Citizens' perceptions towards urban solid waste management system: Case Study of the Municipality of Kozani

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Abstract The aim of this study is to investigate, through a survey the perceptions and attitudes of citizens about urban solid waste management system in the Municipality of Kozani.

The objective of this survey is to obtain information related to: the actual behavior of citizens, the determining factors that influence and facilitate their intention to participate in recycling, their beliefs about the existing waste collection system and their perceptions of the rewarding incentives to those who actively participate in recycling processes.

A structured questionnaire survey method is used as a research tool for data collection from respondents. The design of the questionnaire is based on the recent relevant.

literature. The questions are mainly focused on the knowledge and attitudes of the citizens.

The results of the present study may contribute to citizens' awareness in order to participate actively in recycling and reduce waste. Considering the research findings and final results, stakeholders could design appropriate recycling progresses and schemes, in order to improve the existing urban solid waste management system.

1. Introduction

All over the world, waste generation rates are continuously rising. Solid waste is mainly linked to the urbanization and to the economic development. In 2016 the world's cities generated 2.01 billion tons of solid waste. As countries are rapidly urbanizing and population is still growing, the annual waste generation is expected to increase to 3.40 billion tons in 2050 (Kaza et al., 2018).

Urban solid waste management is a major issue at various levels of spatial planning, from the smallest circular systems of neighborhood to cities and municipalities, since it tries to balance the environmental protection with social and economic needs and goals. Thus, urban solid waste management must be holistically considered in order to address the high degree of urbanization and the low availability of potentially suitable sites for waste disposal.

Understanding, interpreting, predicting and modifying human behavior which is related to factors that decisively influence environmental actions are some of the most emerging goals of environmental psychology.

According to Karagiannidis et al. (2006) the problems that may arise during the design of a waste collection and transportation system can be categorized as follows:

- Problems associated with incomplete design of waste collection system (number and location of bins, number and capacity of garbage trucks, frequency of waste collection).
- Problems that affect and shape the attitude of citizens towards the waste generation at individual level.
- Problems related to the lack of incentives for both concerned citizens and state agencies (waste collection charge, municipal taxes).

Recycling programs influence citizens' participation in separation of household waste (Stoeva and Alriksson, 2017). Two main mechanisms/strategies - incentives and information - are mainly used to increase recycling participation (Iyer and Kashyap, 2007). Particularly, the role of financial incentives is very important in accelerating the recycling of municipal solid waste (Abila and Kantola, 2019). On the other hand, lack of waste separation infrastructure, such as recycling bins, can restrict the recycling behavior and intention (Yoreh, 2011; McDonald and Oates, 2003). Furthermore, the average distance of recycling bins (from residences) may also be a motivational factor of recycling behavior, due

to the fact that a shorter distance is likely to increase recycling program participation (Lansana, 1992).

The aim of this study is thus to investigate citizen's behavior on household waste collection and recycling processes, by using a structured questionnaire, which was designed to adapt to the local conditions and characteristics of the study area (Kozani, Greece).

2. Methodology

A questionnaire was used in order to investigate and measure behavior, attitudes, preferences, opinions and intentions from respondents.

A pretest was conducted to assess whether the survey was well designed and was meeting its intended objectives (Presser et al, 2004). In this context, a preliminary survey was initially conducted with a small number of respondents from the target population in order to identify the level of understanding and then to refine the research questions and methodology.

Stratified sampling is a common sampling method used by researchers in which the total population is divided into smaller groups or strata to complete the sampling process. According to this sampling method, the formation of strata and the allocation of samples to different strata was done in such a way that the sample can represent the population with respect to the characteristics (e.g. demographic characteristics) under study (Arnab, 2017).

Then, a survey was conducted from January 2020 to March 2020 collecting data from 271 participants. All the participants were citizens of the Municipality of Kozani. The questionnaire survey was distributed to potential respondents and responses were collected anonymously in order to protect respondents' anonymity. The sample size was considered sufficient for performing the basic statistical procedures of the present research, as well as for general conclusions to be drawn. The majority of respondents were willing to fill in the questionnaire, so a high response rate answer was noted, further supporting the representativeness of our study population.

3. Questionnaire design

The questionnaire consisted of two (2) sections. 26 open-closed questions were used in the first (1st) section in order to gain a better understanding of citizens' perceptions and motivations concerning the solid waste management system and the recycling practices of the households.

In this section we also seek to identify respondents' level of awareness on urban solid waste management system and policies.

In order to achieve these objectives, we included several questions to examine the determinants that influence citizens' intention to participate in recycling, their views on the existing waste collection system and their perceptions/reaction on different (potential) incentives that may motivate them to be actively involved in different recycling processes. In this section, citizens are also asked to freely express their opinion on how the existing urban solid waste management system could be improved.

The second (2nd) section consisted of personal (demographic and socio-economic) data, seeking thus to find out the background information of respondents' individual characteristics, such as their:

- Gender
- Age
- Education level
- Employment status
- Household monthly income
- Household size (Number of members)
- Residential area.

In previous studies, researchers found that personal variables, such as personality, demographics and attitudes of environmental concern have a direct effect on recycling behavior (Schultz et al., 1995). In particular, factors such as the socio - economic background of citizens (Vicente and Reis, 2008) are very important in enhancing the waste separation behavioral decision. Participants' demographic and socio - economic characteristics are presented in Table 1.

Table 1. Participants' demographic and socio - economic characteristics

Gender		Household Monthly Income (€)	
Male	60%	0 - 500	11%
Female	40%	500 - 1,000	38%
Age		1,000 - 1,500	22%
< 25	13%	1,500 - 2,000	18%
25 - 35	23%	> 2,000	11%
35 - 55	45%	Household size (Members)	
> 55	19%	1	16%
Education level		2 - 4	72%
Secondary education	36%	> 4	12%
Tertiary education	41%	Residential Area	
Master studies	21%	City of Kozani	89%
PhD studies	2%	Local communities of Kozani	11%
Employment Status			
Student		14%	
Self - employed		20%	
Employee		33%	
Public official		33%	

4. Results

The following figures illustrate and represent the main results of our survey, concerning participants':

1. recycling behavior (Figures 1&2)

2. evaluation about the current waste/recycling management systems (Figures 3&4)
3. preferences about the distance of recycling bins from their residence (Figure 5)
4. priorities about: (a) a higher number of recycling bins (Figure 6), (b) lower waste and recycling fees (Figure 7&8)
5. perceptions about the potential (positive) contribution of installing new "Green points" in the Municipality of Kozani (Figure 9)
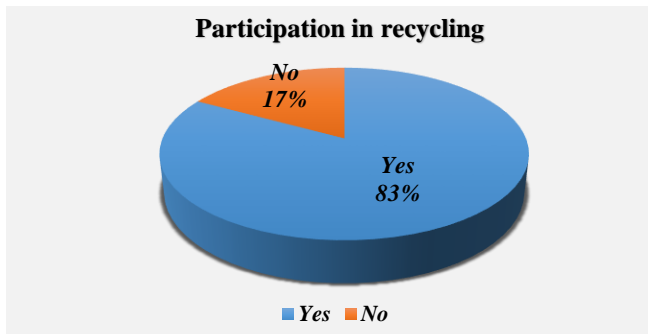6. willingness to participate in a (future) rewarding recycling program (Figure 10).

Figure 1. Participation in recycling
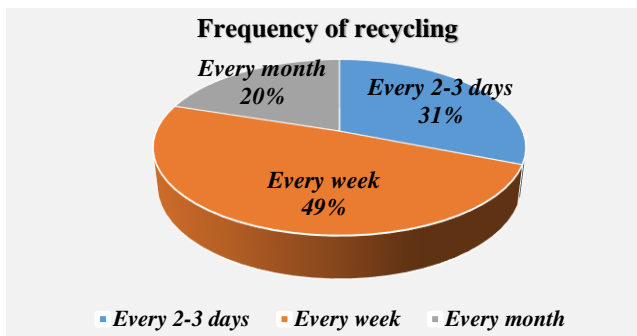
Figure 2. Frequency of recycling
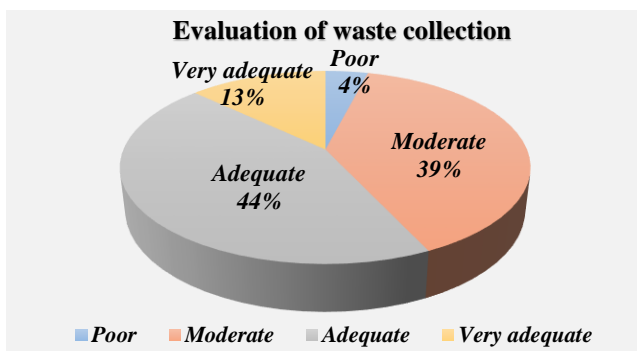
Figure 3. Evaluation of waste collection
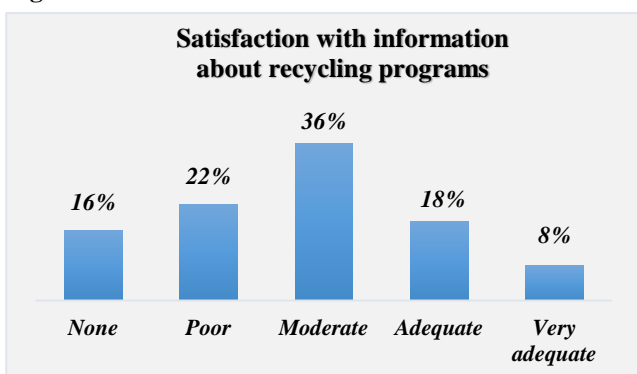

Figure 4. Satisfaction with information about recycling programs
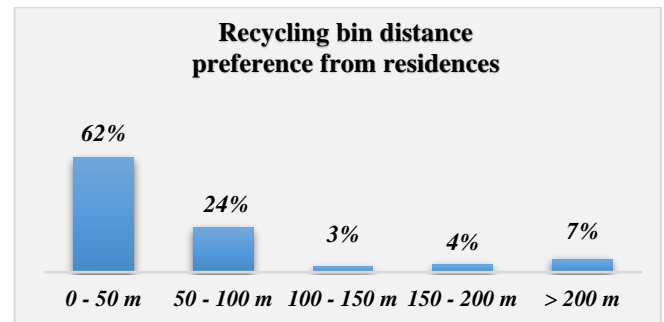

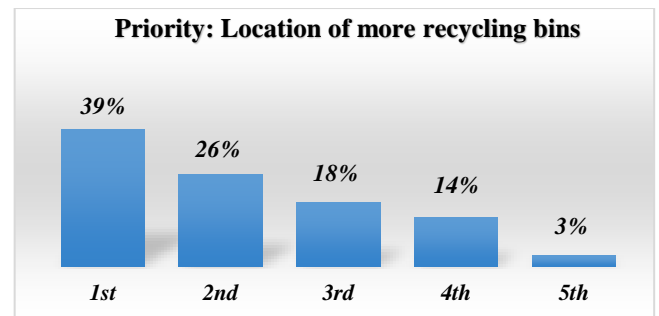**Figure 5**. Recycling bin distance preference from residences

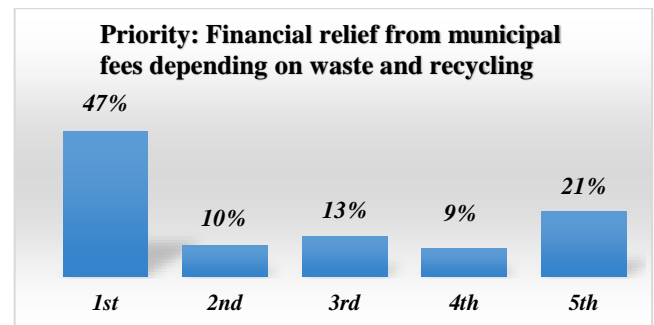**Figure 6**. Priority: Location of more recycling bins

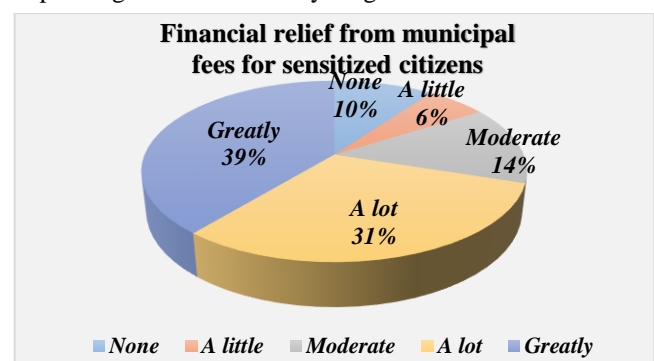**Figure 7**. Priority: Financial relief from municipal fees depending on waste and recycling

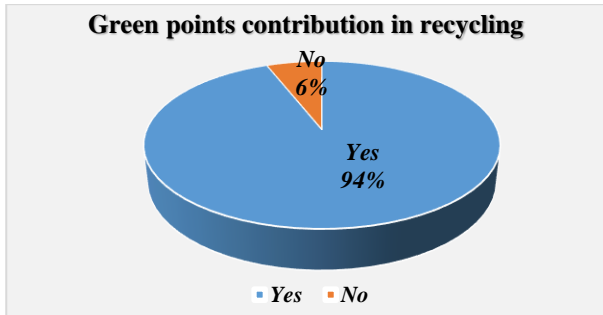**Figure 8**. Financial relief from municipal fees for sensitized citizens

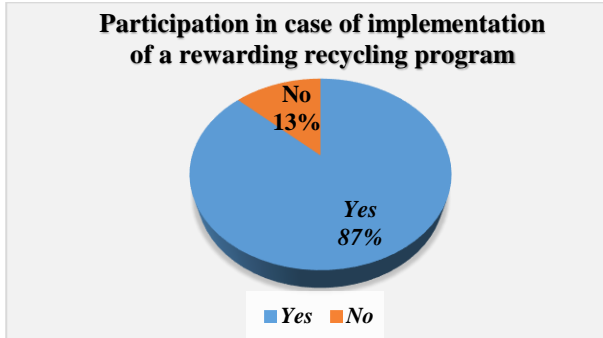**Figure 9**. Green points contribution in recycling

Figure 10. Participation in case of implementation of a rewarding recycling program

5. Conclusions

The statistical analysis of citizens' answers revealed some remarkable results, which can be used from stakeholders in order to re-design waste management and recycling services. Specifically:

- The majority of respondents was found to have a positive attitude towards the urban solid waste management: 83 percent (83%) of respondents are actively involved in recycling processes and 80 percent (80%) of participants claim that recycle every week (31% every two or three days and 49% on a weekly basis).
- Respondents appreciate that the location of "Green points" could improve municipality's recycling rates and they ask for further information about recycling programs and separate collection of biowastes (organic waste collection).
- A strong majority of respondents agree that providing rewarding incentives to citizens has a direct effect on recycling performance and they are willing to participate in a rewarding recycling processes.
- Respondents consider
  - o the financial relief from the municipal fees depending on waste and recycling,
  - o the location of more recycling bins near their residences,

  as high priority criteria (1st on a 5-point Likert scale evaluation) - that could motivate them, - to recycle more quantities and thus to improve recycling rates.

The existing collection system should also be further explored through consultation and active participation of the citizens, in order to:

- strengthen the separate collection of all waste streams,
- achieve the ambitious recycling targets at the level of both regional and national waste management planning.

Subsequently, designing and implementing environmental campaigns to promote citizens' awareness, can further enhance their motivation and participation in recycling and composting processes.

In conclusion, the study results are of great importance for the future improvement of the existing urban solid waste management system, because they provide useful information to stakeholders and policymakers with regard to citizens' behaviors, attitudes and perceptions. In other words, the study results could contribute to the decision-making process in order to achieve improved garbage and recycling services.

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