Providing a Conceptual Model of Metropolises Waste Management (Case Study: Tehran, Iran)

Mohammadebrahim Tavallaei*[1], Ali Asghar Farshad[2], Human Liaghati[3], Jafar Nouri[4] and Gholam Hosein Salehi[5]

[1]Graduate School of Environment and Energy, Department of Environmental Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.
[2]Associate Professor, Occupational Health Research Center, Iran University of Medical Sciences, Tehran, Iran.
[3]Associate Professor, Department of Environmental Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.
[4]Professor, Department of Environmental Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.
[5]Assistant Professor, Department of Environmental Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.

Urbanization and excessive resources consumption including risk of improper waste management are global health and environmental challenge especially in metropolises. Purpose of this study was to provide a conceptual model of metropolises waste management in Tehran, capital of Iran, as a model. Data collection was done through a 25-items questionnaire to examine the people awareness and attitude as well as analyze current and desired situations of wastes management and recycling in 2013. Four hundred fifty residents of Tehran were selected randomly to participate in the study. . Data were analyzed using descriptive and inferential statistics methods by SPSS software and $P < 0.05$ was set as the significance level. The SWOT matrix was used to formulate waste management strategies considering all aspects of comprehensive waste management. Results showed that the awareness level of 90.4% of people was good and the attitude of 81.3% of them was supportive towards recycling. Moreover, more media coverage on this issue and using award and encouragement strategies are the most important factors increasing people participation in the waste management. Furthermore based on the quantitative strategic planning matrix, priorities of waste management strategies are sustainable, social, economic, and environmental development.

Keywords: waste management; Tehran; participation.

As municipal wastes have a lot of recyclable materials[1], their management is one of the most important issue in sustainable development and one of the major concerns of human societies[2,3]. However, municipalities' measures could not resolve wastes management

---

* To whom all correspondence should be addressed.

problems solely, but through people participation in city affairs[4].

An organization or a social system needs to adopt some measures to increase participation of its members if it is going to achieve its goals and implement its programs., The environment control by citizens is the highest level of the participation which involves people in decision making. Recognizing such participation,

2

authorities' success in implementing waste management programs could be evaluated, because participation is one of the fundamental basis for success of this programs[5].

With respect to the Iran waste management act, 2004, recycling has been received a great attention[6]. Waste management are problematic in different cities of Iran due to the cultural context, population, the economy, excessive consumption of materials, lack of awareness, lack of attention to people and responsibility, the heterogeneous and various nature of the waste, disregarding regulations, and lack of facilitates in municipal services[7]. Various studies have been conducted in this field some of which are about societies, families, and student populations attitude and awareness about the waste management. Results indicate that municipalities need the public participation in waste management to separate waste and recycle them[8-13].

Tehran metropolis, as the largest city and capital of Iran, encounters a lot of problems in waste management (7500 ton wastes per day [14]. Analysis results of wastes produced by 11 million people shows that the maximum and minimum waste amounts are allocated to the wet waste of 74.56 % wt and rubber of 1.11 % wt, respectively[15] Analysis of the mean percentage of waste dry components of the study domain in 2013 showed that maximum percentage of dry waste was of plastic materials.

MATERIALS AND METHODS

Study was conducted in two stages. In the first stage a survey was conducted during the year 2013 in the entire 22 administrative sectors of Tehran city. The sample size was determined as 626 residents of Tehran city which were selected randomly by the stratified multistage sampling method from 1, 2, 4, 6, 7, 10, 12, 14, 18, 20, and 22 municipality administrative sectors. The main tool which was used to collect data was a questionnaire which elicited information related to citizens' demographic characteristics, waste management awareness, factors influencing the environment degradation, attitudes toward waste management investments, and willingness to participate in the waste management process.

Willingness to participate in the waste management process was considered as dependent variable, while waste management awareness, factors influencing the environment degradation, attitudes toward waste management investments, and responders' general characteristics considered as independent variables of the study. These variables, except responders' demographic characteristics, were evaluated using a five-point Likert Scale which included strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree.

The questionnaire was validated by using experts' opinion. Some waste management professors of the Tehran University, Science and Research Unit, and experts of waste management organization of Tehran municipality validated the questionnaire after several revisions and corrections. Reliability was measured by Cronbach's alpha coefficient in a pilot test of 30 questionnaires which showed an alpha level of 0.87.

In the second stage, Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was done for waste management in Tehran city. For this purpose, the entire internal and external environmental factors affecting waste management were identified through the result of the above mentioned survey, by reviewing available literature including reports and documents, by interviewing with 18 mangers and experts of waste management organization of Tehran municipality, and field observations of waste management related activities. Also, SWOT analysis was done for Internal Factor Evaluation (IFE) Matrix and External Factor Evaluation (EFE) Matrix. Then SO, ST, and WT strategies were determined by comparing internal strengths with external opportunities, internal weaknesses with external opportunities, and internal weaknesses with external threats, respectively. Finally, the extent of attractiveness and priority of chosen strategies were determined using results of the internal and external factors evaluation matrix, and those of the SWOT matrix, as well as developing Quantitative Strategic Planning Matrix (QSPM).

In order to determine criteria for the waste management strategies formulation, Brain Storming method was done by a group of 40 experts of waste management related sciences including

environmental engineering, environmental health engineering, and environmental management.

RESULTS

Characteristics of the survey participants

The mean age of participants was 32 ± 13.4 years (range 24 to 80 years), 56.7% of participants were female. 2.7% of participants were illiterate, 5.3% had less than high school education, 45.8% were at the diploma level, and 46.2% had bachelor or higher educational level. 35.2% of participants were single and 21.8% were housewives or unemployed, while others were employed (68.9%) and student (9.3%).

Awareness and attitude of participants

The awareness of 90.4% of participants was good and the awareness of 6.1% of participants was intermediate, and the rest had weak level of awareness. Also 81.3% of participants had desirable attitude toward waste management. Performance of 72.9% of participants was good.

There was a significant association between people awareness level of recycling and education ($p < 0.05$). Also, there was a significant association between people awareness level of recycling and gender ($p < 0.05$), women were more aware compared men.

There was a significant association between people attitude toward recycling and education, marital status, and the age of participants ($p < 0.05$).

There was a significant association between marital status and occupation and awareness level and the performance of recycling ($p < 0.05$).

Result of QSPM analysis

The result of QSPM analysis also, showed that there was a significant difference between current and desirable level of waste management score in Tehran (p=0.000).

The result of QSPM analysis also, showed that there was a significant difference between current and desirable level of recycling facilities and equipment score in Tehran (p=0.000) (Table 1).

Table 2 shows the results of SWOT matrix of Tehran waste management considering internal and external environmental factors evaluation. Moreover, Figure 1 represents quantitative planning matrix results and the comparison between Tehran waste management strategies attractiveness.

SO Strategies

a) SO_1 (ST2): Increasing private sector participation to perform waste management long term plans

b) SO_2 (ST2): Increasing job opportunities due to private sector investments allocated to perform waste management processes.

c) SO_3 (ST3): Developing and accelerating separation from the origin plans to prepare initial materials of recycling industries.

d) SO_4 (ST4): Developing recycling industries in the city, creating competition atmosphere between these industries; and therefore, increasing the quality of separated materials.

e) SO_5 (ST5): Increasing urban managers and authorities participation to perform waste management processes.

WO Strategies

a) WO_1 (ST6): Increasing people awareness and educating them to enhance their participation to perform waste management processes using their religious teachings.

b) WO_2 (ST7): Using educational and research potential of Tehran universities to provide expert human resources and research needs

Table 1. Comparing current and desirable status scores of the Tehran waste management and recycling facilitates in 1392

	Mean score	$\pm$ SD	P value
Waste management			
Desirable status	2.5675	0.91197	0.000
Current status	4.1263	1.23125	
Recycling facilitates			
Desirable status	3.4949	1.01526	0.000
Current status	2.9694	0.93867	

of waste management processes.

ST Strategies

a) ST_1 (ST8): Implementing a comprehensive and integrated waste management system

in Tehran city and reducing parallel activities to increase systematic productivity

b) ST_2 (ST9): Increasing inter-sector

Table 2. Results of SWOT matrix of Tehran waste management considering internal and external environmental factors evaluation.

Internal factors

Strengths

	1) Availability of long-term and short-term executive programs of waste management	2) Availability of long-term and short-term executive programs of waste management	3) Availability of long-term and short-term executive programs of waste management	4) Availability of long-term and short-term executive programs of waste management	5) Availability of long-term and short-term executive programs of waste management	6) The type and quality of urban waste compounds	7) Establishing a waste management organization in the municipality organizational structure	8) The type and quality of urban waste compounds	9) Reduction of organization executive role in waste management activities
A) Private sector firms and institutions participation in waste management programs	•	•	•	•					
B) Level of cultural indicators and people religious teachings								•	
B) Recycled materials industries and markets over the city and region	•	•	•	•				•	•
D) National consideration and determination to the region waste management	•		•	•	•	•			
E) Creating job opportunities and									

collaboration and coordination at national level education and awareness w programs for waste management costs.

WT Strategies

a) WT_1 (ST10): Using waste management new technologies considering inappropriate conditions of physical environment as well as lack of budget and credit.

b) WT_2 (ST11): Developing sustainable and available resources to provide costs and credit required for waste management.

c) WT_3 (ST12): Reducing waste production and increasing waste separation to decrease waste filling land.

d) WT_4 (ST13): Increase in awareness of managers and authorities of relevant

governmental and private organizations to perform waste management processes.

e) WT_5 (ST14): Developing a comprehensive waste management database to respond to waste management long-term and short-term problems.

f) WT_6(ST15):Providing waste management applied quideline, rules and regulation to design, instruct, exploit, and monitor the waste management system according to physical, social, environmental, and economic conditions.

Based on quantitative strategic planning matrix results, priorities of waste management strategies for obtaining sustainable development in terms of social, economic, and environmental development could be seen in the Table 3.

Table 3. Strategic prioritization of waste management

| No	Strategy	Evaluation Score	Evaluation Score	Attraction Score
1	Separating at the origin programs development	1.78	1.77	3.55
2	Developing recycling industries, creating the competition atmosphere between these industries; and therefore, increasing the quality of separated materials.	1.52	1.84	3.36
3	Increasing the private sector participation to perform waste management long term programs	1.07	2.06	3.13
4	Reducing waste production and increasing waste separation to decrease land filling waste in applicable fields	1.39	1.68	3.07
5	Increasing people awareness and educating them to enhance their participation to perform waste management processes using their religious teachings	1.3	1.41	2.71
6	Using waste management new technologies regarding inappropriate conditions of the physical environment as well as lack of budget and credit	1.19	1.41	2.6
7	Providing waste management practical instructions (rules and guidelines) to design, instruct, exploit, and monitor the waste management system according to physical, social, environmental, and economic conditions	1.26	1.31	2.57
8	Increasing urban managers and authorities participation to perform waste management processes	1.3	1.21	2.51
9	Implementing a comprehensive and integrated waste management system in the Tehran city and reducing parallel activities to increase systematic productivity and decrease	0.92	1.35	2.27
10	Increasing job opportunities due to private sector investments allocated to perform waste management processes	1.32	0.94	2.16
11	Using educational and research potential of the region universities to provide expert human resources and research needs of waste management processes	0.81	1.26	2.07
12	Increasing inter-sector collaboration and coordination in national education and awareness	1.16	0.75	1.91
13	Developing a comprehensive waste management database to respond waste management long-term and short-term problems	0.68	1.09	1.77
14	Developing sustainable and available sources to provide costs and credit required for waste management	0.66	0.84	1.5
15	Increasing awareness of managers and authorities of relevant state and private organizations to perform waste management processes	0.74	0.6	1.34
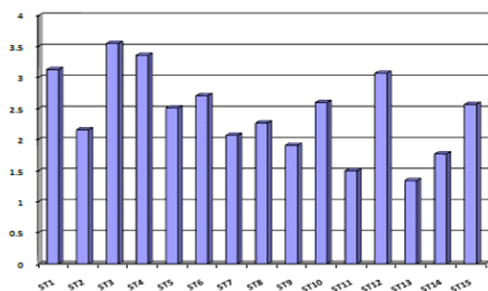
Fig. 1. Comparing Tehran city waste management strategies attractiveness

DISCUSSION

Optimal management of urban wastes is one the most important steps to achieve sustainable development objectives because it reduces problems and concerns of waste production, collection, and disposal [16]. Also, it produces a suitable cycle for recycling and reentering recycled materials to the production and consumption cycle. The public participation in waste management is required for accomplishment of this process. People participation includes the effective participation in all social affairs in decision-making, planning, implementation, exploitation and evaluation processes via unified and coordinated efforts and by all potential facilities and resources[17].

As the urban waste management is crucial, and its services directly related to people's life[18]. Thus, participatory efforts of people in waste management as well as municipality performances have a great effect on developing a positive attitude to the municipality.

Results of this study indicated that most of participants had good level of awareness and desirable attitude to recycling and participation in it.

Also, this study showed that education and employment status did not affect people performance in recycling. But, participation obstacles reduce if civil institutions and non-governmental organizations, which could institutionalize participation culture in the society, are developed and promoted.

This study showed that current situation of waste management in Tehran and current available facilities and equipment are significantly different from the desirable waste management and available facilities and equipment, which show the necessity of planning and investment on this area.

This study, also, showed that developing programs for separating waste at the origin is the most priority step for waste management in Tehran.

ACKNOWLEDGMENT

REFERENCES

1. Agwu MO, Mnisp M., Issues and challenges of solid waste management practices in Port Harcourt city, Nigeria. A behavioral perspective. *American Journal of Social and Management Sciences* 2012; **3**(2), 83-92.
2. Fatta D, Moll S, ETC/WMF., Assessment of information related to waste and material flows. European Envuronmental Agency, Technical report, No. 96, TRED, New York, 2003.
3. Kofoworola of Recovery and recycling practices in municipal solid waste management in Lagos, Nigeria. *Waste Management* 2007; 27(9): 1139-1143.
4. Morrissey AJ, Browne J., Waste management models and their application to sustainable waste management. *Waste Management* 2003; **24**: 297-308.
5. Aado AW, Gosseline AY., Recycling in multifamily dewellings: does Convenience matter. *Economic Inquiry* 2005; **43**(2): 426-438.
6. Monavari M, Sharee AF., Engineering and management of municipal waste collection, Jihad Publication of Amirkabir University, Tehran, Iran, 2010.
7. Monavari SM, Omrani GA, Karbassi A, Raof FF., The effect of socioeconomic parameters on household solid- waste generation and compostion in developing countries (a case study: Ahvaz, Iran). Environ Mohit Assess. 2011; DoI 10.
8. Johari Z, Kholdi N, Tadayon B, Hshemi SR Examining the Awareness, Attitude, and Performance of People referring to health centers relative to waste recycling. Proceedings of the Twelfth International Conference on Iran Environmental Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran, 2009.
9. Omrani G, Alavi Nakhjavani N., Solide Wastes, Vol. 2 (Recycling), Andishe Rafie Publication,

Tehran, Iran, 2009.

10. Mohammadi MT, Taheri MA, Binavapour M, Fatehi A., Examining the Feasibility of Recycling Urban Wastes of the Tehran, 1382. Abstracts of the Eighth National Conference on Environmental Health, 2005; 17-19 Aban.

11. Ghafuri Y, Tabarayi Y., Examining the Awareness and Attitude of Urban Families of Qom to to Increase Participation in Recycling Urban Wastes in the Recycling Model Examination of Qom Urban Wastes Program. Eighth National Conference of Environmental Health, School of Health, Tehran University of Medical Sciences, Tehran, Iran, 2005.

12. Shahmoradi B, Ghavami A, Nanbakhsh H (2003(Examining the Urban Households Knowledge, Attitude, and Performance in Urban wastes Management of the Sanandaj, winter of 2002 and spring of 2003, Proceedings of the Sixth National Conference on Environmental Health, Sari, Iran.

13. Mesgaraf H, Sadeghi H., Examining the Awareness, Attitude, and Performance of People Relative to Urban Solide Wastes Management of the Kermanshah, Proceedings of the Fourth National Conference on Environmental Health, Yazd, Iran, 2001.

14. Tehran Municipality., Environmental conditions of Tehran, Center of Urban Planning and Architecture, Tehran, Iran, 2013.

15. The Recycling and Materials Transformation and Recycling., Physical Analysis of the Tehran wastes, Tehran Municipality, Tehran, Iran, 2012.

16. Duan H, Fortner RW., Chinese college students perception about global versus local environmental issues. *Journal of Environmental Education*, 2005; **36**(4): 23-32.

17. Leena AL., Purpose and challenges of public participation in regional and local forestry in Finland. *Forest Policy and Econonties*, 2004; **6**: 602-618.

18. Mbuligw SE., Assessment of performance of solid waste management contractors: A simple techno- social model and its application. *Waste Management,* 2004; **24**: 739-749.