Assessment of municipal waste management policies by the citizens of Orestiada, Greece

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ABSTRACT

Municipal waste management constitutes a pivotal challenge that Greek cities are to face in accordance with the rapid technological and institutional advances that are closely affiliated with sustainability and quality of life.
In the case study the citizens'views and perceptions on local waste management policies were recorded. The survey was conducted in Orestiada, a Greek city where recycling programmes were introduced very recently (6 months ago), with the use a structured self - management questionnaire. The citizens were called to assess the various means they use in order to derive information for waste management issues. Finally, they were asked to assess the local waste management policies.
The citizens' acceptance is based on waste management measures such as recycling of useful materials, recovery for new use, special management for hazardous waste, reduction of waste production by the citizens, source separation systems, the production of soil fertilizers, waste to energy practices such as incineration and biogas exploitation, the placement of special bins for the organic waste, the proper management of sanitary landfills such as daily coverage with soil and waste weight for every Municipality, as well as its proper rehabilitation. The citizens also argue that additional profits arise from waste management fees while that waste management is a common field for political conflicts.

KEY WORDS: Orestiada, waste management, means of information, quality of life, citizens' views, reliability analysis, factor analysis

INTRODUCTION

In the beginning of the 21st century the pivotal environmental problem that modern Municipalities are to face is effective waste management involving integrated systems, strategies, measures and also motivations for the citizens in order for them to adopt environmentally friendly attitudes. The reduction of waste production and the proper treatment of waste on a tailor – made plan for every different case, are some of the issues standing on the top of the agendas in international conferences for environmental problems closely affiliated with climate change [1].
Whereas, in Greece waste management issues are resolved with the implementation of conventional and also outdated solutions which perpetuate certain environmental, social, financial and political problems. In fact, according to [2] the main waste management method Greece implements is sanitary landfilling, while recycling and recovery for new use are still holding low percentages. According to [3] and [4] Greek citizens acknowledge that recycling is an effective method with many environmental and financial benefits whereas they claim that public awareness is inadequate and at the same time they have limited access to relevant information. Not to mention, that in many cases citizens have limited knowledge on the cleanness regulation and waste treatment methods embedded across their area ([5], [6]). However, some of the major factors affecting policy planning, such as land demand has made other overpopulated countries, like China, to move towards incineration methods [7]. While, another method which is though environmentally friendly is composting. According to [8] composting, comprises an ideal solution for the full use of the organic fraction if sorted effectively from metals, stones or other wastes and can be also used as soil fertilizer. Furthermore national policies are oriented towards source separation systems in order to ensure clearer useful materials collected from the recycle bins, as paper, plastic, glass etc [9].
As regards landfilling, it is still a necessity at least for the remaining fraction of waste after treatment or as mentioned before as the main method for waste management through disposal, which is nonetheless the least environmentally desirable method. There is also a need for special treatment of hazardous waste which is not acceptable to be disposed without incineration or other special treatment. For instance, healthcare waste contaminated with blood and radioactive waste are listed as hazardous waste, which in case of disposal, mixed with municipal solid waste, can serve as serious soil, air or

water pollutants ([10]; [11]). In addition, as for sanitary landfilling [12] appraise the importance of the proper waterproofing of the cells as according to [13] landfill bioreactors that take place within the cells, are based on an acceleration of in-situ waste biodegradation by performing leachate recirculation, containing organic and inorganic pollutants. Moreover, it is also significant for the proper management of the landfill that waste are compressed and covered with certain quantities of soil on a daily basis [12]. Last but not least, it crucial that biogas, which is the released by the anaerobic digestion of the organic disposed waste [14] should be recovered and used for power, heat of combined generation ([7]; [15]).

Despite that there are many tools for every Municipality to manage its waste, sustainable waste management constitutes an integrated process including complex and sophisticated methods and technologies which inevitably increase management costs. Citizens' willingness to pay these costs is usually affected by demographic characteristics, such as age, annual income, education and other factors [16]. While, the Municipality is charged with cost-benefit analysis and implementation of direct charging systems for waste management addressing the citizens. This costs are closely affiliated with waste weighting. Flat charging models as tax – based system and Pay-As-You-Throw (PAYT) strategies are used for charging management of waste flows [17]. While, the last decade there has been a great interest in moving towards PAYT strategies as citizens are to pay in accordance with their individual waste production rate and the use of provided services, where different ways of waste treatment are charged accordingly (disposal, waste to energy, recycling etc) ([18]; [20]).

Not to mention that far from its complexity waste management frame is followed by policies that are designed and aspire to be implemented into an era of barriers and conflicts within the different stakeholders ([1]; [19]). According to [21] local people usually react with "Not in my backyard" behaviors when local authorities present a new plan for the construction of a waste management plant of a sanitary landfill near their area. While [22] claim that such disapproving attitudes are closely affiliated with ineffective functioning of similar waste management plants with negative impacts on human health (unpleasant odors, fires, noise pollution, and traffic) and fall of land value for the broader area. Not to mention that the land value of this areas after their rehabilitation is also calculated in costs of construction and management of a sanitary landfill [23].

The aim of this paper is to examine the views of the citizens of Orestiada on waste management policies – strategies, such as recycling, on a local and national level and also how the non - existence of a sanitary landfill in their area influences their attitudes towards waste management policies – strategies. Also the residents' views on the means of information for waste management issues were recorded.

METHODOLOGY

The Municipality of Orestiada formed the research area. Simple random sampling was applied, due to its simplicity and the fact that it requires less possible knowledge about the population, compared to any other method ([24]; [25]; [26], 1999). The population under investigation was the total of the citizens in the Municipality of Orestiada. The estimation of the arithmetic mean and the typical error of the population (s), the proportion of the population and the standard error of the proportion of the population (sp), were estimated according to the types of simple random sampling.

In order to estimate the sample size we carried out a pre-sampling for 50 people. Also the sample size for every quantitative and qualitative variable was estimated according to the types of simple random sampling ([24]; [25]). Thereby the actual population proportion and sample size was estimated to 400 citizens (for the probability $(1-\alpha)100=95\%$, $e=0{,}049$ and without the correction of the finite population). The collection data was carried out in 2015 and for their analysis the Statistical Package SPSS was applied.

For the multi – variable «trends in waste management» reliability and factor analysis were applied. To estimate the reliability of any measurement process means defining the degree of variance with regard to the ranking given by the inhabitants of Orestiada. In particular, we mean the degree which is due to real differences (and standard errors) and the degree which is due to inconsistencies of measurement ([27]; [28]). In order to find the internal reliability of a questionnaire we use the alpha co-efficient (or the reliability co-efficient a-Cronbach), in order to find if the data have the tendency to measure the same thing [29]. When the alpha coefficient is 0.70 or higher it is regarded as satisfactory [29], and when it is higher than 0.80 it is regarded as very satisfactory. In practice, lower alpha co-efficients, with values not lower than 0.60 may also be accepted [27].

Factor analysis is a statistical method that aims to find the common factors within a group of variables ([30]; [27]). More specifically, we used the principal components method. The selection of the number of factors is a dynamic process presupposes repeatedly the estimation and evaluation of the

model and in particular we employed the criterion of smooth slope on scree plot. [31]. We also resorted to the rotation of the principal components matrix by using the maximum variance rotation method by Kaiser [32]. Finally, we are interested in finding if there are some factors which can explain the correlations between the variables of our data and attempt to provide an interpretation (if possible) [33]. According to [34], the variables that "belong" to each factor are those whose loadings, on the table indicating the loadings of the factors after rotation, are over 0.5 for that factor.

RESULTS

The citizens' assessment concerning policies – strategies for waste management within a scale from 1 (lowest acceptance) to 10 (highest acceptance) are illustrated in Figure 1.

Therefore the highest acceptance receive recycling of useful materials, recovery for new use, special management for hazardous waste, reduction of waste production by the citizens, source separation systems, production of soil fertilizers, waste to energy practices via incineration, landfill cell waterproofing, biogas exploitation, the placement of special bins for the organic waste, plant trees around the landfill site, proper management of sanitary landfills such as daily coverage with soil, waste weight for every Municipality, proper rehabilitation and available space for new use after the landfill closure, additional profits for the Municipality arise from waste management fees and that waste management constitutes a common field for political conflicts.

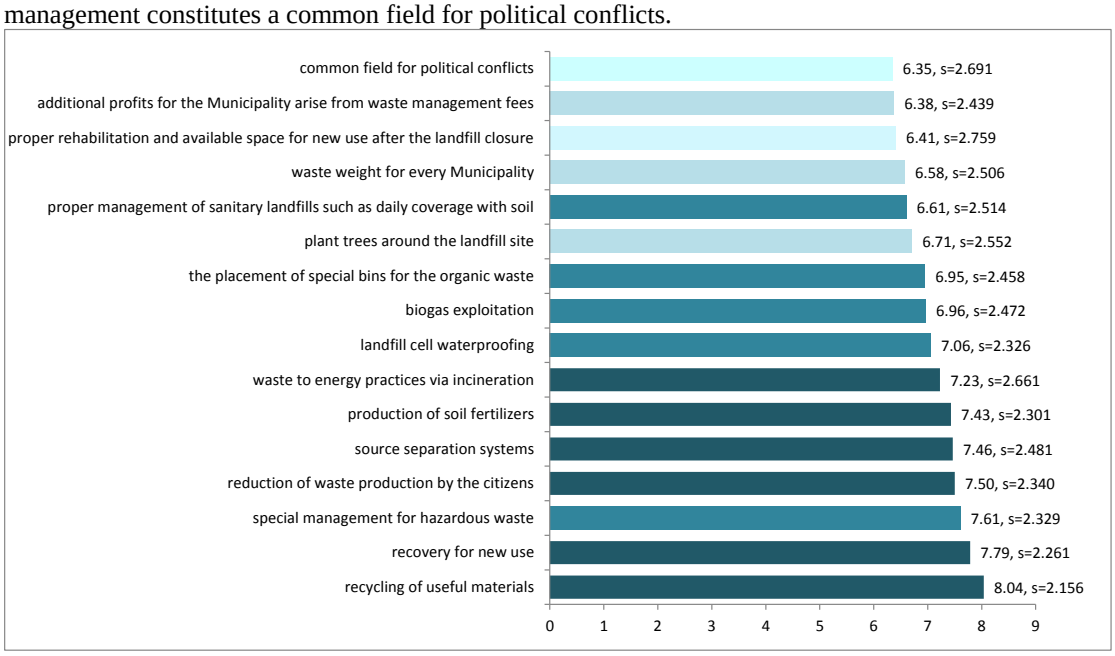

Figure 1. Citizens' assessment concerning policies – strategies for waste management

To the above questions, after completion of all necessary checks, we applied reliability analysis. The value of the reliability coefficient alpha is 0.888. This constitutes a strong indication that our data have the tendency to measure the same thing. Before proceeding with the factor analysis, we conducted all the necessary checks. The value of the Keiser-Meyer-Olkin indicator was 0.879. Furthermore, Bartlett's test of sphericity rejects the null hypothesis that the correction table is unitary and that the partial correlation coefficients are low. The fact that the measures of sampling adequacy have high to very high values also supports the view that the factor analysis model was acceptable. The results of factor analysis are recorded in Table 1. Table 1 lists the load of the partial correlation factors of the sixteen variables with each of the four factors extracted from the analysis. The higher the load of a variable in a factor, the more this factor is responsible for the total degree of variance of the considered variable. The burdens are given in bold show which variables included to each factor.

Table 1. Table with factor burdens, after rotation.

Variable	Factor burdens			
	1	2	3	4
Special management for hazardous waste	**0.713**	0.373	0.011	0.014
Landfill cell waterproofing	**0.700**	0.193	0.260	0.100

Daily coverage of the waste with soil	**0.636**	0.025	0.272	0.313
Biogas exploitation	**0.617**	0.231	0.093	0.316
Placement of special bins for the organic waste	**0.524**	0.196	0.447	0.055
Recovery for new use	0.112	**0.839**	0.146	0.189
Recycling of useful materials	0.465	**0.707**	-0.017	0.050
Reduction of waste production by the citizens	0.040	**0.645**	0.320	0.146
Waste to energy practices via incineration	0.326	**0.618**	0.176	0.061
Production of soil fertilizers	0.546	**0.576**	0.016	0.136
Source separation systems	0.467	**0.490**	0.231	-0.109
Additional profits for the Municipality arise from waste management fees	0.167	0.026	**0.847**	0.003
Waste weight for every Municipality	0.085	0.364	**0.706**	0.142
Plant trees around the landfill site	0.305	0.205	**0.483**	0.357
Common field for political conflicts	-0.014	0.194	0.139	**0.776**
Proper rehabilitation and available space for new use after the landfill closure	0.369	0.011	0.012	**0.700**

The first factor includes the variables „Special management for hazardous waste“, „Landfill cell waterproofing“, „Daily coverage of the waste with soil“, „Biogas exploitation“ and „Placement of special bins for the organic waste and it can be titled as waste management policies – strategies concerning the landfill site. The .second factor involves the variables „Recovery for new use“,”Recycling of useful materials“, “Reduction of waste production by the citizens“, ‘Waste to energy practices via incineration“, ‘Production of soil fertilizers“, “Source separation systems“ and it can be named as general waste management policies – strategies.

The variables “Recycling of useful materials“ “Production of soil fertilizers” and „Source separation systems“ receive high rates at both first and second factor serving as a bridge between them and stressing the correlation between general policies and the policies and measures affiliated with landfill sites.

The third factor titled waste management policies – strategies concerning the Municipality and consists the variables „Additional profits for the Municipality arise from waste management fees”, “Waste weight for every Municipality”, “Plant trees around the landfill site”.

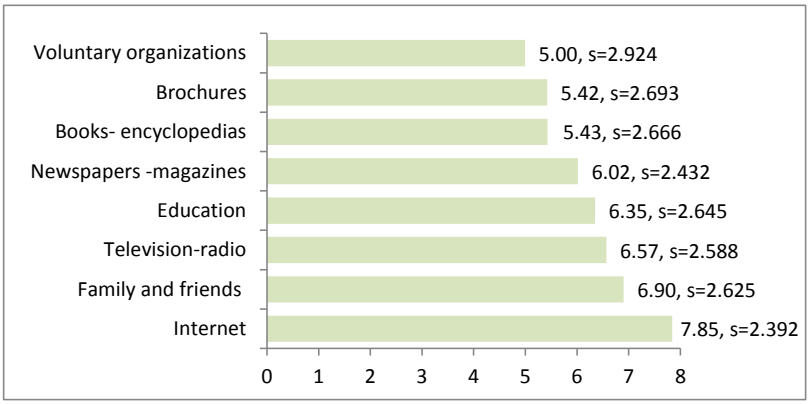

Figure 2. Citizens’ assessment concerning means of information for waste management issues

The fourth factor includes the variables “Common field for political conflicts” and “Proper rehabilitation and available space for new use after the landfill closure” and can be titled as waste management policies – strategies that do not affect the citizens of Orestiada as there is not any landfill site in area while there are not any plans by the Administrative Authorities for the construction of a landfill site in the Municipality of Orestiada.

The citizens’ assessment concerning means of information for waste management issues is presented in Figure 2. Overall, the citizens report lack of information especially as regards voluntary organizations, while most of them consider the internet as the most important source of information for waste management issues.

CONCLUSIONS – SUGGESTIONS

The citizens of Orestiada are environmentally conscious in waste management issues on an integrated basis. Recycling and reuse issues are of outmost importance for them.

Moreover, certain policies and strategies such as waste prevention, source separation systems, production of soil fertilizers and waste to energy through incineration are also issues stand out for their significance, according to the citizens. In fact, the aforementioned variables are classified in the same factor titled general waste management policies – strategies, which reveals that citizens acknowledge how important is to incorporate these policies into the local waste management plan for the city of Orestiada

Next in the sequence come waste management policies – strategies concerning the landfill site and the Municipality. Not to mention that the last factor titled waste management policies – strategies concerning the Municipality includes the variables that are regarded as less important as there are not any plans for the construction of a landfill site in the geographical area of Orestiada.

Nevertheless, when aiming to successful waste management results, taking into consideration only the technical parts of the problem is not a solution. There are specific strategies and measures the Municipality has to apply and certain cleanness regulations to control the whole procedure, from waste production and minimization to collection, treatment and final disposal. Some of the important parts of this procedure are the waste weight and the management of the additional costs the Municipality receives from the existence of a waste management plant across its territory.

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