The Residents' Behaviours and Attitudes towards Municipal Solid Waste Management on Samos Island, Greece

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Abstract. The case study investigates the behaviors of the residents on a Greek Island in the Aegean Sea, where there is a sanitary landfill and disposal is the main solid waste treatment method implemented. With the use of hierarchical log-linear analysis certain correlations were examined including the citizens' quality of life, the performance of waste collection system, the location and allocation of waste containers, the cleanliness services provided, environmental consciousness in everyday life, awareness level on recycling and general waste management issues.

Keywords: waste collection; attitudes; hierarchical log-linear analysis; quality of life; municipal solid waste; behaviors.

1 Introduction

Municipal solid waste management (MSM) has been proven to be one of the pivotal challenges for modern societies resulting from the increasing global population and urbanization [1]; while, it is a fact that the citizens' quality of life is highly dependent on efficient waste management [2]. To this end, the examination of the citizens' views, behaviors and attitudes is of outmost importance in order to define the most effective policies and strategies towards environmentally friendly, energy efficient, cost-effective, and socially acceptable solutions. Moreover, it should be stressed that the citizens' pro-environmental behavior is a major factor in waste management process [3]. Therefore, a foreword towards integrated waste management planning means that

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the citizen's participation in decision making should be considered as granted. According to Gallardo et al. [4], a primary stage in effective planning is the definition of the waste generation and composition patterns of an area, which depend on various socio-economic characteristics, while there are certain differentiations on dense areas and rush hours. The latest consequently affects the organization of waste collection systems in terms of routes, nodes and collection frequencies.

The aim of this paper is to analyze the residents' behaviors and attitudes concerning the operation effectiveness of the municipal solid waste management on Samos island, where the only MSM infrastructure is a sanitary landfill.

2 Methodology

The study area was the Island of Samos in the Eastern Aegean Sea in Greece. Administratively, Samos belongs in the Region of North Aegean and at the Regional Unit of Samos. In the island there are two municipalities and a sanitary landfill in the area of Kamara, in the east part of the island.

Simple random sampling was used due to its simplicity, since it requires the least possible knowledge of the population compared to other methods [5]. The estimation of the proportion of the population and the estimation of the standard error of the proportion of the population s_p, were given by the formulas of simple random sampling [6]. Separate pre-sampling of 50 individuals carried out in order to calculate the size of the sample, which was estimated for every quantitate and qualitative variable according to the formulas of simple random sampling, where t = 1.96 and e = 5% [7]. The sample of the sample was estimated to 400 inhabitants for possibility $(1-\alpha)100=95\%$, e=0,049.

Hierarchical Log-linear Analysis was used to examine two groups of variables. Prior to the application of Hierarchical Log-linear analysis, the expected frequencies in the contingency table were examined [8]. Classes were grouped together in order to satisfy the criteria mentioned by Tabachick and Fidell [9]. For the data analysis the Statistical Package for Social Sciences (SPSS 16) was used. The collection of the questionnaires was conducted in 2018.

3 Results

The residents of Samos state to be satisfied in a percentage of 39.5%, 17.8% very satisfied and 6% absolutely satisfied with the quality of live provided in the island they live; while, less satisfied are the 26.8% and not at all satisfied the 10%.

Slightly more negative rates are also observed for the satisfaction they have with the cleanliness services provided. In particular, 37.8% reckon to be less satisfied, 36% satisfied, 12.5% not at all satisfied, 12.3% very satisfied and 1.5% absolutely satisfied. According to recent findings [10; 11; 12] waste management plays a crucial role for the society as it closely affiliated with the citizens' quality of life.

Addressing the frequency of the waste collection system 45% of residents claim that they are satisfied, 33% are less satisfied, 13.8% are very satisfied, 5.8% are not at all satisfied and 2.5% are absolutely satisfied. More specifically, concerning the emptying of the waste containers on a weekly basis, the 9% of the residents notice that it takes place once a week, the 20.8% twice, the 26.2% three times, the 14.5% four times, the 15% five times, the 10% six times, and the 4.2% every day; the 0.3% did not answer this question. It should be noted that there is a positive correlation between the generated waste and the popularity of the streets, which in turn requires the proper selective collection nodes respectively [13]

The frequency of routes for the waste collection is related to the number of the existing waste containers [14] and consequently to the distance from their users. The distance from the citizens' residence and the waste containers according to the 33.3% of the residents is estimated as being between 16 to 50 meters, the 27% state to be between 51 to 100 meters, the 23% notes that the containers are far from their houses of less than 15 meters and the 16.8% that the containers are farther than 100 meters.

The fact that the containers are under a constant change of position proves that the residents are annoyed by their presence. Indeed the 21.3% affirms that it is true while the 78.8% disprove this fact.

The placement of disinfecting clean waste containers for proper hygiene outputs and foot operated opening mechanism by means of a pedal that ensures that the lid lifts automatically, are two features that tend to make the presence of containers more acceptable by the residents. In the case study it seems that the maintenance of the waste containers is satisfactory in Samos, yet, a low percentage of 6% residents claim to dispose their waste out of the waste containers when they are filled. It should be noted that most of them (94%) place their waste inside the containers. Unfortunately, an important percentage (25.5%) declare that they have unconsciously dispose waste on the street, while the 74.5% of the residents has never adopted this attitude.

Prior to the initiation of the log-linear analysis (in particular the hierarchical), it is intentional to examine the size of the expected frequencies in the crossing table. Is it therefore observed that the only anticipated frequency lower than 5 is 3.4. Therefore, no anticipated frequency is lower than 1 and only one is lower than 5; hence, there exists no problem with low anticipated frequencies. We further observe that there is a disparity between the observed and the anticipated frequencies. This means that the assumption of full independency between these three criteria is incorrect. Through 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 implemented for the variables “provision of cleanliness services”, “distance between the residents’ households and the waste containers”, “waste containers emptying” and “waste containers change of position”. There was no interaction per 4 ή 3 criteria, because the X^2 for Pearson’s test is 4.624 with probability (p) = 0.593 and because the X^2 likelihood ratio is 4.816 with probability (p)= 0.588. The representations are the following:

- Residents that are absolutely satisfied to satisfied with the cleanliness services provided report that the waste containers are emptied four to seven times a week.

On the other hand, those who are not at all or less satisfied with the cleanliness services provided claim that the waste containers are emptied from one to three times a week (Table 1).

- Residents who declare that their home is within 50 meters of the waste containers report that the waste containers are emptied four to seven times a week. On the other hand, those who state that their home is more than 50 meters away from the waste containers affirm that their containers are emptied one to three times a week (Table 2).
- Residents who state that they are absolutely satisfied to satisfied with the cleanliness services provided report that their home is within 50 meters of the waste containers. While, those who say they are not at all satisfied with the cleanliness services provided say that their home is farther than 50 meters away from the waste containers (Table 3).
- Residents who are absolutely satisfied to satisfied with the cleanliness services provided state that the waste containers are not often moved. Whereas, those who are not at all or less satisfied with the cleaning services provided reckon that the containers are often moved (Table 4).
- Residents who report that their home is within 50 meters far of the waste containers regard that the containers are not often moved. On the contrary, the ones report that their residence is farther than 50 meters away from the containers, state that the waste containers are often moved (Table 5).

Table 1. Cross tabulation of variables "cleanliness services provided" and "waste containers emptied per week".

cleanliness services provided		**waste containers emptied per week**		**Total**
		1 - 3 times	4 - 7 times	
absolutely satisfied / satisfied	Count	95	103	198
	Expected count	111.2	86.8	198.0
	Residual	-16.2	16.2	
less -not at all satisfied	Count	129	72	201
	Expected count	112.8	88.2	201.0
	Residual	16.2	-16.2	
Total	Count	224	175	399
	Expected count	224.0	175.0	399.0

Table 2. Cross tabulation of variables “distance (meters) from waste containers” and “waste containers emptied per week”.

Distance (meters)from waste containers		**waste containers emptied per week**		
		1 - 3 times	4 - 7 times	
0 - 50 meters	Count	111	113	224
	Expected count	125.8	98.2	224.0
	Residual	-14.8	14.8	
> 50 meters	Count	113	62	175
	Expected count	98.2	76.8	175.0
	Residual	14.8	-14.8	
Total	Count	224	175	399
	Expected count	224.0	175.0	399.0

Table 3. Cross tabulation of variables “cleanliness services provided” and “distance (meters)from waste containers”.

cleanliness services provided		**Distance (meters)from waste containers**		**Total**
		0-50 meters	> 50 meters	
absolutely satisfied / satisfied	Count	137	62	199
	Expected count	111.9	87.1	199.0
	Residual	25.1	-25.1	
less -not at all satisfied	Count	88	113	201
	Expected count	113.1	87.9	201.0
	Residual	-25.1	25.1	
Total	Count	225	175	400
	Expected count	225.0	175.0	400.0

Table 4. Cross tabulation of variables “cleanliness services provided” and “the containers are often moved”.

cleanliness services provided		**the containers are often moved**		**Total**
		Yes	No	
absolutely satisfied /satisfied	Count	24	175	199
	Expected count	42.3	156.7	199.0
	Residual	-18.3	18.3	
less -not at all satisfied	Count	61	140	201
	Expected count	42.7	158.3	201.0
	Residual	18.3	-18.3	
Total	Count	85	315	400
	Expected count	85.0	315.0	400.0

Table 5. Cross tabulation of variables "distance (meters) from waste containers" and "the containers are often moved".

cleanliness services provided		the containers are often moved		Total
		Yes	No	
0 - 50 meters	Count	33	192	225
	Expected count	47.8	177.2	225.0
	Residual	-14.8	14.8	
> 50 meters	Count	52	123	175
	Expected count	37.2	137.8	175.0
	Residual	14.8	-14.8	
Total	Count	85	315	400
	Expected count	85.0	315.0	400.0

One practical solution towards effective waste management is the prompt emptying of the filled waste containers. Added to that, the less time the waste remains on the waste containers the less disturbances will appear in the close area such as unpleasant odors and hygiene matters. To this end, it would be useful for the citizens to dispose their waste just before they are collected [4] Unfortunately, a large proportion (32.8%) of citizens dispose waste to the waste containers any time of the day, 29.5% in the morning, 18% at night, 12.5% in the evening and 7.2% in the afternoon.

Another important issue for the residents of Samos is that there is insufficient awareness on waste management. 46.3% are said to be less informed, 24% not at all informed, 20.3% informed, 6.5% very informed and 3% absolutely informed. Thus, only 15% of the residents are aware of the cleanliness regulation when the 85% of them are unaware of its content.

However, it seems that they are better informed about recycling; 37% claims to be less informed, 30.5% informed, 14.3% not at all informed, 12.8% very informed and 5.5% absolutely informed. Indeed, 97% of citizens consider that the products they use (paper, aluminium, glass, etc.) should be recycled.

Nevertheless, they also share the opinion that waste management is a procedure that includes costs for them. Namely, the municipal fee they have to pay for waste management in Samos is regarded as neutral for the 42.3%, high for the 35.8%, very high for the 16.5% while the 5% and the 0.5% consider this cost as low and very low respectively.

Hierarchical Log-linear analysis was applied for the variables "Provision of cleanliness services", "unconsciously disposal of waste on the street", "cost of the municipal fee for waste management" and sex. Therefore, there was no interaction per 4 or 3 criteria, because the X^2 for Pearson's test is 10.567 with probability (p) = 0.307 and because the X^2 likelihood ratio is 11.404 with probability (p)= 0.249. The representations are the following:

- Residents who regard they are absolutely satisfied with the provided cleanliness services state that the cost of municipal fees is neutral to very low. On the contrary, those who consider they are not at all or less satisfied with the provided cleanliness services claim that the cost of municipal fees is high and very high (Table 6).

Table 6. Cross tabulation of variables "cleanliness services provided" and "cost of municipal fees"

cleanliness services provided		**cost of municipal fees**		**Total**
		very high - high	neutral - very low	
absolutely satisfied / satisfied	Count	80	119	199
	Expected count	104.0	95.0	199.0
	Residual	-24.0	24.0	
less -not at all satisfied	Count	129	72	201
	Expected count	105.0	96.0	201.0
	Residual	24.0	-24.0	
Total	Count	209	191	400
	Expected count	209.0	191.0	400.0

- The residents that have noticed that unconsciously dispose waste on the street are males while the ones that have not found themselves dispose waste on the street are females (Table 7).

Table 7. Cross tabulation of variables "found themselves dispose waste on the street" and "Sex".

found themselves dispose waste on the street		**Sex**		**Total**
		Male	Female	
Yes	Count	51	51	102
	Expected count	40.8	61.2	102.0
	Residual	10.2	-10.2	
No	Count	109	189	298
	Expected count	119.2	178.8	298.0
	Residual	-10.2	10.2	
Total	Count	160	240	400
	Expected count	160.0	240.0	400.0

Table 8. Demographic features of the respondents

Gender	male	female		
	40.0%	60.0%		
Age				
18-30	31-40	41-50	> 50	
25.3%	32.3%	25.2%	17.0%	0.3%
Marital status	unmarried	married	divorced or widowed	
	40.5%	49.3%	10.3%	
Childhood				
without children	one child	two children	three children	more than three
48.8%	14.5%	25.5%	8.5%	2.8%
Educational level	primary school	lower secondary	technical school	
	4.5%	4.0%	9.8%	
	upper secondary	technological ed.	university	
	30.5%	25.0%	26.3%	
Profession	private employee	public servants	self-employed	farmers or livestock farmers
	24.0%	24.0%	18.8%	3.5%
	students	Pensioners	housewives	unemployed
	7.3%	8.8%	4.5%	9.3%

According to the demographic characteristics of the questioned, a major part was consisted of women (60%), while most of them were allocate to the total of age categories, half of them are married while the half of them have two or no children (25.5%), they are well educated mostly employed in the public and private sector. Finally, almost four out of ten of the residents (33.8%) are satisfied with the incomes; while the, 33% claim to be less, 23% not at all, the 7.8% and the 2.5% as very and absolutely satisfied with their incomes, respectively (Table 8).

4 Conclusions

The residents of Samos claim to be satisfied with their quality of life, whereas they assess the cleanliness service and the frequency of the waste collection system in a negative point of view. On the other hand, the residents who are more satisfied with the cleanliness services report that the waste containers are being emptied more frequently (4-7 times a week), they are located in the close area of their residence (up to 50 meters) and they are not being moved by other residents. The latest leads to the conception that when services are of better quality, they receive better acceptance by the residents they address. In addition, and according to the residents' views there is an association between the acceptance of better services with the lower fee they have to pay at the municipality for the waste management system. Another important

conclusion drawn by the results was that males tend to unconsciously dispose their waste on the street more frequently.

As regards the information that residents receive about waste management it is said to be unsatisfactory, while there is a better notion on recycling raising awareness issues. Accordingly, the residents' knowledge of the cleanliness regulation is regarded as inadequate when at the same time their acceptance of recycling is something established. Eventually, it is clear from the abovementioned that raising awareness addressing the residents of Samos, should be examined and further extended on the general framework of waste management schemes.

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