

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/237392314>

Municipal solid waste management at Salt City in Jordan: Community perspective

Article in *Journal of Food Agriculture and Environment* · April 2009

CITATIONS

6

READS

567

3 authors:



Bassim Abbassi

Al-Balqa' Applied University

24 PUBLICATIONS 221 CITATIONS

SEE PROFILE



Eng. Hassan Khrisat

University of Jordan

2 PUBLICATIONS 6 CITATIONS

SEE PROFILE



Qasem Alnewashi

Sustainable Research and Development Center

6 PUBLICATIONS 12 CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:



UN Women [View project](#)



mercy Corps [View project](#)



Municipal solid waste management at Salt City in Jordan: Community perspective

Bassim E. Abbassi ^{1*}, Hassan Khrisat ² and Qasem Alnewashi ¹

¹ Department of Water Resources and Environmental Management, Faculty of Agricultural Technology, Al-Balqa' Applied University, 19117 Al-Salt, Jordan. ² Ministry of Water and Irrigation, Amman, Jordan. *e-mail: babbassi@bau.edu.jo, abassim@yahoo.com

Received 21 January 2009, accepted 10 April 2009.

Abstract

Current managerial practices of municipal solid waste at Salt City in Jordan are facing a variety of problems. This study aims to evaluate the existing Municipal Solid Waste Management (MSWM) through surveying the citizen's perspectives pertaining to quality of services, awareness level of the present MSWM and their willingness to participate in MSWM. The current status of the MSWM evaluated through questionnaire distribution among all segments of the residents. The collected data has been analyzed based on Likert scale, community satisfaction, level of awareness and readiness to participate in waste recycling projects. The results showed that approximately 60% of the respondents expressed low level of satisfaction with the services related to the quality of solid waste management and the cleanliness services. The results also indicated that citizens' satisfaction is obviously influenced by the demographic variables. The results have demonstrated clearly that the respondents are willing to participate in waste recycling projects. There were a significant evidences that participation in waste management policies not only depends on education level, but also on demographical determinants. This unique study at Salt City reveals that improvement measures on current MSWM are urgently needed and further studies and initiatives are required.

Key words: Solid waste, management, community perspective, questionnaire, statistical analysis.

Introduction

The problems associated with Municipal Solid Waste Management (MSWM) are complex due to the quantity and diverse nature of wastes, the development of sprawling urban areas, the funding limitations for public services, the impacts of technology, and the emerging limitations in both energy and raw materials ¹. The basic problems of waste disposal are normally associated with cultural value system of the society ². Moving toward sustainable disposal involves a change in basic values and notions of economic wealth, which cannot be changed by short-term interventions, rather it would be more reasonable to combine various methods in a cost-effective manner, which is beneficial to the community and meets the need for safe garbage disposal that will continue to be effective for future generations ². Negligent waste disposal is causing problems for the environment and human health because of leaching, contamination and poisoning of land, water, vegetation, animals and humans ^{3,4}.

An Integrated Solid Waste Management (ISWM) evolves in response to regulations developed to implement various laws ^{1,5}, which help in establishing a hierarchy of waste management activities. Several investigations have revealed inadequacy of solid waste management in many cities of developing countries ⁶⁻⁸. Sharholy *et al.* ⁸ have reported that inadequate management of solid waste in most cities of developing countries leads to problems that impair human and animal health and ultimately result in economic, environmental and biological losses. Collivignarelli *et al.* ⁹ stated that solid waste management systems in developing countries confront with many complexities, including low technical experience and low financial resources which often cover only

collection and transfer costs, leaving no resources for safe final disposal.

In Jordan, the disposal of municipal solid waste is a costly and time-consuming business and requires complex measures to control ¹⁰. These measures include the control of solid waste generation, storage, collection, transporting, processing and disposal in accordance with the principles of public health and economics. There are around 23 landfills all over Jordan where about 5000 tons per day of municipal solid waste (MSW) are improperly landfilled ¹⁰.

At Al-Balqa' Governorate, the fourth biggest Governorate in Jordan, about 200 tons are dumped daily in the Hummrah landfill owned and managed by Shared Services Board. Salt city is the capital of Al-Balqa' Governorate and located 30 km west from the capital Amman. According to the statistics of 2006, Salt city had a population of 375,200 and the daily amount of produced solid waste by the entire city districts was about 130 tons.

The current study investigates the municipal solid waste management system in the major five districts of Salt City with a total population of 79,650. The existing municipal solid waste management system in the city was investigated by analysis of the currently used methods of waste collection, transportation and disposal. Specifically, the study attempted to survey the community perspectives related to the existing municipal solid waste management system in the city through investigating the following questions: 1) Which are the solid waste components in Salt City? 2) What is the level of the citizens' satisfaction about the quality of waste management services? 3) Are the citizens in

Salt City aware of the current management system of the solid wastes? 4) Are the citizens willing to participate in the solid waste management system?

Methodology

Baseline data: In order to identify the current solid waste management system, certain indispensable data and documents were collected. These included 1) most recent enumeration of population of Salt City and population growth rate; 2) current amount of produced and transported MSW; 3) current numbers, types and distribution of vehicles, containers and employees involved in solid waste collection and disposal; 4) current plans for waste collection and transportation, including managerial and financial costs.

Classification of waste composition: To ensure representative actual data on MSW, a total of 30 samples with volume of 1 m³ each were collected from the five different districts of the study area. Six samples were obtained from each district to ensure that some degree of randomness and unbiased selection was maintained. A 7.5 m³ truckload was used for picking-up the samples using the door-to-door technique. The manual sorting technique was used to separate the waste components into garden wastes, paper, cardboard, plastics, fiber, glass, metals, rubber, leather, kitchen garbage, stone and others. The sorted wastes are weighed, and a percentage of each component is calculated by dividing the weight of each component by the total weight of all components.

Community perspectives survey

Questionnaire construction: Based on the objectives of this study, it was required to develop a certain study tool to evaluate the current services quality of MSW in Salt City. Similar to the study conducted by Ajani ¹¹, the quality of services was determined to be the main axis of the suggested and developed questionnaire which formed the arbitration questionnaire. It consisted of two parts. The first part represented general information which consisted of 7 clauses. The second part consisted of 9 clauses representing the core of the study objective (quality of services).

The final form of questionnaire was developed based on the arbiters' notes and modifications and consisted of 7 general information clauses followed by 3 main aspects. The first aspect dealt with population satisfaction with the service quality of MSW and consisted of six clauses. The second aspect tackled the citizen's awareness of MSWM and contained two clauses. The citizen preparedness in participation in the integrated municipal solid waste management (ISWM) was the objective of the third aspect which contained two clauses. The scaling technique used in these three packages was based on Likert scale ¹². The Likert scales excellent, very good, good, acceptable, and bad were given weights of 1, 2, 3, 4 and 5, respectively.

Sampling: The study sample consisted of 600 citizens randomly chosen from the city districts to which the questionnaires were distributed. The sample percentage in each district was calculated by dividing the population of each district by the population of Salt City. The first to fifth district's shares were 50, 218, 146, 85 and 101 samples. The number of received questionnaires was 540. Forty questionnaires were excluded because of not meeting the

provisions of the answer. Eventually, statistical analysis procedure was conducted on 500 questionnaires. The variables, on which the questionnaires were evaluated, were number of family members, family income, educational level, mean of waste collection and container type.

Questionnaire stability: In order to determine the extent of the tool stability, test and re-test method was used. The questionnaire was distributed to 20 inhabitants of Salt City randomly chosen from different districts of the city. The questionnaire was then redistributed on the same population sample after one month. By calculating the correlation factor of Berson's coefficient ¹³ between the two applications, it was found that the value of correlation coefficient was 0.976%, which indicated the presence of high stability of the study tool. To determine the extent of the internal consistency between the clauses of measuring, Alpha-Cronbach coefficient ¹⁴ was calculated and the result was 74.54%. This result indicates the presence of a good internal consistency between the scale clauses, since the value for the presence of internal consistence between the scale clauses was 68%.

Statistical analysis: The collected data in the questionnaire were statistically processed by using the program SPSS. The following statistical parameters were determined: standard deviation, arithmetic mean, t-test to determine the differences between two samples, F-test to determine the differences between more than two samples and variance test ANOVA.

Results and Discussion

Current situation of MSWM: According to the law of Ministry of Municipalities in Jordan, the Greater Salt Municipality should implement a solid waste management strategy, which includes streets cleaning and wastes collection from the residential areas. Municipal solid waste is collected by containers of different sizes which are distributed over all the city streets. The large and small compacters upload the wastes from containers and transfer them directly to a landfill located 12 km west from the city with an area of 26.7 hectare. The number of laborers and equipments used in the management of solid wastes in the five districts of the study area are shown in Table 1. It is obvious that the distribution of the municipality staff on the districts is not correlated with density of population. Similarly, the higher density populated areas receive lower number of equipments.

The average annual quantities of the wastes generated from Great Salt Municipality districts were recorded to be 47,495 tons. The study area of 48 km², which represents 61% of the Great Salt Municipality area, daily generates 83 tons of solid waste. In 2006, the total costs and expenditures for the entire solid waste management at Salt City were recorded to be about 571,200 €. However, the total revenues for the same year were about 371,200€.

Analysis of waste composition: The composition of generated solid waste was determined for the entire study area as shown in Table 2. The organic component represents approx. 61% of the entire MSW and is the highest among the other components. Plastic and rubber were found to form 16.6% followed by papers and cardboard of 11.3%, metal and glass of 3.1 % each, and others of about 4.5%.

The maximum amount of organic components in the solid waste

Table 1. Number of labors and the equipments used for management of solid wastes in the districts of the study area ¹⁵.

Issue		District 1	District 2	District 3	District 4	District 5	Total
Staff	Laborers	51	43	30	24	30	178
	Inspectors	5	7	3	4	8	27
	Drivers	2	2	2	2	2	10
	Managers				2		
Equipment	Vehicles	2	2	2	2	2	10
	Containers	50	120	120	70	60	420
	Sweeps	204	126	60	48	60	498
	Carts	15	10	10	10	10	55
	Animals	5	10	8	4	8	35
Frequency of Collection No./week		2	2	2	2	2	10
Population		6674	28792	19417	11295	13472	79650

Table 2. MSW components (%) for each district.

District	Organic	Plastic	Paper	Glass	Metal	Rest
District 1	57.2	19.2	12.6	2.3	3.8	4.9
District 2	63.5	16.4	10.5	2.9	3.4	3.3
District 3	61.3	16.8	10.7	3.1	3.3	4.8
District 4	62.3	14.3	11.5	3.5	2.9	5.5
District 5	62.7	16.3	11.2	3.7	2.1	4.0
Average	61.4	16.6	11.3	3.1	3.1	4.5

shows a great potential of solid waste processing to produce compost which has diverse applications in the region. This is of importance where the landfill is surrounded by many farms and agricultural enterprises. Other way of making use of the organic matter, including paper and plastic wastes, is the implementation of the new concept of waste-to-energy. However, this needs a lot of experience and technical skills in addition to the high investment cost. Waste paper and cardboard represent an important source of raw material to produce recycled paper and cardboards. The frequency of collection of the solid waste in Salt City makes this material a great potential for recycling, as the contact time of paper and cardboard with other waste components is extremely short.

Analysis of community perspectives related to the existing MSWM:

The status of the current MSWM in Salt City has been evaluated through a questionnaire distribution among all segments of the city residents. The questionnaire aimed to identify the community perspectives related to MSWM system in Salt City based on a set of variables agreed in the arbitration questionnaire. These variables were: district, quarter, number of family members, annual income, educational level, means of waste collection and type of the used container.

First question: what is the level of the citizens' satisfaction with the quality of waste management services?

Based on Likert scale, the citizen satisfaction was evaluated according to several questionnaire clauses. The means and standard deviations for the entire clauses within this hypothesis are shown in Table 3. For proper statistical analysis and according to the work of Uebersax ¹², it was proposed to set out a theoretical mean of 3. All clauses with means above the theoretical value indicate that the clauses are nearing toward the excellent evaluation and all means below the theoretical value are nearing toward the weak evaluation.

Table 3 indicates that the highest mean was 3.95 considering the sweepers behavior, which is about 25% higher than the proposed theoretical mean. This indicates a community relative satisfaction with the sweepers' behavior. The lowest mean was the cleanliness of containers with a value of 2.25 which is lower than the proposed theoretical mean and thus away from citizen satisfaction. The overall mean for all clauses was found to be 3.01. This value coincides with theoretical mean. The result of this part of study showed, that generally about 60.2% of the community has low satisfaction with the quality of solid waste services in Salt City.

To determine the significance in the differences between the

Table 3. Citizens' satisfaction with waste collection and cleanliness services.

Item evaluated	Mean ± standard deviation
Number of containers in the street.	2.50 ± 1.30
Distance of the container from the house.	2.95 ± 1.54
Evaluating the containers cleanliness in the street.	2.25 ± 1.25
Number of wastes collection.	3.19 ± 1.24
Cleanliness worker behavior (dealing)	3.95 ± 1.09
Cleanliness worker effectiveness.	3.47 ± 1.17
Cleanliness of the sweepers' clothes.	2.61 ± 1.07
Nature of the services in the street concerning it cleanliness.	2.92 ± 1.32
Services quality in the street, concerning waste collection.	3.16 ± 1.21
Satisfaction	3.01 ± 0.8

measured means and the proposed theoretical mean, t-test was applied and the results are shown in Table 4. The t-test analysis showed that there is a significant difference between the measured mean and the theoretical mean at the significant level $\alpha = 0.05$.

To determine the significance in the citizens satisfaction with cleanliness services considering the change of set of variables: district, quarter, number of family member, the income, the educational level, means of waste collection and type of collection container, ANOVA test was conducted. The results are tabulated in Table 5 and show that there are significant differences in the citizen's satisfaction according to the set of the demographic variables.

Post test analysis indicated that citizens' satisfaction with cleanliness services is indirectly proportional to the size of the family, where small families showed higher satisfaction than large families. This can be explained by the fact, that low amount of wastes generated by small families requires less disposal and handling efforts than those by large families. The results showed also that citizens' satisfaction with cleanliness services is influenced by the family income in favor of low income families. Similar to family size evaluation, this can be explained as low income families usually produce less amount of waste than high income families. As for the educational level, the results indicated that the significant differences are in favor of the high level of education, which indicates that more knowledgeable people are exposed to

more awareness and education events which provide them with proper knowledge, skills and attitudes towards waste management systems.

Second question: how aware are the citizens about the current MSWM system?

The citizen awareness, based on Likert scale, was evaluated according to several questionnaire clauses. The means and standard deviations for the entire clauses within this hypothesis are shown in Table 6. It is clearly seen, that the higher mean was 3.66 considering the expected effects of privatization of wastes collection. This value is about 18% higher than the proposed theoretical mean. This indicated a community relative awareness of the expected effects of privatization of wastes collection. The lowest mean was the evaluating the value of charges and revenues collected as solid waste fees with a value of 3.08 which is higher than the proposed theoretical mean. The overall mean for the entire clauses was calculated to be 3.37. This value is higher than the theoretical mean but is lower than the Likert scale for a complete awareness.

The results of this part of study shows that about 67.4% of the community has good awareness of the existing solid wastes management in Salt City. The t-test was conducted in order to determine significant differences between the calculated mean and the proposed theoretical mean (Table 7).

Table 4. The t-test value for the citizens' satisfaction with cleanliness services.

The mean	Standard deviation	Calculated t	Degree of freedom	Statistical significance level
3.01	0.80	84.278	499	0.000

Table 5. ANOVA analysis for the satisfaction according to set variables.

Variable	Source of the discrepancy	Sum of squares	Degree of freedoms	Mean squares	Calculated F	Statistical significance level
Region	Betw. groups	10.204	4.000	2.551	4.134	0.003
	Inside groups	305.473	495.000	0.617		
	Total	315.677	499.000			
District	Betw. groups	57.649	21.000	2.745	5.085	0.000
	Inside groups	258.028	478.000	0.540		
	Total	315.677	499.000			
Number of family members	Betw. groups	9.928	3.000	3.309	5.369	0.001
	Inside groups	305.748	496.000	0.616		
	Total	315.677	499.000			
Income	Betw. groups	6.169	4.000	1.542	2.466	0.045
	Inside groups	309.508	495.000	0.625		
	Total	315.677	499.000			
Educational level	Betw. groups	12.103	4.000	3.026	4.934	0.001
	Inside groups	303.574	495.000	0.613		
	Total	315.677	499.000			
Means of collecting the wastes	Betw. groups	11.113	3.000	3.704	6.033	0.000
	Inside groups	304.563	496.000	0.614		
	Total	315.677	499.000			
Type of used container	Betw. groups	47.324	3.000	15.775	29.156	0.000
	Inside groups	268.353	496.000	0.541		
	Total	315.677	499.000			

Table 6. Citizens' awareness about MSWM in the city.

The clause	Arithmetical means \pm SD
The expected effects of privatization of wastes collection in Salt city	3.66 \pm 1.42
Evaluating the value of charges and the revenues collected as solid waste fees	3.08 \pm 1.38
The awareness	3.37 \pm 1.05

The arithmetic mean in Table 7 differs from the proposed theoretical mean. This difference has been calculated based on a statistical significance of 0.05 (confidence level 95%). The calculated t value was 71.442 and thus the actual statistical significance was 0.000. The answers' arithmetic mean was higher than theoretical mean, which indicates high awareness of the city community regarding the paid charges and privatization of cleanliness services in the city. To determine the significance in the citizen's awareness according to the differences in education level of citizens, F-test was conducted (ANOVA). Table 8 shows the results of ANOVA test.

Table 8 shows that there are no difference in the extent of citizen awareness regarding the existing SWM at the city according to the differences in the educational levels at confidence level of 95% ($\alpha = 0.05$). The calculated F value was 1.661 with a statistical significance of 0.170. This indicates that there are no effects of educational level of the members of the sample on their awareness regarding the existing SWM.

Third question: are the citizens willing to participate in MSWM? The citizen readiness to participate in waste recycling projects through at-source waste separation was evaluated. The means and standard deviations for the entire clauses are shown in Table 9. The higher mean was 4.55 for the clause "wastes recycling project can solve the solid waste problem". This value is about 34% higher than the proposed theoretical mean which was set to be 3. This indicated a community relative readiness to participate in the waste separation project with a perspective that recycling

project can solve solid waste problems and improves waste management at Salt City. The lowest mean was the evaluating of the domestic waste separation project with a value of 3.90 which is higher than the proposed theoretical mean. The overall mean for all clauses was found to be 4.22. The result of this part of study indicates that about 84.4% of the city community has high readiness to participate in the waste recycling project through at-source waste separation. To determine the significance of the difference between the measured means and the theoretical mean, t-test was conducted. Table 10 illustrates the results of this test.

Table 10 shows that there is a strong significant difference between the theoretical mean and the measured mean at the significant level $\alpha = 0.05$ and the calculated t value was found to be 108.429. The measured mean was found to be higher than the theoretical mean. This indicates that there is high readiness of the community to participate in solid waste recycling project and waste separation.

To determine the significance in the citizen readiness to participate according to the educational level, F-test was conducted and the results are tabulated in Table 11, which shows that there is a significant difference in the citizen readiness to participate in solid waste recycling project related to the education level at the significant level $\alpha = 0.05$. Post test analysis indicated that these differences were in favor of the university educated people than school educated people. Moreover, the results illustrated that the participation in waste management policies is not only depending on education level but also on the age of the sample members.

Table 7. The t-test value for citizens' awareness about the existing MSWM in the city.

Arithmetic mean	Standard deviation	Calculated t	Degree of freedom	Statistical significance level
3.37	1.05	71.442	499	0.000

Table 8. F-test value for citizens' awareness about the existing MSWM in the city according to educational level.

Educational level	Mean	Standard deviation	Calculated F	Degree of freedom	Statistical significance
Less than secondary school level	3.39	1.13	1.611	495	0.170
Secondary school level	3.21	1.11			
Diploma level	3.25	0.98			
Bachelor level	3.43	1.00			
Graduate level	3.55	1.01			

Table 9. Citizens' readiness to participate in wastes recycling project through on-site waste separation.

The clause	Arithmetic mean \pm standard deviation
Evaluating the at-source waste separation project	3.90 \pm 1.31
Evaluating waste recycling project to solve the solid waste problem	4.55 \pm 0.84
The participation	4.22 \pm 0.87

Table 10. The t-test value citizens' participating in recycling project and on-site waste separation.

Arithmetic mean	Standard deviation	Calculated t	Degree of freedom	Statistical significance level
4.22	0.87	108.429	499	0.000

Table 11. F-test value for citizens' readiness to participate in recycling and at-source separation project.

Variable level	Freedom degree	Calculated F	Standard deviation	Arithmetic mean	Educational level
Less than secondary school level	4.34	0.75	0.000	95	6.120
Secondary school	4.08	1.02			
Diploma level	4.04	0.80			
Bachelor level	4.14	0.93			
Graduate level	5.59	0.54			

Conclusions

This study showed that the distribution of municipality staff and equipments among the Salt City districts does not correspond with the density of population at each district. It has been shown, that about 60% of the citizens have low satisfaction with the quality of solid waste services. About 67% of the city community have good awareness regarding the existing solid waste management. The study showed that about 84% of the citizens have high readiness to participate in waste recycling project through at-source separation.

References

- ¹Kreith, F. 1999. Integrated Solid Waste Management: Option for Legislative Action. Genium Publishing Corporation, Schenectady, NY, USA.
- ²Martin, M., Williams, I.D. and Clark, M. 2006. Social, cultural, and structural influences on household waste recycling: A case study. *Resources, Conservation and Recycling* **48**:357-395.
- ³Mayster, L.Y. and Duflon, V. 1994. Urban Wastes, Nature and Characterization. Polytechnic and University Publisher Press, Lausanne, Switzerland.
- ⁴Al-Abbadi, T. 2005. Domestic Solid Waste Management at Amman AREA: Evaluation of Existing Management. M.Sc. thesis, University of Jordan, Amman, Jordan.
- ⁵Tchobanoglous, G., Theison, H. and Vigil, A.S. 1993. Integrated Solid Waste Management. McGraw-Hill International Edition.
- ⁶Berkun, M., Aras, E. and Nemlioglu, S. 2005. Disposal of solid waste in Istanbul and along the Black Sea Coast of Turkey. *Waste Management* **25**:847-855.
- ⁷Imam, A., Mohammed, B., Wilson, D.C. and Cheeseman, C.R. 2008. Solid waste management in Abuja, Nigeria. *Waste Management* **28**:468-472.
- ⁸Sharholly, M., Ahmad, K., Mahmood, G. and Trivedi, R.C. 2008. Municipal solid waste management in Indian cities - A review. *Waste Management* **28**:459-467.
- ⁹Collivignarelli, C., Sorlini, S. and Vaccari, M. 2004. Solid Wastes Management in Developing Countries. CD-ROM of ISWA 2004 World Congress, October 17-21, Rome, Italy.
- ¹⁰Abu Qdais, H.A. 2007. Techno-economic assessment of municipal solid waste management in Jordan. *Waste Management* **27**:1666-1672.
- ¹¹Ajani, O.I.Y. 2008. Determinants of an effective solid waste management in Ibadan metropolis, Oyo State, Nigeria. *Journal of Food, Agriculture & Environment* **6**(1):152-157.
- ¹²Uebersax, J. S. 2006. Likert Scale. Statistical Methods for Rater Agreement Website. (www.ourworld.compuserve.com/homepages/jsuebersax/likert2.htm).
- ¹³Assayed, F. B. 1979. Statistical Psychology. 3rd edn. Ein Shams University, Egypt.
- ¹⁴Bland, E. 1997. Statistical notes: Cronbach's alpha. *BMJ Journal* **314**:572.
- ¹⁵Great Salt Municipality 2006. Annual Report. Environmental Health and Cleanliness Department, Salt City, Jordan.