Door to door recyclables' collection programs: Willingness to participate and influential factors with a case study in the city of Xanthi (Greece)

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Abstract

Purpose

The primary goal of the work was to investigate willingness of the residents of Xanthi to initiate and participate in such a program. In addition, the factors that potentially affect the aforementioned willingness was studied using basic non-parametric statistics.

Method

Questionnaires were distributed randomly to 150 individuals. Twenty-six questions were included in each questionnaire and the replies to those questions were coded using categorical variables. The statistical analysis of the results to investigate statistical differences was performed with SPSS® after applying the non-parametric Mann-Whitney U-test, the χ^2 test as well as by developing empirical models using categorical variables.

Results

The age of the respondents (AGE) influenced the recycling behavior. Orthodox Christians were found to recycle more frequently than Muslims. However, this finding may not be attributed to religious orientations but to income and educational leves, which both affected the recycling behavior. 109 participants were willing to participate in a door to door recyclable collection program while 41 respondents were not interested in doing so. Education level influenced the individuals' willingness to participate in door to door program. Participants who were holder of university degree were more positive to engage in such programs than the ones that have high school or lower education.

Conclusions

The participants who were negative towards the current recycling system and have a positive attitude towards recycling issues in general, were more willing to participate in door to door collection and home composting programs than the rest of the participants. In addition, the participants who had a university degree were more willing to participate in a door to door collection program compared to the ones without a university degree.

1. Introduction

The door to door solid waste recyclable collection scheme is an alternative to the typical curbside recyclable collection scheme. The latter is the most typical recyclable collection system worldwide that usually implements different colored bins for each of the different streams of dry and wet recyclables separated (plastics, metals, paper and biowastes). Although door to door collection is not as popular as the latter, it has been successfully implemented in several regions of some countries, such as Italy and Germany (with the former country being a pioneer in this collection scheme [1]. According to recent evaluations, the source separation participation rates have increased upon the implementation of that scheme compared to the traditional curbside recycling scheme [1]. In addition, Read (1999) [2] had demonstrated that intensive door to door communications strategy can significantly increase public participation in the recycling activities.

In Greece, the dominant recyclable waste collection system is that of the curbside mixed recyclable type; there is currently only one case of a door to door collection system that was recently initiated as a pilot action in a municipality in Athens (end of 2016 for biowastes only). It is common knowledge that the door to door collection system requires the active participation of the residents who need to abide to a strict and disciplined waste collection schedule, perform a good separation at home and store their waste and bins within their own residence.

Many different approaches have been utilized to examine recycling behaviour of individuals. There are two general trends of behavioural research. In relation to applied behaviour, proposed models have aimed to determine incentives or disincentives to explain the reasons for which individuals join in recycling programs. This is based mainly on neoclassical economic criteria which citizens seek to maximize their utility function by acting on positive or negative regulations [3]. Economic incentives and take back systems are some well-known tools implemented to encourage individuals to participate in recycling programs. In relation to personal characteristics, individuals move to recycling programs as a result of internal impulse to save the planet and protect the living beings. This is determined as an attitude approach which offers certain tools to explain behaviour towards recycling projects.

The majority of studies focus on personal and physiological attributes of individuals. In particular, Hopper *et al.* [4] recognize that some altruistic characteristics affect individuals' recycling behavior such as social norms, personal norms and awareness for recycling issues. Similarly, Valle et al. [5] show that recycling behavior is more influenced by personal psychological characteristics (e.g. personal-psychological values, environmental awareness, perceived control and emotions) and less by general ecological attitudes (e.g. personal beliefs for environmental protection). These behavioral models have been criticized regarding the failing of cognitive variables used to explain actual behavior of individuals in recycling programs. Davies *et al.* [6] point out these types of variables (e.g. intention) should be abandoned from studies examining recycling behaviour of people. Similarly, Kraft *et al.* [7] highlight the complexity of utilizing behaviour control variables as signal to predict intention of individuals in recycle programs.

Some classical variables to measure intention of individuals are as follows: easy or difficult, effortless or effortful which are distinguished from attitude of citizens. Other important variables to examine intention of individuals are pleasant or unpleasant, good or bad, beneficial or harmful and rewarding or punishing, nice and nasty, enjoyable and enjoyable, gratifying or revolting. Taylor *et al.* [8] by using planed behavior models seek to identify variables which play critical role for individuals to take part in recycling and composting programs. They found that critical variables for the intention of individuals to composting are subjective norm and perceived behavioral control.

1.1 Scope of the study

During this study, 150 questionnaires were distributed to a corresponding number of household owners. The survey targeted both Christian and Muslim participants (interviewees) so that to adequately represent the typical population composition of Xanthi in terms of religion. Twenty-six questions were included in each questionnaire and the replies to those questions were coded using categorical variables. Some of the variables were considered dependent so that to aid in the modeling that followed in order to find statistically significant correlations.

By determining a number of socio-economic parameters and behavioral attitudes toward recycling, this study aims to fulfill a threefold purpose, namely

i) to delineate participants' recycling profile,

ii) to investigate individuals' intentions to participate in various recycling projects and in particular to door to door solid waste collection program that are not existent in Greece and,

iii) to examine their willingness to pay an extra premium for the implementation of such projects. In addition, the factors that potentially affect the aforementioned willingness was studied using basic non-parametric statistics.

2. Methodology

For the purposes of this research, a survey was conducted in the town of Xanthi, which is located in the region of Thrace (northeastern Greece). A fully structured questionnaire was designed to gather the necessary data and was distributed in a printed form. The questionnaire was divided into three sections exploring a wide range of information. The first section assessed whether respondents were informed about the existence of a recycling program in the town of Xanthi and also their satisfaction level in relation to this recycling system. In addition, this section included questions in order to elicit respondent's beliefs and attitudes toward recycling and to explore their recycling behavior. In the second section of the questionnaire, the goal was to explore whether respondents are willing to take part in home composting and door to door recyclable collection programs under the auspices of the municipality of Xanthi. Moreover, questions were designed to assess respondents' willingness to pay for such recycling programs and their agreement with "pay as you throw" systems. Finally, the third section involved the economic and social-demographic information of the selected sample (i.e. age education level, respondent's income and religion).

Face to face interviews conducted on a random selected sample of residents from Xanthi. In total 150 valid questionnaires were analyzed and several Mann-Whitney U-tests, Kruskal-Wallis H tests and the χ^2 tests for homogeneity were run in order to make the investigations.

Questionnaires were distributed randomly to 150 individuals. Since the population of Xanthi constitutes of around 30% Muslims and 70% Christians, we tried to roughly maintain that percentage among the 150 participants when distributing the questionnaires. This was done in order to be able to investigate whether religious orientations may also have an impact on solid waste management decisions.

Twenty-six questions were included in each questionnaire and the replies to those questions were coded using categorical variables. Some of the variables were considered dependent so that to aid in the modeling that followed in order to find statistically significant correlations. The statistical analysis of the results to investigate statistical differences was performed with SPSS® after applying the non-parametric Mann-Whitney U-test, the χ^2 test as well as by developing empirical models using categorical variables. The summary of questions and their coded replies are included in Table 1.

Table 1. Summary of questions distributed to the Xanthi residents

Questions in brief	Number of coded replies used in the questionnaire
Part A	
Knowledge on existing operation of recycling programs	2
Current use of blue bins	2
Maximum distance to walk to dispose of waste	2
Types of materials currently recycled	9
Nuisance of existing recycling system	6
Frequency of disposal of recycling bags	3
Estimation of amounts of recyclables recycled per household	3
Reasons to perform recycling	4
Part B	
Opinions on waste recycling and home composting	Several questions
Preference on means to promote recycling	4
Willingness to pay exclusively for recycling and home composting programs	Several questions
Part C	
Questions related to the identity of the interviewees (age, income, educational level, household size, type of residence, religion, occupation, others)	

3. Results and discussion

3.1 Economic and socio-demographic factors

According to the descriptive analysis, the majority of respondents were females (61.3%), 66% of the selected sample was aged over 30 and 86 (57%) respondents held at least a university degree. In order to explore the economic status of the respondents, a three-level categorical variable was devised that evaluated their annual income. 29 participants (19%) had a low income (below 7000€), 70 participants (47%) stated that their income had an income between 7000 and 21000€, which is a typical annual income in Greece, while the rest of the respondents (34%) stated that had an income over 21000€. Another important socio-demographic factor was the religion of the participants. Most of the respondents were Orthodox Christian (72%) and Muslims (25.3%), whereas only 4 respondents stated "other religion" (2.7%). Finally, the number of household members was also examined. Based on the respondents' answers, 98 households (65%) were composed of three or more persons and the other 52 households (35%) were composed of one or two individuals.

3.2 Knowledge about the existence of recycling and level of satisfaction

A question was designed to assess if respondents were aware of the existence of a recycling system in the city of Xanthi. Two thirds of the respondents (78%) knew that there was an already installed recycling system and only 33 participants (22%) answered "I do not know". In addition, questions were used to explore whether participants were satisfied with the design and implementation of the current recycling program. Specifically, the satisfaction level of

respondents concerning their accessibility to the recycling spots was evaluated on a four point Likert scale. 27 respondents (18%) were completely satisfied, 38 (25.3%) reported "satisfied", 39 (26%) "slightly satisfied" and 27 (18%) "not at all satisfied". Also, respondents were asked to answer if the implementation of the current recycling system is problematic or not. Interestingly, the majority of respondents (77.3%) stated "yes", while only 34 (22.7%) answered "no".

3.3 Attitudes towards recycling

A set of questions targeted to explore respondents' thoughts and stances on recycling. In particular, a five point Likert scale (from strongly disagree to strongly agree) was used to assess respondents' agreement with the following two statements: a) "recycling is a waste of time" and b) "I do not trust the agents responsible for recycling programs". Most respondents asserted that they disagreed with the above statements (87.3% and 67.3% respectively), which is a clear evidence that respondents had adopted positive stances on recycling issues. In the same context, respondents were asked to report the quantity of wastes that they recycled every week as well as the quantity of recycling wastes that were willing to store in their houses (the quantity of wastes was measured as the number of market bags). 46 (30.7%) respondents stated that they recycled "0 or 1 bag", 41 (27%) stated "2 bags" and 63 (42%) "3 or more bags". With regards to the number of bags stored, 79 (52.7%) reported "up to 2 bags", 43 (28.7%), reported "3 bags" and 28 (18.7%) reported "4 or more bags". Some of the findings related to the attitude of the participants towards recycling are summarized in Table 2.

Table 2. Awareness of recycling system and attitude towards recycling

Question	Response
Awareness over existing recycling system	78% ARE AWARE
	22% ARE NOT AWARE
Current participation in the existing curbside system	83% YES, 17% NO
Satisfaction over the existing distance to the bins	44% NONE / SMALL
	56% MUCH / VERY MUCH
Components recycled	21% NONE
	20% (1 or 2 components)
	31% (3 or 4 components)
	15% (5 or 6 components)
	13% (> 7 components)
Is recycling a waste of time?	87% DISAGREE, 13% AGREE
Preferred means to learn about recycling	51% INTERNET
	33% LEAFLETS
	47% TELEVISION
	20% MOBILE PHONES
	9% LECTURES
Willingness to participate in a door to door collection program	73% YES, 27% NO
Amount of money willing to pay exclusively for recycling / home composting (per month)	51% NONE
	38% 1 to 5 €
	11% 5 to 10 €

Table 3 includes the "independent" variables which were used in this analysis. Moreover, it is noteworthy that some variables have been recoded into a dichotomous format to facilitate the analysis process. Mann-Whitney U test was used to examine a possible difference in the ordinal responses of two groups, whereas, the non-parametric Kruskal-Wallis H test was used to examine possible differences in the ordinal responses of three or more groups. Additionally, a χ^2 (chi-squared) test for homogeneity was utilized to determine if the dichotomous responses of two groups are statistically significantly different.

Table 3. Independent variables used during modeling

Variables	Description of variables	Mean	Std. Deviation
AGE	Respondents' age: 0:20-30 years old, 1: Over 30years old	0.66	0.475
EDU	Educational level: 0:Senior high school but no more, 1:University degree or more	0.57	0.496
PPH	Persons per household: 0: One or two persons, 1: Three or more persons	0.65	0.478
RELIG	Religion: 0: Orthodox Christians, 1: Muslims	0.26	0.440
INC	Annual Income: 1: 0-7000€, 2:7001-21000€, 3: >21000€	2.15	0.718
KNOW	Knowledge about the existence of a recycling system in the city of Xanthi: 0: No, 1: Yes	0.78	0.416
BTHR	Respondents' perception that the current recycling system is problematic: 0: No, 1: Yes	0.77	0.420
STSF	Respondents' satisfaction concerning their accessibility to the recycling spots: From 0: Not at all satisfied to 1: Completely satisfied	1.69	1.094
WAST	Recycling is waste of time: 0: disagree, 1: do not disagree	0.13	0.334
DISTR	I do not trust the public agency responsible for the recycling programs: 0: disagree, 1: do not disagree	0.33	0.471
QNTY	Number of bags recycled by respondents every week: 1: 1-2 bags, 2: 3 bags, 3: Four or more bags	1.66	0.776
STRG	Number of bags that can be stored by respondents in their houses: 1:0 or 1 bag, 2: Two bags, 3: Three or more bags	2.11	0.848

3.4 Respondents' recycling profile

A main goal of this research was to investigate the recycling profile of respondents. To do so, a variable was constructed to evaluate the recycling frequency (RECFREQ). In other words, respondents were asked to report how often they separated their recyclables at home. Forty-eight (48) (32%) respondents reported "rarely", 48 (32%) "few times per month" and 54 (36%) "every day". The results of Tables 4 and 5 include the statistical effects of various parameters on recycling frequency.

Table 4. Effects of parameters on the recycling frequency according to the Mann-Whitney U-test (RECFREQ)

	Variables	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
AGE	20-30	59.97	3058.50	1732.500	-3.335	0.001
	>30	83.50	8266.50			
RELIGION	O.C.	83.25	8990.50	999.500	-4.983	<0.001
	Muslims	45.80	1740.50			
WAST	Disagree	81.41	10664.50	470.500	-4.642	<0.001
	I do not disagree	34.76	660.50			
DISTR	Disagree	84.32	8516.50	1583.500	-3.789	<0.001
	I do not disagree	57.32	2808.50			
KNOW	No	48.23	1591.50	1030.500	-4.333	<0.001
	Yes	83.19	9733.50			

O.C.: Orthodox Christians; a p value lower than 0.005 indicates a statistically significant effect of the corresponding parameter on the recycling frequency. See table 3 for definition of variables.

According to Table 4, the age of respondents (AGE) influenced the recycling behavior. Particularly, respondents that were aged over 30 years do separate their recyclables at home more frequently than the respondents who were aged from 20 to 30 years old. This finding could be explained by the fact that young respondents usually live in small houses and they do not have enough space to separate and/or store their recyclables. Interestingly, another influential factor on recycling behavior was the religion, since Orthodox Christians were found to recycle more frequently than Muslims. However, this finding may be attributed not to religious orientations but to income and educational orientations, which both were factors that affected recycling behavior. In particular, statistical analysis revealed that a 42% of the O.C. (Orthodox Christians) had an annual income over 21000€ and only a 13% of Muslims had an annual income in that same range. In addition, 66% of the O.C. participants had at least a basic university degree, whilst only a 32% of the Muslim respondents had a university degree. That is, the religious orientation is not independent to the educational level and to the income level. Future research should be focused on the factors which might be related to the religion of respondents and their recycling behavior.

Moreover, as expected, respondents who had a positive attitude towards recycling (WAST) and towards the administration of the recycling programs (DISTR) reported a high recycling frequency. In a similar manner, individuals who knew that there is an installed recycling program in the town of Xanthi were found to recycle with a higher frequency compared to the rest. The above findings reveal that the recycling frequency and individual's beliefs or interests in recycling issues are closely linked.

According to Table 5, and based on the Kruskal-Wallis test, recycling frequency is affected by respondents' satisfaction regarding their accessibility to the recycling spots (STSF). Specifically, a post hoc analysis shows that individuals who stated that they were "Completely satisfied" or "Satisfied" or "Slightly satisfied" recycled more frequently than respondents that complained about their access (distance) to the recycling location.

Table 5. Effect of parameters on recycling frequency according to the Kruskal-Wallis non-parametric test (RECFREQ)

	Variables	Mean Rank	Kruskal-Wallis H	df	p
STRG	1	34.02			
	2	80.40	75.413	2	<0.001
	>3	102.60			
STSF	Not at all satisfied	35.28			
	Slightly satisfied	76.12	39.012	3	<0.001
	Satisfied	77.24			
	Completely satisfied	97.15			

See table 3 for definition of variables. df: degrees of freedom; a p value lower than 0.005 indicates a statistically significant effect

3.5. Willingness to participate in a door to door collection system: A χ^2 analysis

Table 6 includes the findings of the χ^2 test to assess the willingness to participate in a door to door collection program.

Table 6. The χ^2 test to assess willingness to participate in a door to door recyclable collection program

Variables		No		Yes		χ^2	p
		N	%	N	%		
EDU	High school	28	43.8	36	56.3	15.147	<0.001
	University	13	23.5	73	62.5		
WAST	Disagree	28	21.4	103	78.6	18.491	<0.001
	I do not disagree	13	68.4	6	31.6		
DISTR	Disagree	21	20.8	80	79.2	6.661	0.010
	I do not disagree	20	40.8	29	35.6		
BTHR	No	15	44.1	19	55.9	6.236	0.013
	Yes	26	22.4	90	77.6		

See table 3 for definition of variables. Variables are considered to affect willingness to participate at p<0.05

The outcomes are slightly different when respondents were asked whether they would participate in a door to door recycling program. In general, 109 participants were willing to participate in a door to door recyclable collection program while 41 respondents were not interested in doing so (see Tables 2 and 6). With respect to the explanatory variables, education level clearly influenced the individuals' willingness to participate in door to door program. Participants who are holder of university degree are more positive to engage in such programs than the ones that have high school or lower education. For example, as Table 6 reveals, 73 respondents with a university degree responded "Yes" to the question on the desire to initiate a door to door collection program. Furthermore, in line with the outcomes from the determinants of recycling frequency, respondents who disagreed with the statements: a)"recycling is a waste of time"(WAST) and b) "I do not trust the agents responsible for recycling programs"(DISTR) expressed a desire to participate in door to door program. Finally, individuals who were not satisfied with the current recycling system (BTHR) were more interested in participating in a new effective recycling system (such as door to door collection programs) than the rest. Interestingly, as Table 6 reveals, the variables Education (EDU) and WASTE affected the willingness to participate in a door to door collection system more

significantly than the variables DISTR and BTHR (due to the lower p values in the former case compared to the 2nd case).

4. Conclusions

The main conclusions of the work are:

- The participants who were negative towards the current recycling system and had a positive attitude towards recycling issues in general, were more willing to participate in door to door collection and home composting programs than the rest of the participants. In addition, the participants who had a university degree were more willing to participate in a door to door collection program compared to the ones without a university degree.

- The participants who were aware of the operation and utility of a waste recycling were found to recycle in a higher frequency (more components and higher mass separated at home) compared to the ones that were not.

- The participants who considered the access distance to the waste recycling location non-satisfactory, recycled at a smaller frequency compared to the ones that consider it satisfactory. In particular, the ones that could walk to a distance greater than 100 m to dispose of their recyclables, were found to recycle to a greater extent (larger number of recyclable components separated at home) compared to the ones that were not willing to walk longer distances.

- The participants who claimed that they have positive attitude towards recycling of wastes, recycled in a higher degree compared to the ones that have a negative attitude.

- The participants who had a basic university degree recycled to a higher extent compared to the ones that had a high school education or lower. In addition, those who were aged over 30 were found to recycle to a higher degree than the younger participants.

- The participants who had an annual income over €21000 recycled to a higher degree compared to the ones with less income.

- The participants who declared to follow the Christian Orthodox religion recycled to a higher degree compared to individuals that declared to follow the Islamic religion. However, this finding may not be attributed to religious orientations after all, but rather to the income and educational levels, as explained earlier.

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