Evaluation of the factors influencing the household waste source separation behaviors based upon different area classes; a case study of Mashhad metropolis in Iran

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Abstract

Source separation programs of dry household waste have been launched in Mashhad since 1997. However, the public participation rate and the amount of separated dry waste is not in a satisfactory level. This research examined the influence of various factors including intrinsic, extrinsic and etc on household waste separation behavior of citizen. The aim was to determine the variables which motivate and deter people to recycle at home. The data was gathered by means of questionnaire from 330 people. The results reveal that age, information and knowledge, situational factors, moral obligation, attitude and perceived behavioral control and social norm are correlated with source separation behavior. The participants stated that the feedback is the most motivating factor for doing domestic source separation while inadequacy of waste facilities or far location of bins from their home hinder them to recycle. The results of multiple regressions showed that the information and knowledge about waste is the best predictor of voluntary waste separation behavior of the participants in Mashhad city.

Keywords: Domestic waste, Source separation, Public participation, Questionnaire

1. Introduction

Integrated waste management based on 3R (reduce, reuse and recycle) has been known as the best approach to reduce the environmental impact of wastes. In this framework, source separation of HW is a critical component and known to be one of the fundamental steps in achieving integrated waste management [5-7]. Source

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separation of domestic waste is currently implemented successfully in many cities of the developed countries. However, it has become the biggest challenge in some developing countries hindering the municipalities from achieving a sustainable and efficient municipal solid waste program [8-12]. Mashhad, the second largest metropolitan city in Iran is a good example of this. Various programs established by Mashhad Municipality Waste Management Organization (MMWMO) to implement and organize source separation of dry wastes, none of which was even moderately successful and the amounts of sorted dry wastes are low compared to the total produced waste. The reasons were reported as following; a) constant enlargement of city borders and consequently increase in municipal waste generation, b) lack of funds and appropriate facilities, c) low participation of the citizens.

Active participation of the community is a key element for success of any social program of these sorts. Without this, if the program not failed, its efficiency would highly be reduced [13, 14]. In the recent years, the influence of different factors affecting the household participation in source separation schemes was investigated. Fenech [15] identified three main factors: intrinsic, extrinsic and others. In many cases, the focuses have been on demographic factors such as age, gender, background socio - economic or type of the housing [13, 16-20]. There are several reports assessing the impact of intrinsic factors (psychological) (e.g. attitude, moral moral obligation, social norms and perceived behavioral control), extrinsic factors (e.g. personal knowledge and information about the environment, participation in environmental activities) and other factors such as the situational variables and participation in decision making were studied on the success of source separation program in different countries [13, 20, 21]. However a few studies were conducted in the cities of Iran such as [2] for Qazvin, [22] for Mahabad. There is a serious dearth of information on source separation behavior of household waste of the citizens in Mashhad. Farzadkia et al [23] evaluated the potential of dry solid waste recycling in Mashhad and concluded that 92 percent of MSW has the capability to be recycled and reused, while the recycling rate was only 7 percent.

Recently, recycling has received the great attention of the municipality of Mashhad. To achieve the optimal conditions for recycling and thereby the conservation of material and environment in Mashhad, it is imperative to understand the factors influencing voluntary participation of the public in source segregation of domestic waste. The present survey fills a gap in the literature. The aims of this research were, firstly to determine the community participation in source separation of domestic waste in three different socioeconomic areas in Mashhad, secondly, to explore the supporting factors affecting and predicting the recycling behavior of the citizen, and finally to understand what variables could motivate or deter people to recycle at home.

2. Method

2.1. Study area

Mashhad, with a population of about 2.7 million people and over 15 million pilgrims in year, is the second largest metropolis in Iran. It is located in the northeast of the country and is considered as one of the most important industrial centers in Iran. Due to population growth and the presence of many industries, huge amounts of solid waste have been generated. Inhabitants are mostly in the apartment, the residence complex and the house. Between 1997 and 1998, Mashhad Municipality Waste Management Organization (MMWMO) started to implement the project of source separation and recycling of dry waste in the city. [1].

2.2. Sampling population

The Cochran statistical formula was used to determine the population size of the sample. For sampling, the residential areas in Mashhad were classified to three socio-economic regions (high, middle and low class areas). In each class, three regions were chosen as a representative of the corresponding classified area. Totally, the questionnaires were distributed to the households in 9 areas of the city. The classification was adopted due to the fact that MMWMO intend to imply different strategies for encouraging the inhabitants of different classes.

2.3. Questionnaire

The data for present survey was collected by means of direct face to face interviews by questionnaire during July and August of 2015. Ten-section questionnaire was designed based upon various literatures [3-5]. It contained the following main parts: (1) socio-demographic information including age, gender, education, occupation, house type, (2) attitude toward waste, (3) waste separation behavior, (4) social norms, (5) perceived behavioral control, (6) situational factors, (7) moral obligations, (8) information and knowledge about source separation of waste, (9) participation in decision making, and (10) motivation and deterrent factors of household source separation. For each item in the questionnaire, except demographic, motivation and deterrent questions, respondents were requested to demonstrate the level of their agreement with the given statements on the Likert scale.

2.4. Data analysis

The statistical analysis of collected data was performed using the Statistical Package for the Social Sciences (SPSS). The reliability of questionnaire was determined by Alpha Cronbach method Descriptive statistics were used to describe the socio-economic characteristics of respondents, the extent of participation in household source separation and the frequencies of motivation and deterrent factors. Correlation technique was used to investigate the relationship between the various factors and separation at source behavior, using Pearson's correlation coefficient. Multiple regression analysis was performed to determine which factors have the most influence on the household source separation behavior.

3. Results and discussion

3.1. Status of waste generation and management in Mashhad

Mashhad produce the second highest amount of daily waste in Iran. The waste generation rate is 700 g/person/day which is comparable to other large cities in Iran like Tehran, Rasht, and Qazvin [1, 6]. Fig 1 shows the amount of municipal waste produced by citizens during the years 2007 to 2016. It is clear that municipal solid waste generation rate are rising fast. The composition of municipal solid waste is shown in Fig 2. As can be seen the maximum amount of municipal waste is organic materials. The portion of other substances in the waste is as follows: plastic, paper, textile, glass, metal, bread and so on. Only 170-100 tons of garbage per day is separated at source which includes bread, metals, glass, plastics, paper, cardboard, and electronic waste. 65 % of the recycled waste was allocated to paper, cardboard, and bread. Source separation is an optional activity and implement as following methods: recycling exchange station, recyclable dry waste collection from offices and schools, paper delivery box, and collection from door to door. The last one is carried out by private sector. It should be noted that in all source separation procedures, people proportional to the amount of waste that was recycled, rewards such as money, garbage plastic bag, detergent, salt, etc. were received. Currently, landfill, composting and recycling are the components of municipal solid waste management system in Mashhad. 60% of MSW is buried in sanitary landfill, 30.3 % is composted and only 9% of it is recycled. Since only 8.5% of the municipal solid waste is separated at source, and the approach of the municipality of Mashhad is based on voluntary recycling program, the active participation of citizens will improve the waste management efficiency.

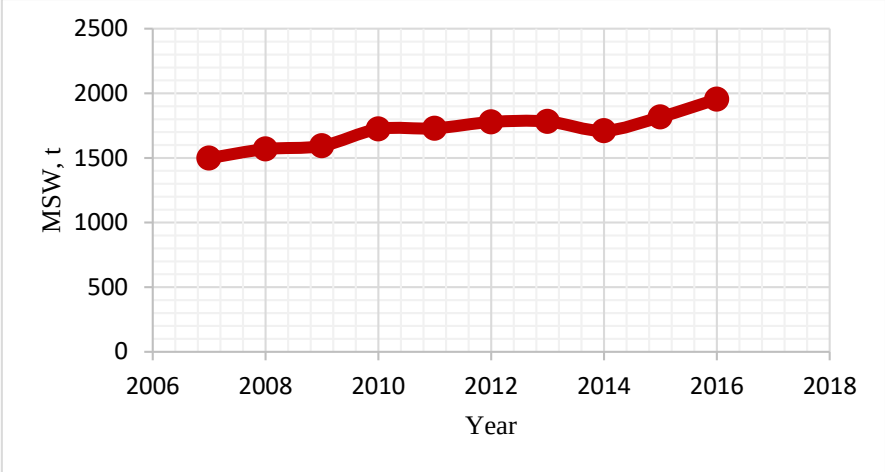

Fig 1, Municipal solid waste generation in the Mashhad 2007-2016

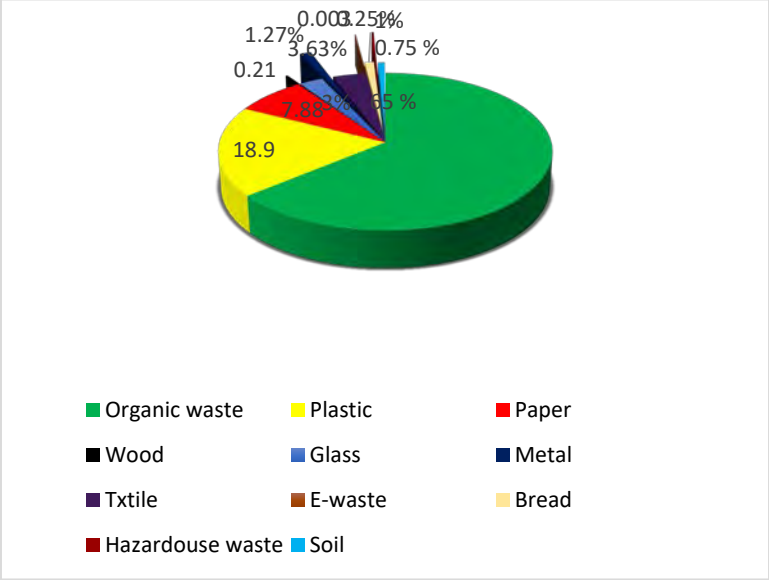

Fig 2. Average composition of municipal solid waste

3.2. Demographic characteristic of the participants

A total of 298 people answered the questionnaires between July and August 2015. Demographic characteristics of the respondents in three class areas are given in Table 1. In high class area, more than half of participants (62.5 percent) were male while 37.5 percent was female. Most of respondents (37.9 percent) had an average age of more than 50 years and often worked as self-employment. The majority of the participants has a university degree with percentage of 48.2. Among the respondents, 55.7 percent reside in the house while 36.4 percent live in apartment building. In the middle class area (Table 1), most of the respondents were female (62.3 percent). The majority of average age in this region was more than 50 (28.8 percent) and 30-39 (27.9 percent) years old and mostly was housewife (38.9 percent). 38.4 percent of the respondents in had at least a bachelor degree and 37.9 percent diploma. 48.7 and 43.4 percent of participants live in apartment and house, respectively. In low class area (Table 1), the percentage of female's participation (47.4 percent) was slightly more than male (43.9 percent). The mean age of the most of the respondents was 39-30 years old and their jobs were housewife (39.8 percent). Majority of respondents (82.2 percent) in low class area are non-academic. More than half of the participants (54 percent) reside in apartment.

3.3. Household waste separation behavior

People' behavior toward source separation of household waste was measured by responses to 4 item based upon Likert scale. The distribution and frequency of the respondents on the behavior toward separation of waste at home is shown in Table 2. As the Table shows, the majority of the participants (89.8 %) claimed that they have been doing source separation of domestic waste, while 11.4 percent did not at all. To be more specific, 18% stated that they just partly separate small amount of, 33.6 % separated average value of, and 41.5 % separated a lots of domestic waste.

In order to determine the relationships between respondents' demographical characteristics (age, gender, education, occupation, type of housing and the area) and their waste separation behavior, Pearson's correlation coefficient was used. The results from the correlation analysis showed that there is a negative correlation (r = -0.143) between age and source separation behavior ($P<0.01$). The researches were done by Pakpour et al [6], Davies et al [7], Pearson et al [8], Swami et al [9] indicated that age is the most predictors of domestic waste separation behaviors. Besides, this finding is consistent with the common expectation that tells since younger

people are more environmental conscious, they like to more involve in recycling programs [10]. In another survey, Gamba and Oskamp [11] found that older citizen are less likely to do source separation. There are however different report; Aki et al [10] and found that older people showed better participation in household waste separation because of having more time.

In connection with the effect of other socio-demographic parameters on waste source separation behavior, some of the studies were consistent with the present research. For example, Yau found that education level and gender of Hong Kong citizens do not have any role in waste source separation behavior [12]. According to the surveys of Gamba and Oskamp [11] and Werner and Makela [13], gender is not an important factor in explaining people's participation in recycling programs.

3.4. Explaining household waste separation behavior

The effect of several factors including attitude, perceived behavioral control, social norm, moral obligation, information, situational factor, participation in decision making on waste separation behavior of citizens of Mashhad city were examined. The results were shown in Table 3. Correlation analysis showed that the dependent parameters like information and knowledge ($r = 0.3$), situational factors ($r = 0.24$), moral obligation ($r = 0.18$), attitude ($r = 0.16$) and perceived behavioral control ($r = 0.17$), with $P>0.01$, and social norm with $P>0.05$ are associated with source separation behavior. Information and knowledge about waste and source separation was the strongest predictor of household waste separation behavior, having the larger correlation coefficient value than other studied variables. Some studies showed that environmental knowledge improves the attitudes and behaviors towards waste recycling which consequently leads to enhancement of the citizens' participation in household source separation. In other word, the knowledge of the citizens is essential for success of recycling scheme [3, 11, 13-15]. For example, Katara and Larsén [16] found that education is a key element in increasing percipients knowledge, leading to recycle behaviors. Diaz [17] in a study on municipal solid waste management in Latin America, stated that personal training is one of the factors that encourage recycling behavior in the community. In the same manner, Zhang et al [18] studied waste source separation behaviors of citizens in Guangzhou, China and their results revealed that environmental knowledge ($r = 0.21$) influences the attitude of household regarding with waste separation programs.

Multiple regression analysis was used to predict a domestic waste separation behavior. To be more precise, the weight-beta (β) was used to determine the most important factor influencing the household waste separation behavior. It compares the relative contribution of each variable in explaining the variance of household waste separation behavior (Table 3). As can be seen from this table, information and knowledge ($\beta = 0.25$) about waste is the best predictor of voluntary waste separation behavior of the participants in Mashhad city, followed by moral obligation ($\beta = 0.22$), attitude ($\beta = 0.17$) and the social norm ($\beta = 0.05$). However, the values of β for these parameters are relatively low, which suggest that there are other factors that may have affected this behavior of the citizens in Mashhad.

In some studies (Table 4), environmental awareness and knowledge have been considered as factors that play important role in public participation in recycling programs. For instance, Ramayah et al [19] examined the predictors of recycling behavior among student society in Malaysia. Their finding indicated that the environmental awareness indirectly had influence on recycling behavior. Actually environmental awareness was significantly linked to personal attitude. Also, Grodzinska-Jurczak et al [20] found that increasing awareness through education and communication has a positive impact on recycling behavior of households in Jasło City (Poland). This results confirmed by Sidique et al [21] in Minnesota community. Our finding showed that it was the most important predictor of source separation behavior in Iranian society. Moreover, 26.9%, 23% and 11.9 % of respondents in high, middle and low class area of Mashhad city stated that having the information about environment and waste motivated them to separated waste at source.

The results of our research showed that the moral obligation positively related to recycling behavior. This is agreement with the conclusion of Zhange et al [4], Pakpour et al [6], Nguyen et al [22] and Chan and Bishop [23] (Table 4) who stated that the moral obligation is the determinant of recycling intention and behavior in

different community. In addition, in some literature, concern for the environment is used to understand the moral obligation. The results showed that environmental concern is growing strongly among people in the city of Mashhad. Respectively 95, 99 and 94 percent of respondents in high, middle and low class of the city stated that the environmental problems that exist nowadays in the city are important to them.

Attitudes towards the waste and environment was another predictors of waste separation behavior in our study. This finding is consistent with prior studies, for example Rhodes et al [24], Malik et al [25], Ramayah et al [19], Tonglet et al [26] and others (Table 4). According to Tonglet et al [26], households are involved in recycling programs when they view them and their consequences positively, so local authorities should promote initiatives to improve positive attitudes toward recycling.

Subjective norm was found that have influence on recycling behavior in our society, but the correlation is low. Rhodes et al [24], Chan and Bishop [23], Nguyen et al [22], Hasan et al [27] and Latif et al [28] found that subjective norm related to waste intention and recycling. Weak correlation between behavior and norm can be justified as follows: The subjective norm refers to social pressure for source separation of waste. This means that the public as well as officials expect that you will separate waste at source. In Mashhad, the participation of citizens in waste source separation programs is optional and there is the given infrastructural problems of waste management like lack access to recycling bins, so the officials do not expect a lot of public turnout. As well as environmental issues for the people has not first priority. So most people do not think that they should recycle my household waste. .

3.5. Factors that motivate or deter citizens to/from participation in household source separation

According to literatures, motivating factors for source separation of household waste includes information about the benefits of the source separation and how to do it, feedback, sufficient and easily accessible waste facilities and reward strategies. In this study, the effect of these motivational factors on household waste recycling behavior was examined. The results are shown in Table 3. As this table presents the most important factor is feedback (37.4 percent) followed by information (21.8 percent), rewards strategies (19.5 percent) and appropriate facilities (18.7 percent).

In this study, the concept of feedback refers to the municipality's efforts to demonstrate the success of recycling programs in the city. Although, a little research has done on the influence of different types of feedbacks on the

household recycling behavior, however Williams and Taylor [11] investigated the possibility of maximizing household waste recycling in England and found that local feedback are more acceptable to the public and lead to long term success of recycling programs. In other survey, Nigbur et al [29] stated that feedback significantly enhances recycling participation. The finding of this study is in consistent with Fenech [3] who revealed that feedback, information and situational factors are the most important motivating factors in the household recycling behavior in Sweden and Malta.

The reasons cited by responders for not participating in household waste separation are also presented in Table 6. The most important deterrent factors that constrain or hinder an individual's recycle behavior included: to be far or inappropriate recycle containers (29.1 percent), lack of space at home (18.1 percent) and Lack of taking out the trash station (13.8 percent). The reason of 2.4 percent of people for not doing waste separation is not separating waste by friends and neighbored (2.4 percent). In a number of studies it has been confirmed that the lack of local recycling facilities such as trash bins and stations and also the lack of space at home were the most effective deterrent reasons.

There are several reports which confirms that the success of any recycling programs is tightly dependant on infrastructure and easily available collection facilities [22, 30-33] such as Coggins [34] in the case of Sheffield, Germany, Abdelnaser et al [6] in Pulau Pinang and DEFRA [35] for Britain

4. Conclusion

The success of any recycling schemes vastly depends on community participation. In this study, the effect of the demographic factors (such as age, gender, education, occupation and the type of dwelling), the intrinsic factors (attitude, moral moral obligation, social norms and perceived behavioral control), the extrinsic factors (information, being active in environmental activities) and other the factors (situational variables and participation in decision making) were investigated on the citizen participation in household waste separation at source. The finding show that the age correlated negatively with domestic source separation behavior. Other mentioned variables, except being active in environmental activities and participation in decision making could explain and predict public participation in Mashhad. The respondents to the questionnaire expressed that the feedback followed by information, rewards strategies and appropriate facilities encourage them to do source separation of domestic waste. Being far away or inadequacy of waste facilities and lack of space at home were the main deterrent factors for household source separation behavior.

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Table 1 The socio-economic characteristic of the participants

Demographic attribute	City Classification			Frequency, n	Percent, %
	High class income area	Middle class income area	Low class income area		
Gender					
Male	55	43	50	148	48.3
Female	33	71	54	158	51.6
Age					
Below 19	8	11	4	23	7.6
20-29	18	23	24	65	21.5
30-39	16	31	30	77	25.5
40-49	12	14	22	48	15.9
Above 50	33	32	23	88	29.3
Education					
Elementary School	2	10	30	42	13.8
Secondary school	10	17	21	48	15.8
Diploma	33	42	41	116	38.2
Bachelor	37	33	10	80	26.4
Post graduate	5	10	2	17	5.6
Occupation					
Housewife	13	44	45	102	33.5
Employee	40	25	44	109	35.8
Doing business	25	35	12	72	23.6
Unemployment	3	4	1	8	2.6
Others	6	5	2	13	4.2
House type					
Apartment	49	55	61	165	54.2

House	32	49	26	107	35.1
Residential complex	7	9	16	32	10.5

Table 2 Household waste source separation behavior of the participants

Categories of source separation behavior	Frequency, n	Percentage, %
none	34	11.4
Low	45	15.1
Average	100	33.6
High	119	39.9

Table 3 The results of multiple regression

Factor	Beta, β	Sig
Being active in Environmental issues	0.05	0.64
moral obligation	-0.22	0.005
Attitude	-0.17	0
Information and knowledge	-0.25	0
Situational factors	0.002	0.96
Behavioral control	0.25	0.13
Participation in desion making	0.002	0.99
Norm	0.05	0.01

Table 4 determinant factor on source separation waste in different society

Ref	Variables													Most influencing variable	Type of community	Country
	A	SN	PBC	SF	EA	MO	T	CR	F	I	CS	RC	RO			
[٤]	×	×	×	×	×	×								Moral obligation	Resident in Guangzhou	China
[5]	×	×	×	×										Attitude	Student of UPM	Malaysia
[6]	×	×	×			×								Moral obligation	Resident in Gazvin	Iran
[22]	×	×	×		×	×	×							Trust	Resident in Hanoi	Vietnam
[27]	×	×	×		×									Perceived behavior control	Student of UPM	Malaysia
[19]	×	×		×	×			×						Environment Awareness	Students of Universiti Sains	Malaysia
[٢٥]	×				×									Attitude	Resident in Putrajaya	Malaysia
[٢٤]	×	×	×	×										Attitude	Resident in British Columbia	Canada
[23]	×	×	×			×								moral norms	Student in Curtin University	Australia
[36]				×											Resident in Kuala Lumpur, Penang and Johor Bahru	Malaysia
[28]									×						Resident in Kuala Lumpur and Kota Kinabalu	Malaysia
[31]									×	×				Feedback	Resident in Portsmouth	UK
[26]	×	×	×	×		×					×	×	×	Attitude	Resident in Brixworth	UK

A: Attitude, SN: Subjective Norm, PBC: Perceived Behavior Control, SF: Situational Factor, EA: Situational Factor, MO: Moral Obligation, T: Trust, CR: Cost of Recycling, F: Feedback, I: Incentives, CS: Concern for Society, RC: Recycling Consequences, RO: Recycling Outcomes

Table 6 Factors that motivate or deter participants for separating household dry waste

Motivating reasons for doing recycling actives	Number	Percentage
Feedback	130	37.4
Information	76	21.8
Rewards Strategies	68	19.5
Appropriate Facilities	65	18.7
Others	9	2.6

deterrent reasons for not doing recycling actives		
To be far or inappropriate recycle containers	74	29.1
Lack of space at home	46	18.1
Lack of Taking out the trash station	35	13.8
Waste separation is too difficult	25	9.8
Lack of patience for waste separation	21	8.3
Waste separation is time consuming	20	7.1
Lack of knowledge of how to perform source separation	17	6.7
Waste separation has no financial benefit for me	10	3.9
My friends and neighbors do not perform waste source separation	6	2.4