistence of legal and illegal landfill (D'Alisa et al., 2010; Iacuelli, 2007[2]). Over the last decades, the latter has represented a big business for camorra (the regional mafia). This has generated toxing waste, considerably damaging the environment and, consequently, the health of people living in particular areas of the region. At this regard, an important contribution by Senior and Mazza (2004) has demonstrated that there does exist a positive correlation between growing cancer rates and the number of landfill areas. Therefore, they have identified the so-called *Triangle of Death* whose perimeter touches the cities of Acerra, Nola and Marigliano[3]

Waste management and in particular landfill diversion depend upon several factors (D'Amato et al., 2013; Highfill and McAsey, 1997; Johnstone and Labonne, 2004; Mazzanti et al., 2009; Mazzanti and Montini, 2009; Shinkuma and Managi, 2011). Among the most important drivers, the literature on the "economic of waste" points out the socio-economic context that differs not only at regional level but also, and importantly, at provincial level. This also helps to explain the Campania waste crisis.

This paper aims to analyze the waste management process in Italy providing guidelines to reduce landfill, which still represents one of the most important goals of European environmental policies (Mazzanti et al., 2009). Analyzing the data of the 103 Italian Provinces for the year 2011, we investigate the territorial aspects of the waste management process. As a matter of fact, given the proximity to the local communities, local governments are considered in a better position than national governments (Lewis, 2000). In the first part of the paper we provide a general statistic summary of the waste management process (i.e. separate waste collection and landfill disposal). In the second part we provide a statistic/econometric analysis of the waste management process with a focus on waste disposed in landfills. Starting from the analysis of the correlation coefficient, we move on to cluster analysis that allows us to identify a possible dual structure in the waste management process. We then proceed to verify the presence of spatial correlation processes that enable us to identify spatial clusters. In this regard, we make reference to techniques of spatial statistics: bivariate Moran's I and bivariate LISA cluster map.

Our results first show a dual structure in the distribution of landfill disposal rate. Second, they importantly suggest that institutional quality and pro-environmental behaviour are significant factors in the waste management process. Our work is akin to Mazzanti et al. (2009). However, while they use a dynamic approach, we carry out a cross-section analysis to stress the spatial interrelationship among Italian provinces. This is our main contribution to the literature. Moreover, differently from Mazzanti et al. (2009) we focus on the institutional quality aspect, resulting as one of the most important determinants of the local economy's development and its capacity for growth (Nifo and Vecchione, 2014).

The rest of the paper is organized as follows. Section 2 presents the main features of the study area. In particular, first we refer to the Italian environmental legislation regulating landfill and separate collection. Second, we collect data on recycling and disposal in landfills; showing a preliminary analysis on the relationship between these two variables. Section 3 develops an empirical investigation on waste management for Italian provinces. In detail, the section features three important subsections. In Section 3.2 we analyze the landfill disposal rate (LDR) by calculating the coefficient of correlation between LDR and the other variables. In Section 3.3 we apply cluster analysis to identify groups of provinces, heterogenous between the groups, but rather homogeneous within each group. In Section 3.4 we develop the spatial analysis, using tool of spatial statistics allowing to test for local spatial autocorrelation and to identify local clusters where contiguous areas show similar values. Among the various possible tools to be used for this purpose, we use the bivariatate Moran Index and the bivariate Local Indi-

[1] ENI web site: http://www.eniscuola.net/en/mediateca/percentage-of-waste-disposed-in-landfill-in-eu-and-italy/; last access February 2016.

[2] http://www.agneseginocchio.it/Documenti%20Uttaro/Levieinfinitedeirifiuti.pdf (Last accessed on 20 February 2016).

[3] According to municipal data, about 59,500 citizens live in Acerra, 34,300 in Nola and 30,000 in Marigliano. Overall, also taking into account areas outside the administrative perimeters, around 550,000 people live within the Triangle of Death. These information make the idea of the gravity of the phenomenon.