Waste management in urban environments: insights of the citizens' views in a densely populated municipality in Greece

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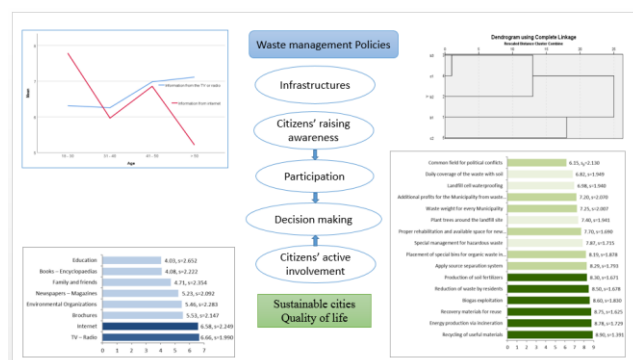
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Graphical abstract

Abstract

Urbanization, industrialization and economic growth have considerable challenged the orientation of waste management policies and practices. Major concerns appear in urban environments, as they receive increased volumes of waste, which in turn pose threats for the environment and public health. The extension of material's lifecycle through reduce, reuse and recycling could preserve resources and coincide with international strategies for sustainable waste management. However, the citizens' awareness and active involvement, in decision making for sustainable waste management policies practices, are preconditions for their implementation. The study examined the citizens' views on the local waste management policies and strategies in the urban environment of Neapolis-Sykies Greece. The application of factor analysis, hierarchical log-linear analysis and hierarchical cluster analysis provided important correlations regarding the citizens' demographic characteristics, littering behavior, sources of information on waste management issues, perceptions about quality of life and provided cleanliness services. In particular, collection points and collection system are positively assessed, while the value of recycling is widely acknowledged. Albeit, the citizens are not properly informed about local policies and practices related to existing waste management issues in their municipality.

Unfortunately, this is deemed to be a barrier in promoting public participation in decision making processes.

1. Introduction

Overpopulation in urban areas accelerates waste generation, improper disposal practices and environmental degradation (Joshi and Ahmed, 2016; Su *et al.*, 2021). Except for industrialization, modern life style, consumption patterns and social status of citizens in urban centers have led to substantial increase in municipal solid waste generation (Sharma *et al.*, 2018). While, the responsibility of solid waste management remains primarily at the municipalities of metropolitan and sub-metropolitan areas all over the world.

There are several Sustainable Development Goals (SDGs) of the United Nations directly or indirectly linked to solid waste management, which top lists the urgent problem of waste on an international basis. More specifically, SDG 11-Sustainable cities and communities and SDG 12-Responsible consumption and production, are directly related to solid waste management. While, indirect linkages may be found in SDG 3-Good health and well-being, SDG 6-Clean water and sanitation and SDG 7-Affordable and clean energy. Waste prevention policies are now broadly promoted as a response to deal with the tremendous amount of waste generated within the globe annually (Bogiatzidis and Komilis, 2016). Coordinated efforts are focused on the embracement of 3R principles - Reduce Reuse and Recycle - in waste management practices (Priti Mandal, 2019).

To this end, Ikhlayel (2018) argues that municipal solid waste management in complex urban environments requires an integrated approach, incorporating the citizens' views as waste producers and their active involvement, by the enhancement of advanced participatory methods. Mixed waste fractions treatment, disposal technologies and recycling handling methods should arise by holistic approaches. The design and

implementation of certain policies addressing our industrialized and urbanized communities should be mainstreamed across all levels of decision making and secure the minimization of waste generation (Zouboulis and Peleka, 2018).

Moreover, policy making should be based on waste management improvements in local environments, able to bring benefits in the short and long-term planning, in densely populated areas. Whereas, technical aspects and widely practiced approaches of waste collection are impacted by the citizens disposal attitudes and by the operators' patterns. It is indisputable that both, waste producers' and operators' methods, must focus on sustainable waste management practices that would safeguard the environment and public health.

Awareness towards safe disposal of waste could bridge the gap between waste management policies and citizens' attitudes. In addition, the creation of waste management infrastructures by the state is a strong component of sustainable solid waste management, also comprising a factor for sustained and environmentally friendly behaviors by the citizens. In fact, Babaei *et al.* (2015) suggest improving the citizens' awareness on waste management issues along with the provision of the necessary infrastructures for waste treatment. The same, after conducting a thorough investigation in the urban area of Abadan Iran, have also found a correlation between the citizens' demographic characteristics such as age, education, gender, occupation and their attitudes on source separation patterns and recycling.

Recycling is another major issue as informal recycling is a common problem, especially in urban environments. On the one hand, unauthorized collectors earn a living by gathering materials from collection points, on the other hand recycling is losing its cost efficiency, as there is a great loss of resources, resulting in poor resource recovery policies (Fei *et al.*, 2016).

The case study was conducted in Greece, where there is a shortage of waste management infrastructures mainly as regards organic waste composting plants. It should be noted that the existing infrastructures to appropriately manage mixed waste and residual, and enhance recycling are not sufficient in order for Greece to meet 2020 target of 50% preparation for reuse/recycling of municipal waste set out in the Waste Framework Directive of the European Commission (OECD, 2020). According to the recent national waste management plan issued in 2020, 43 waste treatment plants and up to 46 composting plants are going to be in full operation by 2030.

The aim of the study was to investigate the citizens' views on the efficiency and performance of waste management systems in the urban environment, of Neapolis-Sykies, a densely populated municipality in the Regional Unit of Thessaloniki in Greece. Several issues were surveyed addressing quality of life in urban areas, satisfaction with the cleanliness services and waste collection system, as well as awareness on local waste management policies and practices taking place.

The initial hypotheses of the research include the insufficient status of the existing infrastructures in Greece and also in the study area. While, the Municipality of Neapolis-Sykies was admitted to meet the characteristics of an urban environment.

2. Materials and methods

2.1. Methodology

The methodology used is depicted in the flow chart of the research in Figure 1. Firstly, a literature review took place, followed by the design of a structured questionnaire, which was the tool for the data collection. Personal interviews were carried out with 400 citizens of the Municipality of Neapolis-Sykies.
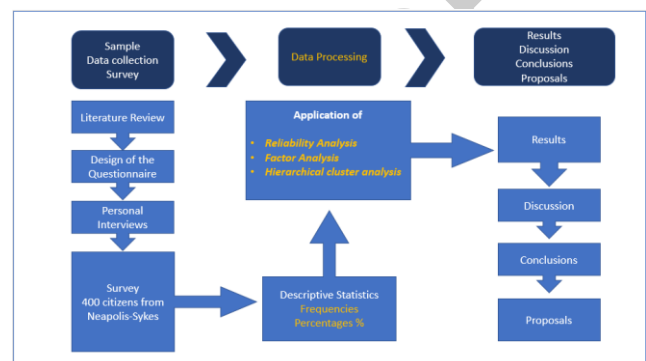

Figure 1. Flow chart of the research.

2.2. Study area and population

The study area was the Municipality of Neapolis-Sykies, a populated area in the urban complex of Thessaloniki, Northern Greece (Figure 2). Administratively, the area belongs to the Region of Central Macedonia, and more specifically, to the Regional Unit of Thessaloniki. The population reaches 84.741 citizens according to the consensus of 2011.

Simple random sampling (SRS) was used due to its simplicity and since compared to other methods, it requires the least possible knowledge of the population (Damianou, 1999; Matis, 2001; Kalamatianou, 2000). The population under investigation comprised by the citizens residing within the boundaries of Neapolis-Sykes Municipality. The mean and standard error (s) of population ratio and standard error (sp) were estimated by the types of SRS.
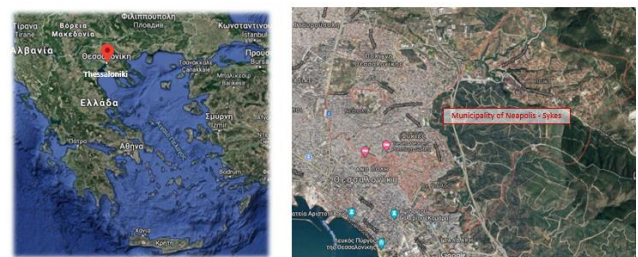

Figure 2. The map of the municipality of Neapolis-Sykies in the regional unit of Thessaloniki, Greece (Source: Google Maps).

2.3. Data collection

To calculate the sample size, a pre-sampling procedure was conducted, addressing 50 citizens. Following, the sample size was estimated for each quantitative and qualitative variable, based on the types of SRS (Kalamatianou, 2000; Matis, 2001). The variables corresponding to the largest sample size were "satisfaction with the cleanliness services provided" and "gender". Thus, the largest sample size was calculated in 400 citizens (for probability (1-a) 100=95%, e=0.049 and without finite population correction). The data collection took place in 2019. SPSS statistical package was used for the analyses of the collected data.

2.4. Data processing

The data processing took place by descriptive statistics, reliability analysis, factor analysis and hierarchical cluster analysis. The statistical package SPSS 16 and SPSS 27 were used for data analyses. The performance of descriptive statistics supported the preliminary outline of the results and data classification. The results generated frequencies and percentages.

2.4.1. Reliability analysis

Reliability analysis was applied to the multivariables "trends in waste management" and "sources used by the citizens to obtain information on waste management issues". The evaluation of the reliability in every measurement process determines the degree of variation in scores for individuals, created by the discrepancy between measured values and actual or true values (standard errors), and by measuring inconsistency (Filias et al., 2000; Siardos, 1999). In particular, alpha or α-Cronbach reliability factor is used to find the internal reliability of a questionnaire (Fragos, 2004), ie if the data intend to measure by the use of the same scale (Howitt and Gramer, 2003; Taber, 2017). An alpha coefficient equal to 0.70 or higher is considered satisfactory (Howitt and Gramer, 2003). A value equal to 0.80 is considered very satisfactory while, in practice, lower reliability coefficients with values up to 0.60, are also accepted (Siardos, 1999).

2.4.2. Factor analysis

Factor analysis is a statistical method used to investigate the existence of common factors within a group of variables (Sharma, 1996; Siardos, 1999). It was used to condense data into a reduced number of interpretable variables by represent most of their inter-relationships (Hauben et al., 2017). In the case study the principal component analysis was performed. The criterion proposed by Guttman and Kaiser was used for the principal component analysis (Cattell, 1978; Frank, 2004). According to this criterion, the limit for selecting the vector of the principal components is defined by the values of characteristic roots that are equal to or higher than 1. The rotation of the matrix principal components was also applied by the use of the maximum variance rotation method by Kaiser (Harman, 1976). Frangos (2004) indicates that the variables that "belong" to each factor are those for which the load on the table -after rotation- show a value higher than 0.5 in this factor.

2.4.3. Hierarchical cluster analysis

Hierarchical cluster analysis was used to investigate the statistical clustering of citizens into defined groups, termed clusters, which were generated by the two factor analyses (Bartholomew et al., 2007; Bechrakis, 1999; Karapistolis, 2001; Karlis, 2005). In fact, it is valid both towards the direction of observations clustering, and to the direction of the variables clustering (Siardos, 1999). The Pearson's X^2 check was used as distance measure and the full bond method, also known as the "furthest neighbor" method, was used to correlate observations in clusters.

3. Results and discussion

3.1. The citizens' attitudes to waste management

The citizens of the municipality of Neapolis-Sykies are neither satisfied with their quality of life. In particular, 41.3% (sp =0.0246) are claimed to be satisfied and 41% (sp =0.0246) less satisfied. While, 8.3% (sp =0.0138) of the citizens stated that they are very satisfied, followed by 6% (sp =0.0119) that were not at all satisfied and 3.5% (sp =0.0092), who believe that were absolutely satisfied with their quality of life in the urban environment of the city.

Similar views were also held by the citizens as regards their satisfaction with the cleanliness services provided by the Municipality. This finding explains the connection between waste management and quality of life. Half of the respondents (50%, sp =0.0250) state that they are satisfied with the cleanliness services, approximately four in ten (39.5%, sp =0.0244) are less satisfied, 8.8% (sp =0.0141) very satisfied, 1.3% (sp =0.0056) not at all satisfied, and 0.5% (sp =0.0035) absolutely satisfied.

The waste collection system is positively assessed by the citizens. Especially, the frequency of waste collection is believed to be satisfactory for most of the respondents (76.8%, sp =0.0211), followed by 14.8% (sp =0.0177) who are less satisfied, 6.3% (sp =0.0121) who very satisfied, 1.3% (sp =0.0056) not at all satisfied and finally, by 1% (sp =0.0050) who were claimed to be absolutely satisfied.

The Municipality of Neapolis-Sykies operates its waste collection system by fixed routes and pre-determined. In order to further examine the waste collection system effectiveness, the citizens were asked how many times per week the bins were emptied. About half of the respondents (50.5%, s_p=0.0250), answered that are emptied four times per week, followed by 27% (sp =0.0222) who said that they are emptied three times per week. More frequent waste collection and bin emptiness receives lower rankings. Especially, 17.3% (sp =0.0189) believe that bins are emptied from five to seven times on a weekly basis. Only 2.3% (sp =0.0074) answered that bins are emptied once a week and 2.8% (sp =0.0082) twice a week. The collection frequency in urban environments is organized according to the number of the existing bins within the collection route. Consequently, waste collection is closely affiliated with the distance between

the bins and their users, as the location of waste bins is designed in line with the levels of waste generation (Johansson, 2006).

Most of the citizens (54% sp =0.0249) argue that the distance between the bins and their residence is from 15 to 50 meters. Approximately, one in five claims that the distance is less than 15 meters (24.5% s_p=0.0203), or between 51 and 100 meters (20.8%, s_p=0.0203). While, only the 0.8% (sp =0.0043) answered that the bins are farther than 100 meters. Gallardo et al (2010) notice that the allocation of waste bins in a way that meets the citizens' accessibility standards could be serving as an essential measure to reform collection systems. While, according to González-Torre and Adenso-Díaz (2005) there is a common view shared by the citizens as regards recycling bins, which also serves for encouraging the citizens towards recycling.

Before applying the hierarchical log-linear analysis in both of the following cases, we have checked the cross-tabulation tables. The observed and estimated expected frequencies were compared and it became apparent that there is no expected count less than 5. Therefore, low expected frequencies are acceptable. There is also an inequality between observed and expected frequencies and the hypothesis of complete independence between the three criteria is incorrect.

Through, from the application of hierarchical log-linear analysis, in both cases (municipalities) after the removal of the third class degree of correlation, it was established that the most appropriate model was the one, which included the impact and the interaction of the variables divided by two.

Hierarchical log-linear analysis was applied on the variables "satisfaction with the cleanliness services provided by the Municipality", "satisfaction with the pick-up frequencies of the waste collection system" and "waste bin distance from the residence". There was no interaction per three criteria, because the X^2 for Pearson's test was 2.660 with probability (p) =0.265 and because the X^2 likelihood ratio is 2.770, with probability (p)=0.250. The following correlations were generated:

- Citizens who are absolutely satisfied to satisfied with the cleanliness services provided by the Municipality, share the same positive opinions regarding the pick-up frequencies of the waste collection system. Whereas, the ones declaring less to not at all satisfied with the provided cleanliness services, are also dissatisfied at the same extend with the pick-up frequencies of the waste collection system. It seems that the operation of the collection system is highly correlated with the effectiveness of the overall waste management system in an urban environment. This might be attributed to the cumulating unpleasant impacts of filled waste bins in large cities, such as odors and landscape disturbance.

- Citizens who state absolutely satisfied to satisfied with the pick-up frequencies of the waste collection system, claim that the farthest distance between their residence and the waste bin reaches 50 meters. On the contrary, citizens who are less to not at all satisfied with the pick-up frequencies of the waste collection system report that distance between their residence and the waste bin is farther than 50 meters

Citizens are impacted by the bins allocation. They are often annoyed with the placement of the waste bins in a close proximity with their residence. When they experience unpleasant consequences such as odors caused by the bins that remain filled for long periods or by overflowing bins, there is a tendency of bin displacement. Bin displacement is a common phenomenon when citizens use the bins' wheels to move them some meters away from their residence in order to avoid unpleasant odors or rodents and insects infestations. Ghiani *et al.* (2014) argue that bin allocation is an important factor that should be taken into account when planning the collection of solid waste. Andrea *et al.* (2020) highlight the importance of integrating disinfecting systems for hygiene purposes in traditional waste bins. The same also report the need for mechanical solutions such as foot operated pedals to lift lids, which are used to open bins automatically. As regards modern aspects of waste collection, smart bins are highly recommended in dense populated environments as part of smart-city applications (Karadimas *et al.*, 2016). Smart waste bins have using sensors to monitor the empty space in bins. Then, with the aim of Internet of Things, they are employed to efficiently organize collection routes (Fallavi *et al.*, 2017). The solutions addressing both traditional and modern collection systems and bins may improve hygiene and unpleasant conditions for waste collection systems and become more acceptable by urban dwellers. It seems that in the Municipality of Neapolis-Sykies the situation is highly acceptable as 94.5% (s_p=0.0114) of the citizens declare not to have experienced bin displacement issues, with a merely 5.5% (s_p=0.0114) sharing the opposite view.

In general, the system and condition of bins are perceived to operate in an efficient way and the vast majority (93.8%, sp =0.0121) state to dispose their waste into the bins. Whereas, only a small percentage (6.3%, sp =0.0121) answered that that they dispose their waste out of the bins although they are empty. As regards littering, namely the improper disposal of waste in the street, unfortunately a larger percentage (18% sp =0.0192) of citizens admit littering unintentionally in the street, while 82% (sp =0.0192) affirm that they have never adopted such an irresponsible behavior for the disposal of their waste.

To this end, an optimal and plain disposal solution that could importantly improve waste management is to promptly remove waste from the bins. To perform this task it is vital that the citizens carry their waste shortly before their collection. It is a fact that the citizens opt for the least inconvenience as regards waste collection while for the municipality, as an operator, it is necessary to

collect waste in line the services provided and the existing capacity (González-Torre and Adenso-Díaz, 2005). Unsuccessfully, it seems that in the Municipality of Neapolis-Sykies, the citizens are not used to follow the model of collection times employed by the municipal cleanliness services. Although pick-up schedules include both day and night collection due to large volumes on the collection route in the urban environment of Neapolis-Sykies, citizens are not cooperating. Waste should be placed until 6 pm to be loaded in the vehicles during the day-time pick up, and until 9:00 pm to be respectively loaded at the night-time pick up. In particular, a large percentage (44.3%, sp =0.0248) of the citizens carry their waste in the bins at any time of the day, which constitutes a problem because the remaining wastes for hours in the bins create unpleasant odors. Furthermore, approximately 3 in ten citizens (22.8% sp =0.0210) carry their waste in the morning, followed by 18.3% (sp =0.0193) who carry their waste in the evening, 8 % (sp =0.0136) in the afternoon and 6.8% at noon (sp =0.0125).

Raising awareness on waste management issues has been also investigated. Despite the fact that it is considered as important element influencing the citizens' views on the efficiency and performance of the waste management system employed by the Municipality, in the case study was assessed as poor.

Almost half of the respondents (53.5%, sp=0.0249) believe they are less informed, while the 16.5% (sp=0.0186) are claimed to be not at all informed. Approximately one in five 23% (sp=0.0210) think they are informed on waste management issues in the Municipality when very informed (5.8%, sp=0.0116) and absolutely informed (1.3% (s_p=0.0056) receive very low percentages. In the same line, there is insufficient awareness concerning the cleanliness regulation of the Municipality as the vast majority 92.8% (sp=0.0130) declare unaware of its content.

The citizens are quite more informed on the existing recycling system. In particular, about half of them (46%, sp=0.0249) believe they are informed, while 15% regard themselves as very (10%, sp=0.0150) and absolutely (5%, sp=0.0109) informed. An important percentage of 37.5% (sp=0.0242) claim to be less informed and only the 1.5% (sp=0.0061) are said to be not at all informed. Moreover, they share an overall positive view on recycling. The 95.5% (sp=0.0104) of the respondents think that the products they use every day such as paper, aluminum, glass, etc. should be placed in recycling bins, following the European strategies for circular economy and zero waste.

However, the residents understand that waste management has certain costs for them. They state that the cost of municipal fees they pay for the collection of their waste is high at 59.5% (sp=0.0245), moderate 31.8% (sp=0.0233), very high 8.5% (sp=0.0139) and small 0.3% (sp=0.0025).

The urban environment of Neapolis-Sykies operates a waste management system which is regarded as expensive. In particular, the waste management fee charged by the Municipality of Neapolis-Sykies represents almost half of the total amount of municipal fees that the citizens have to pay every two months, and it is included in their electricity bills. More specifically, the fee is considered as high to very high for most of them (high 59.5%, sp=0.0245; very high 8.5%, sp=0.0139), when 31.8% (sp=0.0233) argue that it is neutral and only the 0.3% (sp=0.0025) characterize it as low.

Hierarchical log-linear analysis was applied for the variables "Satisfaction with the cleanliness services provided by the Municipality", "Littering unintentionally" "Municipal fees for waste management". We have no interaction per 3 criteria, because the X^2 for Pearson's test is 3.237 with probability (p) =0.198 and because the X^2 likelihood ratio is 3.221 with probability (p) =0.200. The following correlations were generated:

- The citizens who think that are satisfied to very satisfied with the cleanliness services provided by the Municipality, have also admitted littering unintentionally in the streets. Whereas less to not all satisfied citizens with the cleanliness services, have never adopted a littering behaviour. The latter seem to be stricter with their evaluation on waste management services, while they are also more environmentally conscious. Thus they have more demands for quality services.

- Citizens who tend to litter unintentionally in the streets of the urban environment assess as low to neutral the existing municipal fees charged for its waste management. On the contrary, the ones presenting themselves as more environmentally conscious as they are not littering unintentionally, believe that Neapolis-Sykies municipal fees for waste management are high to very high.

3.2. Waste management policies and practices

Municipal waste management policies and practices employed in the urban environment of Neapolis-Sykies have been also a standpoint for investigation. Figure 3 depicts the citizens' assessment on the existing waste management policies and practices on a scale from 1 (lowest acceptance) to 10 (highest acceptance). It became apparent that typically, the municipal waste management policies and practices, receive the acceptance of the citizens. As most acceptable ones are perceived recycling of useful materials, energy production via incineration, recovered materials for reuse, biogas exploitation, reduction of waste production by residents and production of soil fertilizers. While, other policies and practices receive the least acceptance including the notion that waste treatment facilities comprise a common field for political conflicts, daily coverage of the waste with soil and the landfill cell waterproofing practices.

In order to test the consistency of the equivalent questions of the above multivariable, reliability analysis was applied. The value of the alpha coefficient is significantly high (0.9144). This constitutes a strong

indication that the data has the tendency to measure the same thing. In fact, this is also supported by the significantly high partial reliability coefficients alpha after the deletion of any variable, since even then no increase of the reliability coefficient is observed.

In addition, before proceeding with the application of factor analysis, we conducted all the necessary checks. The value of the Keiser-Meyer-Olkin indicator is 0.846. Furthermore, Bartlett's test of sphericity rejects the null hypothesis that the correction table is unitary and that the partial correlation coefficients are low.

Table 1. Factor analysis loadings after rotation (bold numbers show the factor that belongs to each variable)

| Variables	Factor loadings		
	1	2	3
Reduction of waste by residents	**0.737**	0.235	0.187
Recovered materials for reuse	**0.817**	0.179	0.134
Recycling of useful materials	**0.751**	0.360	0.048
Energy production via incineration	**0.884**	0.147	0.119
Production of soil fertilizers	**0.626**	0.477	0.302
Special management for hazardous waste	0.315	0.369	**0.615**
Daily coverage of the waste with soil	0.234	0.064	**0.847**
Landfill cell waterproofing	0.074	0.147	**0.907**
Plant trees around the landfill site	0.014	0.532	**0.608**
Apply source separation system	0.318	**0.676**	0.255
Waste weight for every Municipality	0.267	**0.559**	0.443
Additional profits for the Municipality from waste management fees	0.296	**0.531**	0.369
Placement of special bins for organic waste in household yards	0.367	**0.747**	0.109
Biogas exploitation	**0.693**	0.194	0.169
Proper rehabilitation and available space for new use after landfill closure	0.104	**0.698**	0.173
Common field for political conflicts	0.185	**0.514**	0.023
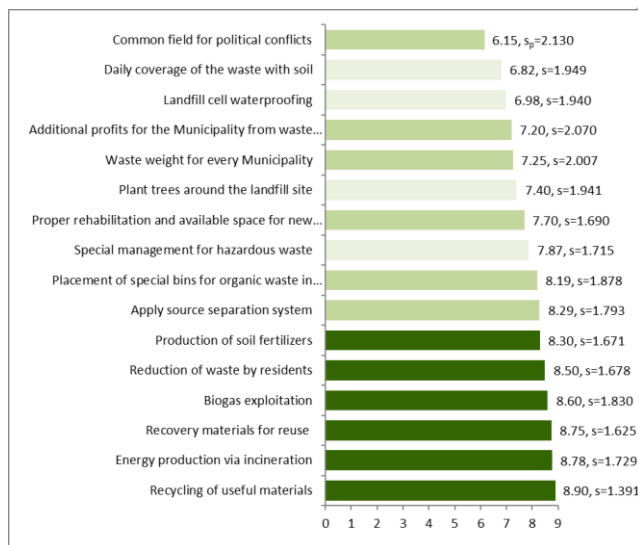
Figure 3. Citizens' assessment on the existing waste management policies and practices in the Municipality of Neapolis-Sykies, Greece." (the different colours depict the three factors arising after factor analysis was applied to the above variables).

The fact that the measures of sampling adequacy have high to very high values also supports the view that the factor analysis model is acceptable. The factors extracted are three. Table 1 reveals the loads that are the partial correlation factors of the sixteen variables with each of the three factors resulting from the analysis. The higher the load of a variable in a factor, the more this factor is responsible for the total degree fluctuation of the considered variable.

The first factor involves the variables " Reduction of waste production by residents", " Recovered materials for reuse ", " Recycling of useful materials", " Energy production via incineration", "Production of soil fertilizers" and "Biogas exploitation" and it could be termed as *General waste management policies and practices*.

The second factor consists of the variables " Apply source separation system", " Waste weight for every Municipality", "Additional profits for the Municipality from waste management fees", "Placement of special bins for organic waste in household yards", "Proper rehabilitation and available space for new use after landfill closure" and "Common field for political conflicts" and it could be named as *Municipal waste management policies and practices*.

The third factor titled as *Landfill waste management policies and practices*, includes the variables "Special management for hazardous waste", "Daily coverage of the waste with soil", "Landfill cell waterproofing" and "Plant trees around the landfill site".

Figure 4 represents the citizens' assessment on the sources used to obtain information on waste management issues - on a scale from 1 (lowest acceptance) to 10 (highest acceptance).

Primary insights reveal that citizens receive insufficient information on waste management issues.

In particular, television, radio and the internet, are indicated as the most used sources. Whilst, the least used sources are education, books and encyclopedias. In fact, s values are relatively high, indicating that there is great variability in citizens' responses.
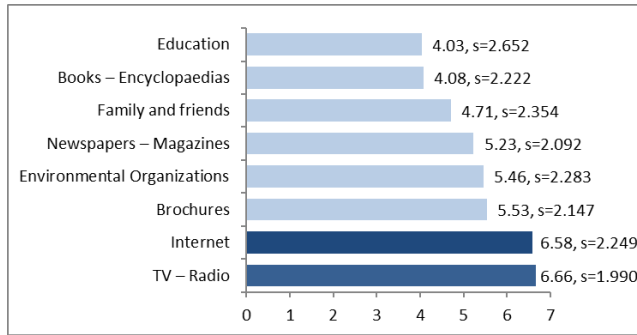
Figure 4. Citizens' assessment on the sources used by the citizens to obtain information on waste management issues (the different colors depict the three factors arising after factor analysis was applied to the above variables).

The value of the alpha coefficient is also significantly high in this multivariable (0.7573), indicating that the data tend to measure the same thing. Thus factor analysis was applied and the results are presented in Table 2. It should be noted that the data had been checked before the application of factor analysis in order to secure their appropriateness while, it was also investigated the suitability of the variables to be used in the model.

Table 2. Table with factor burdens, after rotation

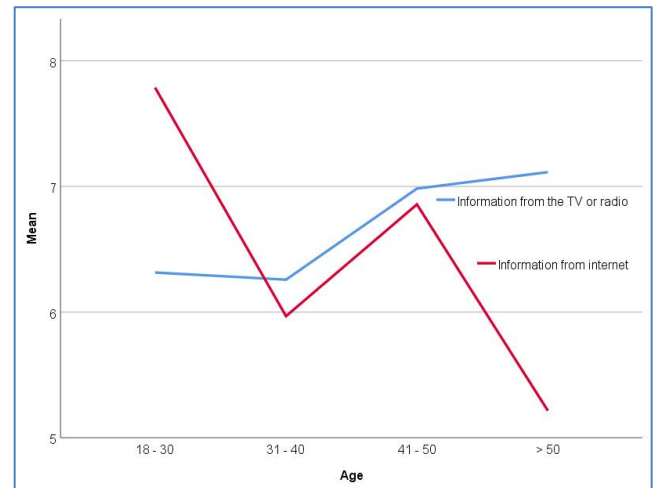| Variables	Factor loadings	
	1	2
Family and friends	**0.687**	-0.224
Education	**0.802**	0.059
TV – Radio	0.255	**-0.737**
Newspapers – Magazines	**0.601**	-0.049
Books – Encyclopaedias	**0.783**	0.006
Internet	0.293	**0.751**
Brochures	**0.707**	0.086
Environmental Organizations	**0.631**	0.301

Figure 5. Correlation between the most important sources of information on waste management issues with age classes, in the Municipality of Neapolis-Sykies, Greece.

The first factor depicts "***The least important sources of information on waste management issues***" (Family and friends, Education, Newspapers and Magazines, Books and Encyclopeadias), while the second factor - "***The most important sources of information on waste management issues***" (Television and Radio, Internet). The minus sign between the variables "Television and Radio" and "Internet" reveals that there is a negative correlation between them. More specifically, the citizens who use television and radio as sources of information on waste management issues, do not use the internet and vice versa.

Table 3. The citizens' socioeconomic profile

1. Gender				
Male	Female			
46.5% (s_p =0.0249)	53.5% (s_p =0.0249)			
2. Age				
18-30	31-40	41-50	>50	No answer
27.0% (s_p=0.0222)	23.3% (s_p=0.0211)	29.8% (s_p=0.0229)	19.8% (s_p=0.0199)	0.3% (s_p=0.0025)
3. Marital status				
Unmarried	Married	Divorced or widowed		
27.3% (s_p=0.0223)	58.8% (s_p=0.0246)	14.0% (s_p=0.0173)		
4.Childhood				
Without children	One child	Two children	Three children	More than three children
29.3% (s_p=0.0227)	16.5% (s_p=0.0186)	46.3% (s_p=0.0249)	7.0% (s_p=0.0128)	1.0% (s_p=0.0050)
5. Educational level				
Primary School	Lower Secondary School	Technical School	Upper Secondary School	Technological education
6.5 (s_p=0.0123)	11.5% (s_p=0.0160)	11.8% (s_p=0.0161)	38.8% (s_p=0.0244)	11.8% (s_p=0.0161)
University				
19.8% (s_p=0.0199)				
6. Profession				
Private employee	Public servants	Self-employed	Students	
32.5% (s_p=0.0234)	5.8% (s_p=0.0116)	13.0% (s_p=0.0168)	13.8% (s_p=0.0172)	
Unemployed	Housewives	Pensioners	Farmers or stock-breeders	
6.3% (s_p=0.0121)	18.0% (s_p=0.0192)	10.5% (s_p=0.0153)	0.8% (s_p=0.0043)	

This variation is further surveyed and explained in Figure 5, which correlates information sources with the citizens' age. In particular, it was proven that citizens under the age of thirty use the internet, while the citizens aged over fifty years old, use television and radio. Intermediate age classes show similar correlation.

The results of the hierarchical cluster analysis of the extracted two factors are presented on Figure 6 comprising the dendrogram of the variables (in this analysis the factors are termed variables). The variable "Landfill waste management policies and practices" appears to produce the highest average intercorrelation with the variable "The least important sources of information on waste management issues" and followed by "Municipal waste management policies and practices". Accordingly, the variable "General waste management policies and practices" is pairing even more remotely with "The least important sources of information on waste management issues".
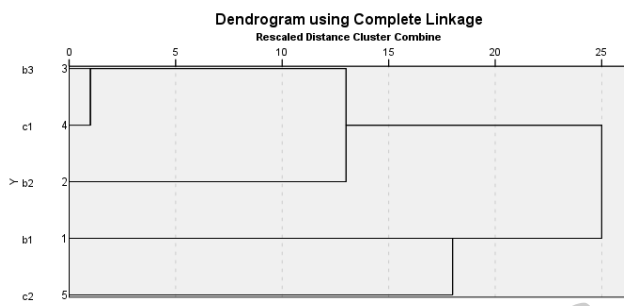

Figure 6. Dendrogram of the hierarchical clustering.

3.3. The citizens' socioeconomic profile

The citizens' socioeconomic profile and demographic characteristics are given in Table 3. The respondents were male in female in shared percentages. As regards their age, they were normally allocated within all age classes from 18 to over 50 years old. Their family status was mean married with two children and their education level is regarded as medium and high.

Eventually, the residents of the Municipality of Neapolis-Sykies are primarily less satisfied with their income (57.3%, sp =0.0247), while almost one in five (22.6%, sp =0.0210) claim not at all satisfied, followed by 19.3% state satisfied and 0.8% (sp =0.0043) very satisfied. The citizens hold similar views as regards their quality of life as most of them feel satisfied (41.3%) and less satisfied (41%).

4. Conclusions

This investigation aimed to depict the citizens' views on the efficiency and effectiveness of waste management system in the urban environment of Neapolis-Sykies. The study reasoned conceptualization of waste management, which is influenced by the citizens' socioeconomic profile. It was evident the citizens' perceptions about an average quality of life in the urban area, denotes disapproval of the provided cleanliness services and their incomes.

Waste collection points and the operation of the collection system in the urban area of Neapolis-Sykies seem to be in competent level. More specifically, the

application of hierarchical log-linear analysis revealed the citizens' overall satisfaction with the cleanliness services to be closely affiliated with the frequent waste collection, the bins' allocation. While, collection points seem to meet sanitary standards as they the bins not moved away – displaced by their users.

The transportation hours of waste from residence to collection points is another very important issue which presupposes the citizens' raising awareness and active involvement. The less time waste remains in bins located in urban areas, the less inconvenience is caused to urban dwellers. Hence, it is critical to ensure coordination between waste disposal time operated by citizens, and collection routes operated by the waste management service. However, in Neapolis-Sykies waste management raising awareness is insufficient on both collection system (they dispose waste in bins at any time of the day) and the cleanliness regulation established by the Municipality. As regards the latter it seems that the primary information citizens receive is mainly about the high cost of the municipal fees. Nonetheless, the citizens are better informed on recycling issues.

The positive correlation among satisfaction with the cleanliness services, littering behavior, and assessment of waste management municipal fees as quite reasonable. Potentially this is due to the conception of paying fees as means of compliance with a more rational and environmental conscious behavior.

The most widely accepted waste management policies and practices address general waste management policies and practices such as recycling, rather than policies and practices about local waste management issues. Therefore, it is highly recommend that local authorities and waste management bodies committing themselves in providing more sustained solutions in the local challenges of waste management that would generate a better quality of life in the urban area of Neapolis-Sykies.

To attend the above matter, it is vital to enhance raising awareness on the local dynamics of the urban waste management system. The citizens though declare poor information flow concerning waste management issues, while they also indicate as the most commonly used sources television, radio and the internet. These also prevailed as the most important means, after the implementation of factor analysis. In fact, age plays an important role on the means used as the older prefer television and radio, and the younger the internet.

Furthermore, important interrelations emerged regarding general waste management policies and practices and the most important sources of information on waste management issues. Respectively, another association between landfill waste management policies and practices, and the least important sources of information, comprises a strong evidence that the citizens are not properly informed about local policies and practices - related to existing waste management issues in their municipality.

5. Proposals

Public accountability in degraded urban environments constitutes a keystone towards sustainable waste management and promotion of sustainable cities, which in turn presuppose informed citizens. Unless policy makers embrace this structural component in their vision, the citizens' abstention from decision making processes will remain a status quo.

Consequently, a questioning issue arises as policies and practices on waste management are very difficult to implement. The lack of citizens' participation in decision making often deprive of public acceptance. The key weakness is that these decisions that are not designed to empower people in order to adopt environmentally friendly behaviors such as recycling, reduction of waste production and reuse.

To deepen the understanding of the numerous challenges in waste management policies and practices in urban environments and transform them into realistic solutions, it is of outmost importance to incorporate the citizens' views in decision making.

Citizens should be given all the means to directly involve in decision making processes and of course they should have access to information about waste management. To this end, employment of digital technology could serve as useful tool for policy makers, to enhance urban participatory methods (Wilson *et al.*, 2017) and meaningfully raise awareness on local waste management issues. Social media campaigns are gaining more and more followers as they provide a user friendly environment for all ages. In nowadays it is easy and affordable to have internet connection as well as obtain and operate smart devices.

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