IMPLICATIONS OF THE SOLID WASTE MANAGEMENT PRACTICES ON THE SOCIO-ECONOMIC STATUS AND QUALITY OF LIFE OF PEOPLE: A CASE STUDY FROM KOLLAM URBAN AREA, KERALA

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ABSTRACT

The type of solid waste management practiced by the urban holds were surveyed along with collection of data on the socio-economic status and quality of life related subjective attitudes of households on selected parameters. Open dumping of solid wastes on the earth's surface was the main type of solid waste management practice in Kollam urban area, irrespective of the educational qualifications, quality of housing, economic status and the satisfaction levels of households on the waste management facilities available to them. The percentage of households adopting open dumping decreased from lower objective quality of life (QOLo) to higher QOLo. Majority of households were not satisfied with the solid waste management facilities available to them, but still they used open dumping as their main method of solid waste management.The tendency to incinerate solid wastes increased with increase in educational qualifications. The practice of burying the solid waste has shown a decrease in trend with increase in educational qualifications and increase in quality of housing. Recycling has shown no relationship with educational qualifications, but it has shown an increase in trend with increase in quality of housing. In the case of housing colonies, recycling was the main mode of solid waste management. In slums, independent houses and flats, burying, incineration and recycling were less practiced compared to open dumping.

KEY WORDS : Solid waste management, Socio-economic environment, Quality of life of people

INTRODUCTION

Solid waste management has become a very important global issue over the last decade due to rapid growth in world population, industrialization and urbanization.Poor management of waste led to contamination of water, soil and atmosphere and to a major impact on public health. In medieval times, epidemics due to consumption of water contaminated with pathogens decimated the population of Europe and even more recently (19th century), cholera was a common occurrence. Some of the direct health impacts of the mismanagement of waste are well known and can be observed especially in developing countries. Municipalities, usually responsible for waste management in the cities, have the challenge to provide an effective and efficient system to the inhabitants.

Mamady (2012) found no relationship between educational background, income and other similar socio-economic factors and the type of attitude of individuals towards solid waste management practices in the capital city of Guinea. Study by Srun and Kurisu (2019) revealed that personal and social norms like perception of pressure from friends, family and government influenced the intention of people not to dispose solid wastes on public places. But the influence of external factors on this was less. Baud *et al*. (2001) studied the contributions of new alliances in urban solid waste management system on the quality of life of people in Chennai in India, Manila in Philippines and Lima in Peru. The role of

socio-economic status on the quantity and composition of solid wastes for the design of an effective solid waste management plan is very important (Lakioti *et al*., 2017).The solid wastes generation in a coastal city was assessed based on different socio-economic parameters like education, occupation, income and size of family etc. (Khan *et al*., 2016). The socio-economic factors like population, population density, education, per-capita income, inequality and human development were studied for their impacts on municipal solid wastes generation. The results of the study showed that socio-economic factors are very important in solid wastes generation. It stressed the need to consider inequality as a complimentary factor to income in solid wastes generation (Vieira and Matheus, 2017).

Studies relating the solid waste management practices and quality of life of people in Indian cities are rare. This study aims to find the probable link between the type of solid waste management practices adopted by people, and the socio-economic environment in the area and the Quality of Life (QOL) people living in the area.

MATERIALS AND METHODS

In order to assess the nature of waste management practicesadopted by the inhabitants of Kollam urban area and the probableimplications of these practices on the socio-economic status of people residing in the area and the Quality of Life (QOL) of people, as a first step a socio economic/ Quality ofLife (QOL) survey was conducted in the study area.

160 households from four wards of Kollam urban area (Karicode ward, Mulamkadakom ward, Kadappakada ward,Thamarakulam ward) were selected for the survey by stratified random sampling. From each selected ward, households were selected for the survey again by stratified random sampling. Before surveying a household, the economic status of the household was assumed from the size of the house and on this basis, people belonging to all economic classes were included in the survey. The survey was evenly spread to people belonging to all classes of the society. From the survey, details regarding the educational qualifications, settlement types, house type, source of income, type of solid waste management practices and data on the family assets and facilities were collected. Factors of subjective quality of life (QOLs) like satisfaction levels of households regarding the waste disposal facilities, water availability, water quality, income, educational facilities andhousing werealso measured.

The data on the socio-economic status of the households and an attempt to correlate the socio-economic status and the waste disposal practices adopted by the residents were also done. Based on the subjective responses given by the inhabitants over the parameters of QOLs, parameter-based satisfaction indices also were developed.

Each parameter was given a weightage such that the sum total of all the weightages gives hundred. Total percentages of people having responses under different satisfaction levels were calculated. The satisfaction levels were also given a weightage. The Satisfaction levels were measured on a 5-point scale. The product of the weightage of the parameter and the point of the response and the percentage of people having that response divided by 10000 gives the overall satisfactory index. The satisfactory indices were again weighted and then summed up to arrive at the QOL_s (cumulative index).

RESULTS AND DISCUSSION

Socio-economic status of the people

The inhabitants of Kollam urban area have diverse socio-economic status. In order to assess the socio-economic status of the households, the results of the survey on educational qualifications, house type, settlement type, main source of income etc were analyzed. This information is correlated with the results of the solid waste management practices of the people in the study area. The important socio-economic parameters of households and their solid waste management practices are summarized in Table 1.

The people of the area under study have different educational backgrounds and qualifications. Majority (32%) have technical educational qualifications. Illiterate people are minimum (2%). About 21% of the inhabitants have qualifications up to higher secondary level. Post graduates and graduates are 18% and 16% respectively. People with pre matriculation and matriculation qualifications are 4% and 7%.

It can be seen that the house types of people in the area are bungalow, huts, semi pucca houses and pucca houses. Maximum number (37%) of houses is pucca. The minimum number (3%) of the houses in the surveyed samples is hut. About 31% of the houses are semi pucca and the remaining 29% are

bungalows. It is interesting to note that in the study area, settlement types like housing colonies, slums, independent houses and flats are present in almost equal numbers. Majority (29%) of the settlement types selected were housing colonies. About 22% of the people in the selected households were residing in slums. Flat type settlement was 24% and independent type was 25%.

The main source of income of majority (41.2%) of people is income from the tertiary sector. It means that it is similar to the main source of income of the state. It further indicates that the surveyed sample is belonging to part of a consumer society. This has implications on the amount of solid waste generated and managed by the community. The percentage of people depending on primary sector is minimum (23.8%) (Table 1). The people depending on secondary sector are 35%.

The predominant waste disposal method followed by the households to dispose their waste is open dumping. Out of the 160 households surveyed, 75% of them use open dumping to dispose the waste generated in their houses. About 10% use incineration, 9% of them adopt to recycle and only 6% use burying.

Waste disposal practices and socio-economic status of the households

The predominant waste disposal method practiced in the Kollam urban area is open dumping. Now it is necessary to compare the parameters of socio-economic status with the methods of waste disposal practices adopted by people. The selected parameters are educational qualifications, house type, settlement type, economic status and QOLs parameter-based satisfaction level of households.

Educational qualifications

The relationship between the educational qualification possessed by the inhabitants and the waste disposal methods practiced by the households was analyzed.

About 75% of the illiterate people use open dumping for disposing the waste generated at their houses and 25% of them adopt burying to manage the waste. Out of the 160 households surveyed, 4% of them are pre matriculate. In this group of people, 50% adopt open dumping, 33.3% export the waste to recycle and 16.7% burry the solid waste. Here also the main type of practice is open dumping About 5% of the surveyed households are matriculates. Majority (90.9%) of matriculates use open dumping for managing their solid waste and the remaining 9.1% of the people adopt burrying.In the surveyed region, hoseholds with higher secondary qualifications were about 21%. Majority (84.8%) of them practiced open dumping and the percentage of households exporting their waste for recycling was minimum (3.0%).
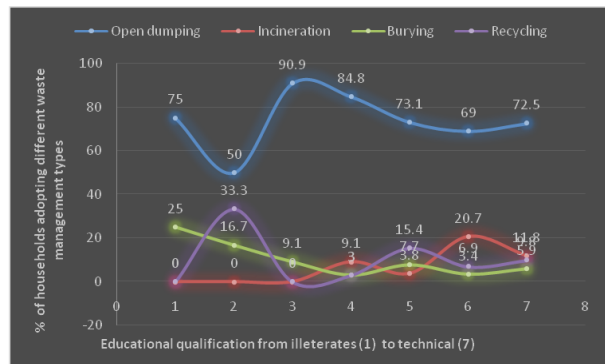

Fig. 1. Percentage of people adopting different types of waste disposal methods vs their educational qualifications

Incineration is being practiced by 9.1% and 3% of them adopt burying for managing solid waste. About 16% of the total households surveyed are

Table 1. Socio-economic parameters of households and their solid waste management practices

Parameter	Types	%	Parameters	Types	%
Educational Qualifications	illiterate	2	House types	Huts	3
	pre-matriculate	4		Semi-pucca	31
	matriculate	7		pucca	37
	Higher secondary	21		bungalow	29
	graduate	16	Incomegroups	primary	23.8
	postgraduate	18		secondary	35
	technical	32		tertiary	41.2
Settlement Types	slums	22	Waste Disposal	incineration	10
	housing colonies	29	Methods	Open dumping	75
	flats	24		burying	6
	Independent house	25		recycling	9

graduates. The majority (73.1%) adopt open dumping and people who are using incineration are minimum (3.8%). About 15.4% of them export the waste generated in their houses for recycling and 7.7% of them burry the waste in their backyards. About 18% of the surveyed households are post graduates. Majority (69%) of them adopts open dumping and 20.7% of them use incineration to dispose the waste. About 6.9% of them export the waste for recycling and 3.4% of them burry the waste in their own backyards. About 32% of the total households surveyed are technically qualified people. It is clear that even among people with technical qualifications, the predominant waste disposal method is open dumping (72.5%). About 11.8% of the people incinerate the waste generated from their households and 9.8% of them export the waste to recycle. Only 5.9% of them adopt burying.

Fig.1 shows that open dumping of solid waste is the main practice of solid waste management in the Kollam urban area, irrespective of the educational qualifications of people. Burying of solid waste, even though practiced by comparatively a smaller number of households, the percentage of people adopting this method shows a decrease in trend with increase in educational qualifications. Tendency to incinerate solid waste slightly increases with increase in educational qualifications. The practice of recycling does not show any relationship with educational qualification of households in the area.

House types

Out of the total households surveyed, 3.1 % of them were huts or houses with lower quality than semi pucca houses. From the survey, it is clear that majority (40%) of the people residing in huts adopted open dumping as the waste management method. Households exporting the waste for recycling were found to be nil. Fig 2 shows that 40% of the households adopt incineration and 20% of them burry the waste in their own backyards. Semi pucca houses in the surveyed area were about 31. Fig. 2 depicts that, the majority (89.8%) of the inhabitants use open dumping to dispose the waste and 8.2% of them burry the waste. Only 2% adopt incineration. Pucca Houses constitute 37% of the surveyed area. Majority (69.5%) of the people residing in pucca houses use open dumping as the waste disposal method and 13.6% of them use incineration for disposing the waste. About 11.9% of them export the waste to recycle and 5.1% of them

adopt burying. In the surveyed region, 29% of the houses were bungalows. Majority (70.2%) of the people residing in bungalows follow open dumping. About 14.9% of them export the waste for recycling and 10.6 of them incinerate the waste. Only 4.3% of them burry the waste in their own backyards.

Majority of people residing in the study area adopt open dumping for managing the solid waste irrespective of the quality of houses in which they reside. Though the recycling of solid waste is practiced by less proportion of households in the area, there is an increase in trend of this practice with quality of housing. Burying of solid wastes shows a decrease in trend with quality of housing. The tendency of households to incinerate solid waste does not indicate any specific relationship with quality of housing (Fig. 2).
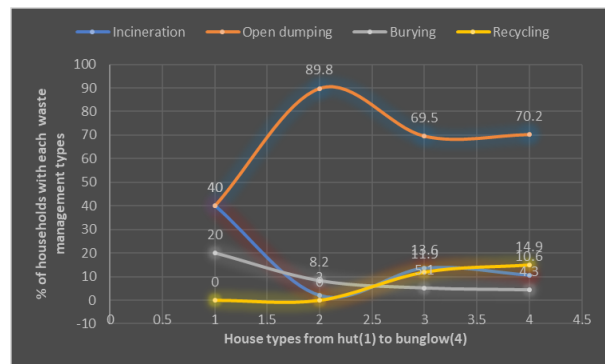

Fig. 2. The percentage of households adopting different waste management practices vs different house types

Settlement types

One of the factors that could probably have an impact on the waste disposal practices followed by the inhabitants is the settlement type in which they reside.

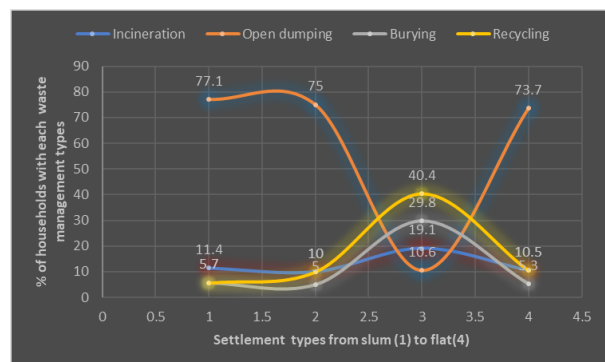From Fig. 3, it can be seen that among the people

Fig. 3. Waste disposal practices of people residing in various settlement types.

residing in independent houses, majority (75%) of them practice open dumping for the waste disposal and 5% of them adopt burying. About 10% of them practice incineration and only 10% of them export the waste to recycle. In the cases of slums, majority (77.1%) of them use open dumping and 5.7% use burying. About 5.7% use export to recycle and 11.4% of them incinerate the waste. In the cases of housing colonies, majority (40.4%) of the inhabitants export the waste to recycling, 29.8% of them burry the waste in their own backyard, 19.1% of them incinerate the waste generated by them and only 10.6% of them dump the waste into open dumping sites. In the case of flats also majority (73.7%) of the people adopt open dumping for managing their solid waste. About 10.5 % of the people export their waste to recycle and incinerate them. Burying is adopted by a minimum of 5.3% of inhabitants. The above discussion shows that except in the case of housing colonies, people in all the other settlement types adopt open dumping of waste either in the backyard or public places.

Except in the case of housing colonies, all other types of settlements use open dumping as the main method to manage the solid wastes. In housing colonies, the percentage of households adopting open dumping is minimum followed by incineration, burying and recycling. In slums, independent houses and flats, the percentage of households using incineration, burying and recycling is less compared to open dumping.

Quality of life (QOL) of people

Quality of life of people in an urban area like Kollam is the sum of objective conditions available in the place of residence and the subjective attitude of people towards the available facilities of life. Accordingly, there are objective quality of life (QOL_o) and subjective quality of life (QOL_s). In the present study the QOL_o is studied with the help of an index namely family assets and facilities (FAF) index. The QOL_s is studied with respect to the satisfaction levels expressed by the inhabitants of the study area towards the existing facilities of life.

QOLo based onFAF index

QOL_o of the people is studied based on the objective conditions available in the houses in they reside. In order to assess that, index of the assets and facilities present in the houses is considered. It is the FAF Index. To reveal probable relation between QOL_o and the waste disposal methods that the people

practice, a comparison between FAF index and waste disposal methods is done. FAF Index is an index on a scale ranging from 0 to 1. This index is a measure of the economic status of a household calculated on the basis of the assets, properties and facilitiesof eachhousehold. Data regarding the assets, properties and facilities were collected from the houses as part of the socio-economic survey.

A list of probable household facilities and assets were made. Out of the listed items, the items which the surveyed household owned were enlisted in the survey proforma at the time of thesocio-economic survey.The total cost of the items owned by the household to the total cost of the enlisted items gives the FAF Index. The FAF Index from 0 to 1 was divided into four classes for the economic classificationof the households as shown in Table 2.

Table 2. Classification of households based on FAF Index

Class	Classification	FAF Index range	Percentage of people
1	Poor	0-0.25	60.62
2	Middle class	0.25-0.5	10.00
3	Moderately rich	0.5-0.75	9.38
4	Rich	0.75-1.0	20.00

The surveyed households were classified as poor (60.62%), middle class (10%), moderately rich (9.38%) and rich (20%) as per the calculated FAF Index of the household and analysis was done regarding the waste disposal methods adopted by households belonging to various economic categories.

From Fig. 4, it can be seen that, among people falling in the category of economically poor households, majority (78.4%) of them use open dumping as the waste management practice, 6.2% of them burry the waste in the backyards of their own
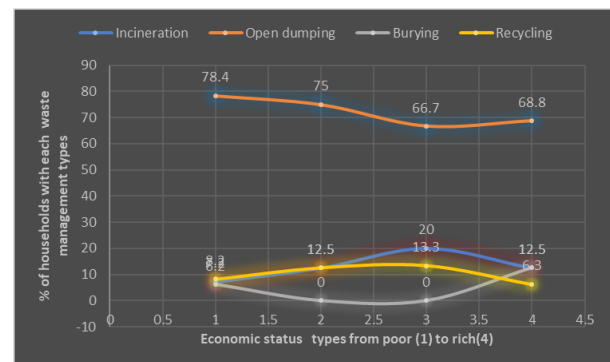

Fig. 4. Waste disposal methods of various economic classes of people.

houses, 7.2% of them incinerate the generated waste and 8.2% of them export the waste to recycle. While analyzing the households that fall under the category of economically average households, again majority (75%) of them use open dumping as the waste disposal practice. About 12.5% of them incinerate the waste, 12.5% of them export the waste for recycling and none of them buried the waste that they generate. In the category of moderately rich people, majority (66.7%) of them use open dumping as the waste management practice. None of them burry the waste in the backyards of their own houses, 20% of them incinerate the generated waste and 13.3% of them export the waste to recycle. In the case of the households that fall under the category of economically rich households, again majority (68.8%) of them use open dumping as the waste disposal practice. About 12.5% of them incinerate the waste generated, 6.3% of them export the waste for recycling and 12.5% of them bury the waste that they generate.

If you consider the FAF Index as a direct measure of QOL_O, irrespective of the fact that whether the people belong to higher, medium or lower QOL_o categories, all of them practice open dumping as the major waste disposal method. Also, it is clear that the percentage of people adopting open dumping decreases from the lower QOL_O category to higher QOL_O category.

Satisfaction level of households on existing facilities

During the socio-economic survey, the satisfaction levels of the inhabitants related to various parameters of QOL_S like satisfaction on waste disposal methods adopted, quality of water, water availability, educational facilities, income generated and housing were studied (Table 3).

From Table 3, it can be seen that majority (41.9%) of the inhabitants were unsatisfied about the waste disposal practices followed by them and 15% of the people were highly unsatisfied. About 22.5% of

them were neutral regarding the subject. About 4.4% of the inhabitants were highly satisfied and 16.3% were satisfied with the practices. In the case of water availability, majority (30.6%) had no comments. Still, 25.6% of the inhabitants were unsatisfied, 16.3% highly unsatisfied, 19.4% satisfied and 8.1% were highly satisfied. Regarding the quality of the available water, 19.4% were highly satisfied, 21.9% satisfied, 23.8% had neutral stands, 16.9% were unsatisfied and 18.1% were highly satisfied. In the case of net income of the households, 15% of the inhabitants were highly satisfied with the income they get, 27.5% satisfied, 31.9% neutral, 23.1% unsatisfied and 2.5% were highly unsatisfied. About 33.1% of the householdswere extremely happy about the educational facilities available to them, 30.6% were satisfied, 34.4% neutral, 0.6% unsatisfied and 1.3% were highly unsatisfied about the educational facilities. About 23.8% of the households were highly satisfied with the housing facilities they had, 18.8% satisfied, 18.1% neutral, 16.9% unsatisfied and 22.5% were highly unsatisfied on the quality of housing.

From the above discussion, it becomes evident that, among all the parameters of QOL_S majority (56.9%) of the people were not satisfied with the waste disposal methods they practiced.

The parameter ofQOL_s on waste disposal

Table 4. QOL_s Index of people on various parameters of QOL

Weightage assigned (%)	Parameter of QOL_s	Parameter wise satisfaction Index
15	Waste Disposal Methods	0.38
15	Water availability	0.42
15	Water quality	0.46
20	Income	0.66
15	Educational Facility	0.59
20	Housing	0.61
QOL_s	0.53	

Table 3. Satisfaction levels of households on various aspects of QOL

Parameter of QOL_s	Highly Satisfied (%)	Satisfied (%)	Neutral (%)	Unsatisfied (%)	Highly Unsatisfied (%)
Waste Disposal Methods	4.4	16.3	22.5	41.9	15.0
Water availability	8.1	19.4	30.6	25.6	16.3
Water Quality	19.4	21.9	23.8	16.9	18.1
Income	15.0	27.5	31.9	23.1	2.5
Educational Facility	33.1	30.6	34.4	0.6	1.3
Housing	23.8	18.8	18.1	16.9	22.5

methods shows a minimum value of 0.38.This is in agreement with the finding of the survey that maximum number of people are not satisfied with the waste disposal practices they adopt. It is seen that higher values of parameter based QOL_s are shown by income, housing and educational facilities. The satisfaction index on water availability and water quality are 0.42 and 0.46 respectively. The overall subjective QOL of people in the area is indicated by the cumulative index of 0.53 (Table 4).

From the survey, it is clear that the predominant waste disposal method being practiced is open dumping. About 75% of the total population followed open dumping which is one of the most unscientific methods of waste disposal. The most scientific method which is the recycling was only practiced by 9% of the total number of households surveyed.

Responses were taken specifically about the satisfaction levels in the waste management systems followed in the study area.

From Fig. 5, it can be seen that all the households who were expressing their different satisfaction levels like highly unsatisfied, satisfied, neutral, satisfied and highly satisfied on waste management facilities available, were using open dumping as the main type of waste management practice. Households who expressed neutral in the satisfaction level were least in the use of open dumping and they were using incineration followed by recycling and burying as their waste management practices. Households who were highly satisfied in the waste management facilities available to them used open dumping followed by burying, incineration and recycling. Even the households who were satisfied and highly satisfied with the waste management facilities available to them, used open dumping as their main type of

Fig. 5. Waste disposal practices of people with various satisfaction levels in waste management practices.

solid wastemanagement practice. It means that they believe that there is no problem with the open dumping of solid wastes on to the surface of the earth.

CONCLUSION

Open dumping of solid waste is the main practice of solid waste management in the Kollam urban area, irrespective of the educational qualifications of people. The percentage of people adopting burying of solid wastes shows a decrease in trend with increase in educational qualifications. The percentage of households who incinerate solid waste slightly increases with increase in educational qualifications. The practice of recycling does not show any relationship with educational qualification of households in the area.

Majority of people residing in Kollam urban area adopt open dumping for managing the solid waste irrespective of the quality of houses. There is an increase in trend of recycling solid wastes with quality of housing. Burying of solid wastes shows a decrease in trend with quality of housing. The tendency of households to incinerate solid waste does not show any specific relationship with quality of housing.

All types of settlements use open dumping as the main method to manage the solid wastes except housing colonies. In housing colonies, the percentage of households practicing open dumping is minimum followed by incineration, burying and recycling. In slums, independent houses and flats, the percentage of households incinerating, burying and recycling the solid wastes is less compared to open dumping.

Irrespective of the fact that whether the people belong to higher, medium or lower QOL_o categories, all of them practice open dumping as the major waste disposal method. Also, it is clear that the percentage of people adopting open dumping decreases from the lower QOL_O category to higher QOL_O category. It becomes evident that, among all the parameters of QOL_S majority (56.9%) of the people were not satisfied with the waste disposal methods they practiced.

All the households who were expressing their satisfaction levels like highly unsatisfied, satisfied, neutral, satisfied and highly satisfied on waste management facilities available, were using open dumping as the main type of waste management practice. Households who expressed neutral in the
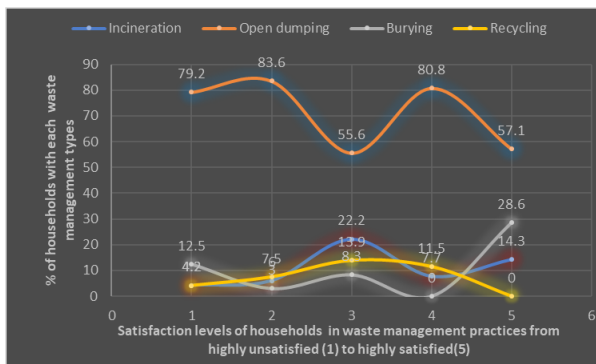
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REFERENCES

Baud, I. Grafakos, S. Hordijk, M. and Post, J. 2001. Quality of life and alliances in solid wastes management: contributions to the urban sustainable development. *Cities.* 18 : 3-12.

Khan, D. Kumar, A. Samadder, S.R. 2016. Impact of socio-economic status on municipal solid wastes generation rate. *Waste Management.* 49. doi: 10.1016/j.wasman.2016.01.019.

Lakioti, E. Moustakas, K. Komilis, D.P. and Domopoulou, A.E. 2017. Sustainable solid waste management: Socio-economic considerations. *Chemical Engineering Transactions.* 56 : 661-666.

Mamady, K. 2016. Factors influencing attitude, safety, behavior and knowledge regarding household waste management in Guinea: A cross sectional study. *Journal of Environmental and Public Health*. doi.org/10.1155/2016/9305768.

Srun, P. and Kurisu, K. 2019. Internal and external influential factors on waste disposal behavior in public open spaces in Phnom, Penh, Cambodia. *Sustainability*. 11:1518. doi:10.3390/su11061518.

Vieira,V.H.A.M. and Matheus, D.R. 2017. The impacts of socio-economic factors on municipal solid waste generation in Sauo Polo, Brazil. *Waste Management and Research.* 36 : 79-85.

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