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Household waste compositional analysis variation from insular communities in the framework of waste prevention strategy plans

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ABSTRACT

Waste management planning requires reliable data regarding waste generation, affecting factors on waste generation and forecasts of waste quantities based on facts. In order to decrease the environmental impacts of waste management the choice of prevention plan as well as the treatment method must be based on the features of the waste that are produced in a specific area. Factors such as culture, economic development, climate, and energy sources have an impact on waste composition; composition influences the need of collecting waste more or less frequently of waste collection and disposition. The research question was to discover the main barriers concerning the compositional analysis in Insular Communities under warm climate conditions and the findings from this study enabled the main contents of a waste management plan to be established. These included advice to residents on waste minimisation, liaison with stakeholders and the expansion of kerbside recycling schemes.

1. Introduction

Waste management planning needs reliable data concerning waste generation, influencing factors on waste generation and forecasts of waste quantities based on evidences. Information about related influencing factors is vital for estimating the consequences of changes in general conditions (e.g. economic system, demography, domestic heating systems), policy measures (Mazzanti and Zoboli, 2008) or waste management measures (e.g. increasing the rate of home composting) on upcoming waste quantities (Zorpas and Lasaridi, 2013). Thus forecast models should include multiple factors and predictions according to social and economic changes (Purcell and Magette, 2009; Chung, 2010).

Municipal solid waste (MSW) management systems are becoming more complex in many countries as well as in insular communities with the move from landfill-based to resource recovery-based solutions, following the setting of international and national targets, to divert waste from landfill and to increase recycling and recovery rates. Local authorities need waste compositional information at the local level to plan, organize, develop, implement and observe waste management schemes that will facilitate them to meet their contribution to the National targets (Burnley, 2007; Zorpas and Lasaridi, 2013). The total amount of municipal solid waste has been continuously increasing for the last 30 years and the problem of the disposal or management of those wastes are more difficult in small islands due to the limited space. In 2008 (Eurostat, 2011), the total waste generation in the EU-27 was up to 2.62 billion t. This was slightly lower than in the years 2004 and 2006 where the EU-27 total amounted to 2.68 billion t and 2.73 billion t respectively. In 2008, 98 million t or 3.7% of the generated total were classified as hazardous waste. This means that per capita in 2008 each EU citizen produced on average about 5.2 t of waste, of which 196 kg were hazardous, while during the year 2012 this amount increased from 2 to 10% per capital (Eurostat, 2011; Zorpas et al., 2012a). Small Countries (which are islands) like Cyprus and Malta and other small islands in Mediterranean like Sicily, Crete etc, wastes are continual increase as those destinations are the main tourist resorts in Tourist Industry (Zorpas et al., 2012a; EEA, 2013). Also they present similarities as they have urban, mountainous, rural and purely tourist regions. Sicily for example landfilled 93% of its generated municipal waste (EEA, 2013) while Cyprus up to 90% until now (ENVITECH, 2013). Although the total quantities of wastes are sufficient for the development of a central waste to energy plant, due to the absence of specific strategic policy, wastes are proceeded for landfill. On the other hand, building incineration plants may not be economically

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efficient and waste reduction strategies may not be very effective for small islands according to Chen et al. (2005). Furthermore, significant weaknesses according to Santamarta et al. (2014) of the waste management system in insular communities are based on infrastructure and lack of local recycling programs.

As far as the household level is concerned (Eder et al., 1983; Dennison et al. 1996a,b; Bandara et al., 2007; Benitez et al., 2008) it is easier to identify valuable quantitative and qualitative information regarding the standard of living and the cost living. Studies at the national or centralized level (Bogner et al., 1993; Daskalopoulos et al., 1998; Mazzanti and Zoboli, 2008) or the analysis of time series of a single region (Chung, 2010) discover general correlations, such as the interface between MSW and gross domestic product (Bogner et al., 1993; Daskalopoulos et al., 1998) and could be interesting at a high political level. Nevertheless, they cannot be used for precise planning (waste prevention or waste management or zero waste approach) at lower regional levels, since no information is provided for the spatial distribution which is considered equally essential, as the gross quantity of waste, concerning waste management planning (Purcell and Magette, 2009).

Furthermore, compositional analysis technique is used to estimate in detail the nature, scale and origin of food waste with survey work on household attitudes, claimed behavior and socio-demographics (WRAP, 2008; Zorpas and Lasaridi, 2013). When using this approach, it is a good practice to verify the data using separately collected data on MSW generation, treatment and disposal, especially in cases where they are based largely on modelling. This method is only more accurate than the approaches given above if countries have good quality, detailed data on each end point, and have verified the information (IPCC, 2006; Zorpas and Lasaridi, 2013). Waste composition is one of the main factors influencing emissions from solid waste treatment, as different waste types contain different amount of degradable organic carbon and fossil carbon. Waste compositions, as well as the classifications used to collect data on waste composition in MSW vary widely in different regions and countries (IPCC, 2006; Zorpas and Lasaridi, 2013), as well as is influenced by many factors, such as level of economic development, cultural norms, geographic location, energy sources, and climate (Lebersorger and Beigl 2011)

This paper focuses on the waste compositional analysis from insular communities in the Easter Region of Cyprus. Through the waste compositional analysis (WCA) is estimated how the management plan is being affected and how the cost of living affects the waste production. Hence the data will be used for the development of the new zero waste approaches that Municipality Councils wants to implement.

2. Materials and methods

2.1. Model region

Municipality of Paralimni is based on the Eastern Region of Cyprus (Map 1) and According to the last inventory studied which was carried out by the Cyprus Statistical Services on November 2011 the permanent population are 18,601. However, as the Municipality consists of the main economical lungs of the island due to the fact that in this area there are the largest hotel resorts the permanent population increases during the tourist period (April–October) from 45,000 to 75,000. There is no any major waste consuming industries in the project area, and according to the available development plants the situation will remain the same in the future. 115 Hotels and apartments are presented according to the Cyprus Tourist Organization (2010), almost 6000 houses (on which the 70% belong to the more Urban Area (inland), 5 petrol stations and more than 12 cars cleaning services,

approximately 20 machinist's craftsmanship, small industries like bakeries, confectioneries, car wash, food suppliers, supermarkets, schools (5 primary, 2 secondary has the ability to guest almost 2500 students), clinical laboratories, 2 private clinics and 1 public hospital, football fields and athletic activities, chicken farms (approximately 30,000 chicken/y), 2 big laundries, 1 concrete plant, 1 waste water treatment plant, and some small industrial activities which don't produce liquid waste consist the main activities of the Municipality (Zorpas et al., 2011; Zorpas et al., 2012a; Zorpas et al., 2013; Zorpas, 2013).

2.2. Municipality waste data

According to Zorpas et al. (2012b) the current waste management plan (for the Municipality) consists of the collection of the mix waste (door by door) twice a week and their transmission in the Koshis Municipal Waste Treatment Plant (KMWTP) which is about 65 km from the Municipality of Paralimni traveling to the Capita Town. The KWMTP was constructed as a BOT (Build Operation and Transferred) plan. According to the Ministry of Interior Affairs KWMTP, for a period of 10 years, will be run under a private commercial company.

The total amount of mix waste according to 2011 data was 15,100 t, at the end of 2012 was up to 16,250 t and at the end of 2013 was 16,865 t. The recycle materials are collected from Green Dot Cyprus (GDC) twice a month and the total amount for the year 2011 were 962,615 kg, for the year 2012 were 1,032,256 kg and at the end of 2013 were 107,590 kg. There is a zero charge policy from GDC for the collection of PMD and glass. However, there is specific charge for the paper which includes the collection and the rent of the recyclable brown bins. The Municipality pays 65% of the total cost while the rest is covered by GDC. Per tone of waste paper the total amount is up to € 166.63.

The total cost (gate fee of KWMTP, which cover only processing and disposal) for the year 2011 was up to 1.47 m €, for the year 2012 was up 1.59 m € while at the end of 2013 was up to 1.62 m €. Those amounts were paid to the KMWTP directly from each Municipality that is participated in the system and the Municipalities charge directly their citizens. According to the Clauses 84Z, of the National Law N(I) 111/1985, any Local Authority is authorised to charge waste fees according to the follow principle: (i) for houses (regardless of square meters) maximum 171 €/year, (ii) for shops, stores, coffee shops and similar up to 855 €/year, (iii) for restaurants, bars, tourist apartments up to 6848 €/year, (iv) for Hotels up to 17,100 €/year and (v) for industries, private hospitals or other manors not included above fees up to 13,680 €/year.

KMWTP charge 54.8 €/t for the mix waste (household), 46.8 €/t for the green waste, 80.80 €/t for the recyclable waste and 100.80 €/t for the rest of the waste streams (like furniture, equipment etc). During 2006, Ministry of Interior Affairs Develop a Strategic Plan for a Green Point Network (GPN) in Cyprus. The plan focuses on the recycle waste in the whole island and for the collection of several special wastes (like furniture, WEEE, equipment's etc.). According to this plan, Municipality of Paralimni has two GPN which until now have never been established. The reasons are due to economic crisis and due to the fact that the one is very close to a sensitive NATURA 2000 (CY3000005) area and the Impact assessment study hasn't finished yet.

2.3. Waste compositional analysis

Until the end of 2011 there wasn't any compositional analysis of the Municipality. The waste characterization study was carried out for a period of summer (2 weeks during August, 2012), autumn (2 weeks October and November of the year 2012), winter