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A multi-scale analysis of urban waste metabolism: density of waste disposed in Campania

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ABSTRACT

The waste crisis in Campania has inspired a vast amount of studies. Nevertheless, very little research has been done to explain the figures of waste generation and disposal in the region. The analyses carried out so far according to the indicators used by official statistics – i.e. Waste Generated, Waste Generated per capita and Separate Collection – fail to represent this *hot spot* case. This paper attempts to bridge this gap. Adopting the rationale of a new accounting system, the Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM), two waste indicators are proposed to complement the conventional ones: the Metabolic Rate of Waste and the Density of Waste. Then a multi-scale analysis of the Density of Waste Disposed (DWD) tests its suitability to characterise Campania's waste patterns. The data cover the period from 1999 to 2007. The results show that the DWD complements available indicators and further helps to explain the biophysical pressure and ecological unsustainability of the waste management in the region. The multi-scale analysis shows that regional data hide a relevant territorial diversity, emergent in the provincial analysis and even more so in the municipal one. These results have implications for governance and for the debate about mono-scale versus multi-scale solutions to waste management problems. Finally, the analysis allows some analytical generalisations on the suitability of the DWD to detect situations of potential waste crisis in other study-contexts.

1. Introduction

Waste management is causing growing concern due to emissions into soil, water and air, - such as leachate, methane, heavy metals, CO_2, dioxins, etc - as well as social conflicts around disposal sites and loss of resources and energy. These issues are amplified by demographic changes, economic growth, the increasing complexity of technological solutions and the unequal distribution of impacts. This complex picture, whose social, economic and political aspects are necessarily interlinked, makes waste management a fundamental system that must be analysed if a transition to a sustainable society is to be achieved (Seadon, 2010). A sound discussion about sustainability should adopt a bio-economic approach and take into account the unavoidable waste associated with all production processes of modern societies, as first pointed out by Georgescu-Roegen (1971).

More than one decade ago, scholars denounced the missed achievement of waste reduction (de Jong and Wolsink, 1997); indeed, in spite of cleaner production efforts and prevention policies, waste generation continues to rise (Ekvall, 2005). Sustainable household consumption patterns are still far from being reached; therefore an integrated approach could help take relevant steps in this direction (Caeiro et al., 2012).

Waste is one of the key areas of environmental policy and waste hierarchy – preference for waste reduction over recycling, incineration and landfilling[2] - has proven a valid rule of thumb by the Life Cycle Analysis (Finnveden et al. 2005; Moberg et al. 2005).

Common sense tells us that waste generation and disposal rates are related to population density, economic strength, available technology, and political decisions. However, when

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[2] Even if some assumptions and valuation can make landfilling more preferable (Moberg et al., 2005).

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generating an integrated analysis of all these factors, analysts are forced to face a serious epistemological challenge in the resulting quantitative representation: the issue of multiple scales. When applying quantitative analysis a technical conundrum is caused by the issue of scaling, about how to "deal with the information transfer between levels of the organization (including changes in the associated scales) not only within each dimension but also between dimensions" (Ewert et al., 2011). In the face of this challenge it is not always simple to translate common sense perceptions into effective quantitative representations. For example, when assessed at the local scale, an increase in efficiency has the effect of reducing the consumption of resources, whereas, when considering the implication of the same change at a larger scale we can observe the opposite result – this is known as the Jevons paradox (or rebound effect) – (Polimeni et al., 2008). For this reason, the paper addresses the problem of how to bring about a useful description of waste generation across multi-scales and make it possible to identify the role that extensive (e.g. size of population) and intensive (e.g. consumption per capita) variables play in generating the overall load of waste to be processed. Such a description should be able to characterise socio-economic units defined at different hierarchical levels (household, municipality, province, region, whole country) developing indicators capable of analysing similarities and differences of these social units in time, across geographical regions. By using this multi-scale integrated characterisation it should be possible to detect the possible occurrence of critical emergencies.

The analysis of waste management patterns basically relies on the information provided by four main indicators: the total amount of Waste Generated, the Waste Generated per capita, the fraction of Separate Collection and the Waste Disposed. These indicators are used by official statistics to develop rankings among countries or regions (Eurostat, 2010; OECD, 2008; ISPRA, 2001-2008). They are also used as inputs in both the theoretical and empirical models carried out to evaluate the effects of waste policies (Mazzanti et al., 2009; Zhang et al., 2010; Nicolli et al., 2011).

Still, current analyses based on conventional indicators describe on average Italian waste patterns, but do not explain "*specific hot spots …e.g. the well known case of Naples and Campania region*" (Nicolli et al., 2011, p. 12). We argue that such indicators need to be integrated with new ones to give a more exhaustive picture of waste metabolic patterns and, more directly, to assess the environmental burden of waste disposal in Campania.

Even though a vast amount of work has been carried out to deal with the Campania waste crisis, no one has yet given a deep analysis of the problem on the basis of the figures of waste generation and disposal in the region. This work attempts to bridge this gap by enacting an *ad hoc* case study to scrutinise the characteristics of the Campania hot spot (Nicolli et al., 2011).

By means of a new system of accounting – the Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM) – we propose two new indicators: the Metabolic Rate of Waste and the Density of Waste. Then, we test a multi-scale analysis of the Density of Waste Disposed to describe the waste management patterns of Campania and give corraborative evidence of their environmental impact of these, as new information flows are able to do when applying an integrated approach (Seadon, 2010).

The rest of the paper is organised as follows: Section 2 provides a description of Campania's case study. Section 3 presents the conceptual basis of the MuSIASEM and its application to the analysis of waste metabolism. Section 4 carries out the multi-scale analysis at regional and provincial level, followed by an analysis among Campania's municipalities. Section 5 discusses the main results and Section 6 draws some general conclusion.

2. The Campania case study

2.1. Background story

Campania and its capital, Naples, are the icons of waste mismanagement in Europe. Hundreds of articles in international newspapers and thousands of websites and blogs have diffused news of this socio-ecological disaster. Still, for D'Alisa and Armiero (2011) the available information fails to provide a deep and plural understanding of this hot spot case, one which, furthermore, acts as an outlier in different models for the analysis of Italian waste patterns (Mazzanti et al., 2009, Nicolli et al., 2011).

The standard narrative is that the Campania waste emergency could be easily solved if the policies proposed by the government and experts were effectively and fully implemented, overcoming the preposterous opposition from local protestors. An example of this overly simplistic narrative is an editorial in The Economist (2008a). The author claims that:

> The underlying problem is that Campania has no modern incinerators. This is because plans to build them have met determined, and often aggressive, opposition from local people. Their protests are frequently backed, if not orchestrated, by Campania's powerful organised-crime group, the Camorra, which makes succulent profits from disposing of waste in illegal dumps

According to this reading, the Campania community's protesters, encouraged by the camorra, have blocked the enactment of an effective waste policy (The Economist, 2008b). It fails to admit another possibility, namely, that the government may have been grossly negligent in assessing the dimensions of Campania waste crisis. On the contrary D'Alisa et al. (2010) have argued that it is possible to speak about the waste crisis as a crisis of democracy. Since 1994, the ongoing failure to plan new waste facilities has been largely due to the poor quality of inputs provided by both politicians and technical experts. These socio-political actors have helped to cultivate speculative interests (Laino, 2010). A deepening authoritarian stance of political decision-making has further put the lives and livelihoods of local communities at risk. This crisis of democracy has created the context for the camorra's business proliferation and for policy failures and has dramatically increased civil unrest. The challenge of sustainable waste management has been met with a top-down planning disaster without any possible participation of the citizens (Lieto, 2009).

The complex picture of the problem of waste management in Campania can be obtained by looking at several studies, dossiers, books and papers that have appeared during the last decades. Distinct aspects need to be taken into account, such as: the abuse of legal power by the government and the institutional responsibilities of waste mismanagement (Lucarelli, 2007; Raimondi, 2007; Rabitti, 2008); the social, economic and political implications of illegal trade of toxic waste (Iacuelli, 2007; Fontana et al., 2008; Barbieri and Piglionica, 2007); the impacts of legal and illegal landfilling on the environment and human beings (Senior and Mazza, 2004; Comella, 2007; de Medici, 2007; Ortolani, 2008; Fazzo et al., 2008; Martuzzi et al., 2008); and the impact of activists' and the experts' discovery of the inter-linkages between society and nature (Armiero, 2008).

In spite of this deluge of analysis, the figures of waste generation and disposal in the region, which reveal the biophysical root of the problem, have not been duly analysed so far. Hence, the idea that conventional indicators are not sufficient to explain the waste crisis in Campania has remained a silent thesis until now, with just a few exceptions among scholars (e.g. D'Alisa et al., 2010; Laino, 2010) and local activists. In particular, discussions with Genovese A.,