

Investigating the Level of Citizen Participation in Waste Recycling Stations in Isfahan Metropolis, Iran

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Abstract

Aims: This study aimed to investigate the level of citizen participation in solid waste recycling in the Isfahan metropolis. **Materials and Methods:** To assess the proportionate rate of citizen participation in 15 districts of the city, 400 questionnaires were filled out by participants through stratified random sampling method. The statistical analysis (Correlation and regression analysis) of the data was performed using the SPSS software. **Results:** The results showed that despite popular belief, the situation of solid waste recycling in Isfahan is unfavorable. Moreover, the highest level of citizen participation is related to district 10 (29.91%) and the lowest amount is associated with district 5 (12.22%). Applying strategies tailored to the social, economical, and cultural characteristics of each district and based on the current level of participation of citizens in each district can improve the current status. **Conclusion:** The results showed that the citizens need more education to increase their participation in Comprehensive Waste management. However, the provision of educational programs through mass media along with municipality co-operation leads to elevate the people awareness.

Keyword: Citizen participation, Isfahan, recycling, solid waste

INTRODUCTION

Population growth, continuous economic-industrial development, increasing urbanization, enhancing the welfare of people, and consumerism will exacerbate the amount of solid waste production and environmental problems.^[1,2] Solid waste generation is an inevitable part of human life, and urban solid waste management has become one of the major concerns during the last two decades.^[3-5] Increasing the production of solid waste has attracted the scientific attention of executive experts around the world to the proper disposal and recycling of these wastes.^[6] However, the most budget of solid waste management is spent for the collection and transportation. Nonetheless, any targeted change and planning can enhance community environmental and mental health, and client satisfaction by improving the level of an operational and technical system.^[7,8]

Today, roughly about 3.5 million tons of waste products are being generated on a daily basis globally. Approximately, 50,000 tons of which on average is generated daily in Iran. About 80% of the generated solid waste in Iran is produced by urban dwellers,

and only 20% of such is recycled.^[9,10] These substances cause a lot of biological and environmental pollution and endanger human health due to improper management.^[11,12] Contrary to the declining global trend, the solid waste production in Iran shows increasing trend and caused serious problems in many parts of the country and creates many environmental risks due to the lack of strategy and legislation.^[9,13] One aspect of social development is solid waste management in urban communities. There are different methods for solid waste management; however, in today's world, recycling and reuse are very important due to some benefits such as reducing the use of resources, solid waste production, and conserving energy resources.^[14,15] However, the success of the recycling process depends on the participation of citizens and interactions with responsible institutions, as well

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as the goals of sustainable development, can be achieved by public participation.^[10,13,16] The results of the studies showed that each Iranian citizen produces about 750 g of solid waste per day that 29% of which can be recycled.^[2,17,18] Shumal *et al.* reported that, each citizen in Isfahan was produced 660 g solid waste per capita per day. Isfahan with a population of around 2,243,249 is the third most populous city in Iran.^[19] About 1000 tons solid wastes are produced in this city, 700 tons, of which are unrecyclable and the rest remains to be recycled.^[19] Although Isfahan is mentioned as a pioneer city in solid waste management and public participation in Iran, about 140 tons of such produced wastes are remain unrecyclable.^[20] The largest share of the recyclable dry solid waste collection is related to recycling stations in Isfahan.^[20] Therefore, it is possible to achieve the level of citizen participation in solid waste recycling by analyzing the performance of these stations. To our knowledge, no research has been previously performed to evaluate the level of citizen participation in waste recycling stations in Isfahan metropolis. However, in the present study, the influencing factors on citizens' participation in municipal solid waste recycling and the analysis of the status of these important factors were investigated.

MATERIALS AND METHODS

The city of Isfahan is located at 32°38' N 51°38' E and at the height of 1575 m above sea level.^[21] According to the latest urban divisions in 2013, Isfahan has 15 districts with specific legal boundaries and zones. In terms of favorable conditions for solid waste generation and recycling, Isfahan is in the first rank compared to the other cities in Iran.^[22] Currently, 16 hauled and 60 stationary recycling stations are operated in 15 different districts of Isfahan. The location of recycling stations in Isfahan and the amount of received solid waste are shown in Figure 1.^[20,22] The present study is descriptive-analytical, and the data are collected through questionnaires. The questionnaires were performed by citizens in the spring of 2018. Cochran's formula was used to determine the sample size. Therefore, considering the population size, the sample size was equal to 384 subjects, which was increased to 400 to achieve higher reliability. The survey was conducted among the residents of Isfahan through the classified stratified random sampling. Thus, 400 questionnaires were filled out in different stations across the city. The scale of a questionnaire which was used in this study consisted of the following two main parts:

The first part includes questions to collect demographic information related to background and personal characteristics (including gender, marital status, age, etc.).

The second part includes specialized questions related to inner traits (including mental and psychological variables) based on the Likert model which was designed by interviewing citizens and obtaining the experts' and specialists' opinions in the relevant fields.

To confirm the validity, the questionnaire was improved and confirmed by five university professors. To ensure that questionnaire reliability, the first 30 samples of which

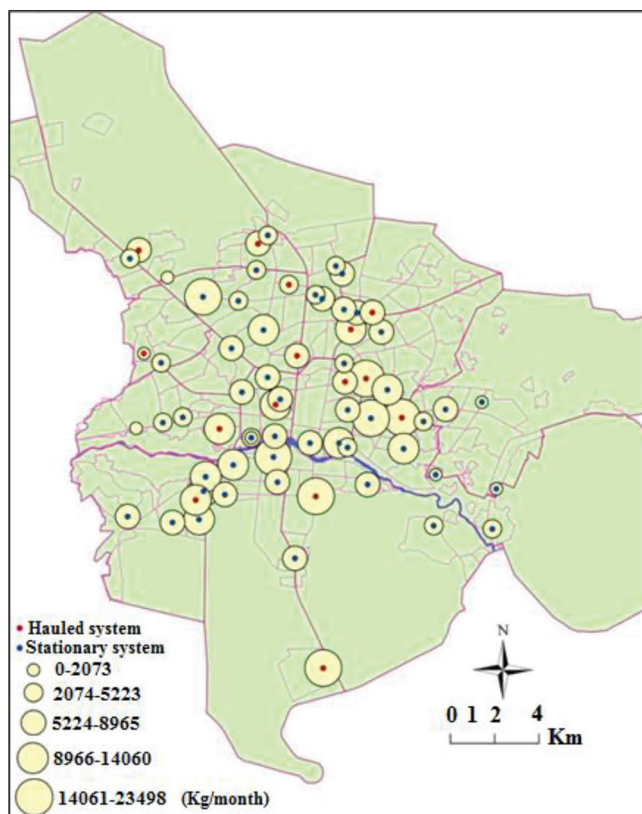


Figure 1: Location of the recycling stations in Isfahan along with the amount of monthly received solid waste

were pretested and after calculating Cronbach's alpha, it was found that the designed questionnaire has high reliability. The Cronbach's alpha value for the designed questionnaire was 0.871. After receiving the questionnaires, the data were analyzed using the SPSS software version 23 (Armonk, NY: IBM Corp). The statistical tests were selected to measure the relationships between the variables according to the type of collected data, Pearson correlation coefficient test, and regression analysis by simultaneous and stepwise methods.

RESULTS

In this study, 50.5% of participants were female, and the rest were male; moreover, 43.8% of those were single and 53.5% were married, and 2.8% were without a spouse (died/divorced). It was observed that the most participants (48.3%) were 25–44 years old, and the lowest frequency (0.8%) was related to the teenagers (<15 years). More than half of the statistical sample (66.3%) had an academic degree and the other was lower diploma. Twenty-nine percent of them referred to the recycling booths 6–10 times a year, 11.8% one or two times a month, 13.3% three or four times a month, and 21.8% once a week or more.

The average annual amount of recycled items which were collected by recycling stations in 15 districts is shown in Figure 2.

At first glance, it seems that the highest level of citizen participation in solid wastes recycling (based on the number of recycled items delivered to the stations) is in the 10, 5, and 4 districts; while the lowest is related to districts 11, 2, and 15. However, these figures are not a good criterion for judging the level of citizen participation in recycling due to influencing factors such as population and the number of recycling stations in each district. Therefore, an index should be defined to compare the level of citizen participation in different districts by considering the important factors. The annual production and collection amounts of household dry solid wastes in the different districts of Isfahan are presented in Table 1. As seen, regardless of the population factor, the amount of collecting recycled items in districts 10, 5, and 4 is the highest, and that districts 11, 2, 15, and 14 are the lowest. By considering the population factor in the amount of produced and collected dry

solid waste annually, districts 1, 6, and 13 are pioneers in this field whereas districts 11, 14, and 15 are in poor condition.

Figure 3 shows the ratio of collected solid waste to generated solid waste based on percentage. As shown, the level of citizen participation in each district in solid waste separation and delivery to residential recycling stations are presented. Furthermore, it can be seen that districts of 10, 9, and 13 have the highest citizen participation, and 5, 11, and 8 districts have the lowest.

In this study, the willingness of citizens to participate in solid waste recycling is presented in seven scales. As well as, the results are demonstrated in Table 2.

In this study, the analysis of the status of research variables was limited to the variables related to mental and psychological factors. Therefore, the analytical hierarchy process and averaging method were used to combine the scales. The mental and psychological variables and the mean values of each variable are seen in the Table 3.

In this study, the Pearson correlation coefficient test was used to measure the correlation between participation rate and independent mental variables. The matrix related to the significance levels of the mentioned variables is presented in Table 4. Accordingly, there is a significant relationship between the means of the participation variable and the introduced mental variables (except for N, X, Y, and Z variables).

Table 1: Annual generated and collected amounts of household dry solid waste in 15 districts of Isfahan

Number of district	Population (individual)	Annual collected solid waste (ton per capita)	Annual generated solid waste (kg per capita)	Annual collected solid waste (kg per capita)
1	91,702	760.40	48.31	8.29
2	76,088	307.45	27.82	4.04
3	129,225	658.51	24.52	5.10
4	148,038	840.22	25.99	5.68
5	191,826	995.99	42.46	5.19
6	131,203	770.68	34.77	5.87
7	174,717	558.42	16.84	3.20
8	278,980	745.07	19.40	2.67
9	86,125	487.16	20.86	5.66
10	249,557	1338.90	17.93	5.37
11	69,520	139.31	16.10	2.00
12	147,689	559.52	16.84	3.79
13	138,967	809.39	24.52	5.82
14	197,094	419.38	13.91	2.13
15	132,518	342.80	12.81	2.59

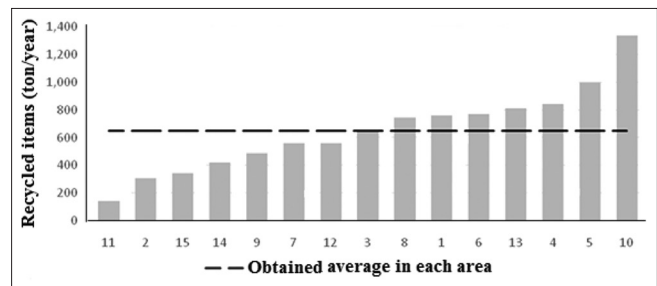


Figure 2: Amount of recycled items in 15 districts of Isfahan in recycling stations (tons/year)

Table 2: Citizens' opinion to participate in solid waste recycling in Isfahan

Eagerness to participate	Frequency (%)						
	Motivation and desirousness for solid waste recycling	Tendency to separate solid waste and deliver it to agents and recycling booths	Presence at events and introductory classes on environment, solid waste and recycling	Collaborate on solid waste management and recycling classes	Pay a reasonable amount to advance the recycling process	Encourage others to cooperation for solid waste recycling	Participate in planning and decisions related to the recycling field
Very low	17 (4.3)	22 (5.5)	84 (21)	101 (25.3)	147 (36.8)	22 (5.5)	47 (11.8)
Low	12 (3)	29 (7.3)	109 (27.3)	101 (25.3)	95 (23.8)	38 (9.5)	71 (17.8)
Medium	95 (23.8)	76 (19)	113 (28.3)	119 (29.8)	104 (26)	87 (21.8)	137 (34.3)
High	126 (31.5)	139 (34.8)	63 (15.8)	50 (12.5)	41 (10.3)	144 (36)	106 (26.5)
Very high	150 (37.5)	134 (33.5)	31 (7.8)	29 (7.3)	13 (3.3)	109 (27.3)	39 (9.8)

Table 3: Titles of mental variables and their mean values

Variable	Mental and psychological variables	Mean values
K	The individual's desire to participate	3.13
L	Experience of voluntary and charitable activities	2.50
M	Religious and cultural values and beliefs	3.82
N	Existence of financial incentives	3.45
O	Sense of commitment and responsibility toward the environment and residential place	4.26
R	The person imagines about participation and importance to play the own duty	4.04
Q	Individual awareness about the issue of participation and its consequences	4.18
S	Imagine of person about the own abilities and skills	3.60
T	The person imagines about participatory norms	3.30
U	Individual tendency to participatory behavior	3.84
V	The degree of individual effectiveness from others	3.51
W	Trust in the performance of the responsible institution (municipality)	3.94
X	Citizens' satisfaction about the performance of the responsible institution (municipality)	3.05
Y	Citizens' satisfaction about the performance of the formal education institute	3.12
Z	Citizens' satisfaction about the performance of nonformal education institute	3.33

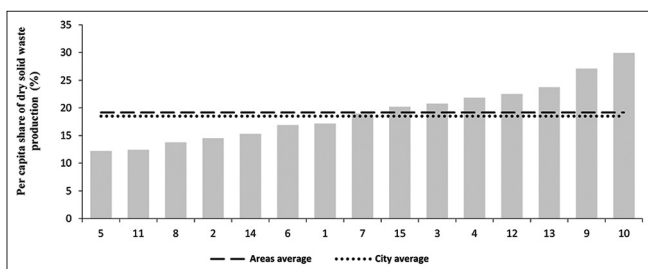


Figure 3: Index of "Per capita share of collection from per capita household dry solid waste production" in the regions (%)

Multiple linear regression analysis was used to investigate the relationship and the effect of independent variables on the dependent variable. Table 5 shows the coefficients of regression analysis. As seen, among the introduced independent variables, the K, T, S, and O variables have an acceptable level of significance. It should be noted that the participation variables are shown as P. Therefore, it is possible to discuss their effects on the participation variables according to the B values and the beta coefficient. The obtained regression equation by the simultaneous method is as follows:

$$P = 0.492 K + 0.404 O + 0.277 T + 0.273 S - 2.575$$

DISCUSSION

In this study, the level of citizen participation in solid waste recycling in 15 districts of Isfahan megacity was examined. The

results showed that, there is a significant, direct, and positive relationship between citizens' awareness and participation. In other words, as the citizens awareness increased, the citizens' participation enhanced. However, the provision of educational programs through mass media along with municipality co-operation leads to elevate the people awareness.

Studies showed that the amount of generated and recycled dry waste items in each district need to be analyzed concerning each other with considering the population of the district. Therefore, the ratio of recycled items to generated solid wastes in a district can be considered as an indicator to measure citizen participation and source reduction of solid wastes.^[1,9]

In this regard, Beshruye *et al.* reported that the education factor has a significant relationship with the level of people's participation and it is necessary to provide more educational programs.^[14] Furthermore, Brotosusilo *et al.* reported similar results.^[1] In addition, a research done by Khorramabadi *et al.* showed that only 5%–20% of the people were living in Khorramabad, were familiar with recycling and reported that the lack of continuous education is the main reason for the unfamiliarity.^[23] However, the results of a study in China showed that the level of education had the greatest impact on the participatory behaviors of citizens to separate solid waste.^[24]

In a research done in Tehran demonstrated that the most important factors that motivate citizens for solid waste sorting and source reduction were positive attitude, awareness, comfortability, situational factors, and economical parameters, respectively.^[25] Fahiminia *et al.* investigated the status of urban source reduction in Qom, Yazd, and East Azerbaijan provinces. The results of their study showed that a high percentage of citizens were familiar with the solid waste recycling and know its benefits and some applicable programs from municipalities can improve the percentage of citizen participation.^[26]

Rafeie *et al.* studied the solid waste sorting in the urban districts of Mashhad and concluded that districts with a moderate degree of development were in the first place and deprived districts were in the second rank.^[27] Zamanian and Farokhiyan (2015) reported that the highest tendency of citizens to participate in the solid waste management in Abadan was related to the homemakers. Besides, the age did not affect the willingness to participate, although the income impacts on that.^[7]

Different patterns of waste production, socioeconomic conditions, public awareness, citizenship education, geographical location, and type of season can affect the outcome of the study. Therefore, identifying important and influential individual variables in participation can be the first step in focusing on appropriate strategies such as education, institutionalization, legislation, and culture to make purposeful plans.

The present study showed that the share of dry solid waste collection is very low related to its production despite the claims of Isfahan municipality. The best indicator for

Table 4: Matrix of significant levels of variables ($P < 0.05$)

	P	K	L	M	N	O	R	Q	S	T	U	V	W	X	Y	Z
P		0.000	0.000	0.000	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.021	0.474	0.083
K	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.127	0.000	0.009	0.000	0.013	0.273	0.005
L	0.000	0.000		0.000	0.009	0.001	0.000	0.000	0.000	0.129	0.000	0.008	0.009	0.015	0.085	0.005
M	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.004	0.014	0.000
N	0.025	0.000	0.009	0.000		0.422	0.020	0.001	0.000	0.010	0.019	0.391	0.030	0.473	0.052	0.001
O	0.000	0.000	0.001	0.000	0.422		0.000	0.000	0.000	0.192	0.000	0.000	0.000	0.066	0.464	0.134
R	0.000	0.000	0.000	0.000	0.020	0.000		0.000	0.000	0.278	0.000	0.000	0.000	0.484	0.486	0.077
Q	0.000	0.000	0.000	0.000	0.001	0.000	0.000		0.000	0.021	0.000	0.000	0.000	0.010	0.055	0.001
S	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.219	0.023	0.000	0.011	0.000
T	0.000	0.127	0.129	0.001	0.010	0.192	0.278	0.021	0.000		0.023	0.049	0.079	0.000	0.067	0.003
U	0.000	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.023		0.000	0.000	0.113	0.372	0.008
V	0.000	0.009	0.008	0.001	0.391	0.000	0.000	0.000	0.219	0.049	0.000		0.000	0.273	0.188	0.222
W	0.000	0.000	0.009	0.000	0.030	0.000	0.000	0.000	0.023	0.079	0.000	0.000		0.313	0.006	0.098
X	0.021	0.013	0.015	0.004	0.473	0.066	0.484	0.010	0.000	0.000	0.113	0.273	0.313		0.000	0.000
Y	0.474	0.273	0.085	0.014	0.052	0.464	0.486	0.055	0.011	0.067	0.372	0.188	0.006	0.000		0.000
Z	0.083	0.005	0.005	0.000	0.001	0.134	0.077	0.001	0.000	0.003	0.008	0.222	0.098	0.000	0.000	

Table 5: Coefficients of simultaneous regression analysis

	Nonstandardized coefficient		Standardized coefficient	T	Significance
	B	SE	Beta		
Constant	-2.58	0.700		-3.68	0.000
K	0.49	0.114	0.260	4.33	0.000
L	0.097	0.087	0.056	1.17	0.265
M	-0.015	0.089	-0.009	-0.16	0.870
N	0.014	0.058	0.012	0.24	0.814
O	0.404	0.181	0.146	2.23	0.026
R	-0.116	0.130	-0.055	-0.89	0.374
Q	0.114	0.152	0.048	0.75	0.455
S	0.273	0.118	0.134	2.30	0.022
T	0.277	0.082	0.155	3.39	0.001
U	-0.123	0.135	-0.050	-0.91	0.364
V	0.185	0.120	0.076	1.54	0.123
W	0.030	0.083	0.020	0.36	0.719
X	0.043	0.101	0.020	0.43	0.666
Y	-0.057	0.092	-0.040	-0.62	0.535
Z	-0.012	0.108	-0.007	-0.11	0.912

SE: Standard error

measuring the true level of citizen participation for source reduction is the “recycled solid waste to produced recyclable solid wastes per capita on daily basis.”

The comparison of the initial data in Figure 2 with the information provided in Figure 3 shows that, except for district 10, the rank of other districts changed and the highest rate of change is related to district 5. This district, which is in the second place in Figure 2 (and at first glance is considered as one of the districts with favorable citizen participation), has the lowest rank in Figure 3, which means the lowest level of citizen participation in solid waste recycling in Isfahan. Although the number of recycling stations and their availability has significant impacts on the level of citizen participation,

the present study assumed that the situation of recycling stations has the least impact on that. However, if people obtain necessary educations, be aware about the benefits of recycling and source reduction, and the municipalities consider rewards for participants, they will participate in the municipality programs eagerly.

CONCLUSION

The present study showed that only a little amount of the produced solid wastes were recycled in Isfahan metropolis. Furthermore, there is a misconception about the level of citizen participation in the field of source reduction and recycling in this megacity. In point of public and municipality clerks view, Isfahan is known as a pioneer city for solid waste recycling in spite of this study results. However, the study demonstrated that low citizen participation happening as a result of improper education and lack of awareness. Moreover, deep thinking and avoiding shallow perceptions in various dimensions of urban management, especially for solid waste recycling, is an important step to meet sustainable development goals. In this regard, municipalities in under developing countries can be inspired by the pioneer cities in developed countries, in particular in the field of solid waste sorting and recycling.

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Conflicts of interest

There are no conflicts of interest.

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