Eurasian Journal of Analytical Chemistry
ISSN: 1306-3057 OPEN ACCESS 2018 13 (SP): 380-389

Solid Waste Management Awareness in Gated Communities in Chennai – An Innovative Approach

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Received 08 November 2018 ▪ Revised: 30 November 2018 ▪ Accepted: 06 December 2018

Abstract: As per World Bank, India's daily waste will be touching 377,000 tonnes by 2025. The growing urbanization and industrialization have created tons of wastage which is tangible and troubling. The Urban Local Bodies have a big challenge in setting it right day by day. The household in major cities constitutes an important agenda for the Municipal solid waste. The composition of the household waste becomes an important factor in effectively designing the solid waste management planning for the city. With growing gated communities in cities like Chennai it becomes necessary for more innovative approaches and techniques to create awareness among residents. The objective of the study is to understand and analyze the awareness on Solid Waste Management (SWM) among the residents of gated communities. To suggest suitable innovative approaches to create better awareness among residents of gated communities in Chennai on SWM.

Keywords: Innovative Approach, Awareness, Solid Waste Management.

INTRODUCTION

Solid Wastes can be classified into different categories based on their source like Household wastes as municipal waste, industrial waste and biomedical waste which are hazardous and infectious wastes respectively.

The Municipal solid waste consists of construction debris, household wastes, residue from sanitation and street wastes. This waste is generated from residential and commercial complexes/communities. Rising urbanization and changing lifestyle and food habits have gradually increased the amount of municipal solid waste and its composition.

The consumer market has grown rapidly in the last few years. This has led to packaging of products in cans, plastics and other non-biodegradable items that is causing harm to the environment. Banning the usage of plastics and other non-biodegradable items and awareness on not using such items can be a bigger success for SWM.

LITERATURE REVIEW

Fact 1- Solid Waste Management

NEERI (1995), As per MSWM-2000 rules, the non-recyclable wastes are supposed to be disposed in sanitary landfills sites. However, MSW is majorly thrown in road sides or deposited in the out skirts of the towns that undergoes natural composting.

Shekdar, A.V. (1999), Many non-government organizations (NGOs) have been involved by municipals for collection and transportation of waste and this decision has led to improvement and cleanliness in local streets.

Joseph, K. (2002), These towns are going for transfer stations for intermediate segregation of the solid waste.

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Sexton D, Spelman D (2003), pointed out the underground waste storage methods replacing the bins and containers.

CPCB, (2004), Most of the Indian towns falling under the category of class II and III do not have specific collection, transportation, and disposal systems in place.

McBean et al., (2005), in developing countries collection is disregarded due to limited space for development and government budgets are limited.

Sunil Kumar, J.K. Bhattacharyya, A.N. Vaidya, Tapan Chakrabarti, Sukumar Devotta, A.B. Akolkar (2008), The garbage is dumped and being burned openly.

Zhen-shan et al., (2009); Batool and Ch, (2009); Chung and Carlos Lo, (2008), points out the neglection of management of Municipal solid waste management in urban cities of developing countries.

Daniel Hoornweg and Perinaz Bhada-Tata (2012), the municipal solid waste (MSW) the most important by-products of an urban lifestyle, is growing faster than the rate of urbanization. 10 years ago, 2.9 billion urban residents generated about 0.64 kg of MSW per person per day. Today the amounts have increased to about 3 billion residents generating 1.2 kg per person per day. By 2025 this may increase to 4.3 billion urban residents generating about 1.42 kg/capita/day of municipal solid waste (2.2 billion tonnes per year).

Low-income countries still spend most of their waste management budgets on waste collection and a fraction towards disposal. The scenario is quite opposite in high-income countries where the expenditure is more on disposal. The higher the income level and urbanization rate, the greater the solid waste production. OECD countries produce close to half of the world's waste whereas Africa and South Asia regions produce the least waste. Urban residents produce twice as much of waste as rural residents.

India and China have disproportionately high urban waste generation rates per capita relative to overall economic status due to the large relatively poor rural populations. Collection rates range from 41% in low-income countries to 98% in high-income countries.

In developing countries recyclables are removed by waste pickers prior to collection and source separation impacts the amount of material recycled and its quality. Recyclables recovered from mixed waste are tend to be contaminated further reducing marketing possibilities. Source separation and separate collection can involve costs to the waste collection procedure.

Landfilling and thermal treatment of waste are the mostly used methods of MSW disposal in high-income countries. But Low & middle-income countries dispose of their waste in open dumps without any controlled dumping technology

Edjabou et al., (2015), reliable data on waste is important for planning and assessing the waste and for its management. Study in Denmark showed waste composition from single family and multi-family homes were different indicating the need to consider the housing type component.

Ibro Skenderovic, Becir Kalac, Suad Becirovic (2015), 500 m3 of biogas is generated from one ton of organic waste with a thermal capacity of 24,000 KJ/m3. The municipal scraps contain major portion of food scraps with high density and humidity. Medium-sized cities and rural areas can make use of biodegradation especially on smaller farms. Non-waste technology can provide support for development and production of new products with the possibility of re-use.

Wajeeha Saleem, Ayesha Zulfiqar, Muneeba Tahir, Fatima Asif, Ghazala Yaqub (2016), discussed on the need of latest environmentally friendly technologies in the area of municipal solid waste management to handle it efficiently

Halkos, George and Petrou, Kleoniki Natalia (2016), focuses on the waste treatment option under the concept of Circular Economy approach for efficient use of resources. Landfill to be considered as the last option for waste disposal.

Fact 2 - Recycling

Monit Shukla (2007), focus of waste management with waste minimisation and re-use of waste materials through the process of re-cycling.

Vipin Upadhyay, Jethoo A.S, Poonia M. P (2012), Suggested for a three-bin system for biodegradable waste, deposition and recyclable waste. Also, use of trolleys for road side and residential waste collections.

Halkos (2013), refers recycling as the systematic collection, processing and reuse of materials like iron, paper, plastic, wood, glass, & aluminium products.

Jil Tushar Sheth, Kinara Patel, Prof. Dipsha Shah (2016), Adopting segregation of wastes at source and decentralisation scheme helps in aesthetic condition of the locality/place, it reduces secondary collection of waste by the municipality and lesser volume in the dumping site, provides better income and employment opportunities for underprivileged sections of the society.

UNEP (2015), discusses on the upstream focus and addressing the problem from the beginning; designing of waste, preventing wastage, quantity reduction, reusing resources, and, where residuals were kept concentrated and preserved for recycling and preventing them from contaminating. The shift from 'waste disposal' to 'waste management' and considering 'waste' to 'resources' is the existing idea.

EPA (2016), Recycling benefits the following; Reduces the waste sent to landfills, Conserves natural resources like timber, minerals and water, prevents pollution by reducing collection of new raw materials, saves energy, reduces greenhouse gas emissions, helps for sustained environment and reduces climate change, Helps creation of jobs in the recycling and manufacturing industries.

Fact 3- Public Awareness

Fourie (2006), the main problem is not just absence of environmental legislation but also lack of enforcement and availability of other feasible alternatives in dealing with solid waste management.

Timlett R.E., Williams I.D. (2008), mentioned the need for public support as important for the success of a recycling programme and the actions of householders is necessary for sustaining those waste management policies.

Abdelnaser Omran, Maria Gavrilescu (2008), Improving community awareness, public information on SWM and new mode of collection methods with management capacity and better investments. Support initiative for communities that will help them for self -organised will reduce on future collection burdens and segregation methods and costs. This will engage civil society with waste management.

Kassahun Tassie Wegedie (2018), households view lack of strict penalty and improper execution of law as the reason for ineffective waste management. Insisted on environmental awareness on sorting and composting among residents to reduce the quantity of waste. The positive relationship between the quantity of waste and household income and size and also the negative effect of education on waste generation was discussed. Organisational strengthening and better management system of the conservancy section to bring change in the condition of solid waste management to an acceptable standard was stressed.

Pussadee Laor (2018), identified that level of education & age having significance on the Knowledge, attitude and practice among the residents in Thailand on Municipal Solid Waste Management

The above literature iterates on the points that there is a lack of proper Solid waste management system prevailing in major urban cities in India and economically recycling will be the future option for better management of Solid wastes and this requires an awareness in the residential communities. The awareness can lead to a better cooperation between the growing residential communities and Urban Local bodies in SWM.

REASONS FOR GROWING GATED COMMUNITIES IN CHENNAI

3.1 Better Social Life: Day by day increasing busy life and schedules of people have created distance among the residential houses and technology is the only medium to limit those distance but it can't be a great substitute. The growing gated community takes care of the socialization aspect and will be the future residential living style.

3.2 Better Life Style: Also, the people's perception of buying a house with lots of amenities and safety aspect has grown up. People no longer look for individual houses rather would prefer gated communities with high class facilities like, swimming pool, play court, community centers, security etc. This perception of people has boosted real estate businessmen to go for gated communities.

3.3 NRIs investment in gated communities: The growing NRI's investment in gated communities has also been one of the factors. As many NRIs have plans to settle in cities in high class gated communities.

The above reasons indicate that the gated communities will be the future residential planning for many people living in the city. Therefore, it becomes essential to create more awareness on SWM among the residents of gated communities, management of gated communities & real estate builders. This will facilitate in creating a better system and well ahead planning for Solid wastes management in these gated communities in Chennai.

METHODOLOGY

The sample has been selected from the residents of gated communities in Chennai. Convenient sampling technique has been done in choosing the gated communities. 9 gated communities spread across the different regions of Chennai city were selected with each community having more than 100 dwelling units. The number of respondents in each community were taken proportionately to the total member of dwelling units in that community. Out of total of 410 questionnaires distributed 396 were found to be valid. Reliability and validity of the research instrument was checked through a pilot study of 40 respondents. Cronbach's Alpha 0.704 was obtained out of reliability test which is a good indicator. Hypothesis were framed to find out the relationship of awareness and attitude of residents on solid waste Management. Statistical tools such as regression, Anova and correlation were used to understand the awareness of residents towards solid waste management. The following were the hypothesis:

Hypothesis 1

$H0_1$: There exists no significant difference between age and the awareness on solid waste management among gated community residents in Chennai.

Hypothesis 2

$H0_2$: There exists no significant difference between the occupation and the awareness on solid waste management among gated community residents in Chennai.

Hypothesis 3

$H0_3$: There exists no significant difference between the gender and the awareness on solid waste management among gated community residents in Chennai.

Hypothesis 4

$H0_4$: There exists no significant difference between the income and the awareness on solid waste management among gated community residents in Chennai.

Hypothesis 5

$H0_5$: There exists no significant relationship between the attitude and the awareness on solid waste management among gated community residents in Chennai.

DATA ANALYSIS

Difference between Age Groups and the Awareness on Solid Waste Management among Gated Community Residents in Chennai

Table 1: Descriptive table on Age Group

Descriptives								
AWARENESS								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
18-28 yrs	126	18.13	6.936	.618	16.91	19.36	7	35
29-35 yrs	154	18.85	6.639	.535	17.79	19.91	7	34
36-55 yrs	68	20.10	6.929	.840	18.43	21.78	7	33
above 55 yrs	48	20.46	6.665	.962	18.52	22.39	7	35
Total	396	19.03	6.814	.342	18.36	19.71	7	35

Table 2: ANOVA on Age Group and Awareness

ANOVA					
AWARENESS					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	282.106	3	94.035	2.041	.108
Within Groups	18060.467	392	46.073		
Total	18342.573	395			

One-way Anova tool was used to interpret if there exists any significant difference among the age groups (18-28,29-35,36-55 and above 55yrs) and awareness on solid waste management among gated community residents in Chennai. The research finding shows that there exists no significant difference between the age groups and awareness on solid waste management among gated community residents in Chennai as F= 2.041 and p>0.05. Hence the null hypothesis is accepted. Therefore, it also states that the age differences have no effect on the awareness on SWM among gated community residents in Chennai.

Difference between Occupation and the Awareness on Solid Waste Management among Gated Community Residents in Chennai

Table 3: Descriptive table on Occupation

Descriptives								
AWARENESS								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Professional	127	19.02	7.212	.640	17.75	20.28	7	35
service pvt/gvt	141	18.29	7.189	.605	17.09	19.49	7	35
Homemaker	83	19.58	5.852	.642	18.30	20.86	7	33
Student	45	20.40	5.952	.887	18.61	22.19	7	34
Total	396	19.03	6.814	.342	18.36	19.71	7	35

Table 4: ANOVA table on Awareness and Occupation

ANOVA					
AWARENESS					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	186.486	3	62.162	1.342	.260
Within Groups	18156.087	392	46.317		
Total	18342.573	395			

One-way Anova tool was used to interpret if there exists any significant difference among the occupation (professional, service pvt/govt, homemaker, student) and awareness on solid waste management among gated community residents in Chennai. The research finding shows that there exists a no significant difference between occupation and awareness on solid waste management among gated community residents in Chennai as F= 1.342 and p>0.05. Hence the null hypothesis is accepted. Moreover, it also states that occupation have no effect on the awareness on SWM among gated community residents in Chennai.

Difference between Gender and the Awareness on Solid Waste Management among Gated Community Residents in Chennai

Table 5: Descriptive table on Gender

Descriptives								
AWARENESS								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Male	200	18.40	7.207	.510	17.39	19.40	7	35
Female	196	19.68	6.342	.453	18.79	20.58	7	34
Total	396	19.03	6.814	.342	18.36	19.71	7	35

Table 6: ANOVA table on Awareness and Gender

ANOVA					
AWARENESS					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	164.390	1	164.390	3.563	.060
Within Groups	18178.183	394	46.138		
Total	18342.573	395			

One-way Anova tool was used to interpret if there exists any significant difference among the Genders (Male and Female) and awareness on solid waste management among gated community residents in Chennai. The research finding shows that there exists no significant difference between the genders and awareness on solid waste management among gated community residents in Chennai as F= 3.563 and p>0.05. Hence the null hypothesis is accepted. Therefore, it also states that genders have no effect on the awareness on SWM among gated community residents in Chennai.

Difference between Income Groups and Awareness on Solid Waste Management among Gated Community Residents in Chennai

Table 7: Descriptive table on Income

Descriptives								
AWARENESS								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
less than 10k	39	13.44	6.295	1.008	11.40	15.48	7	29
10k to 20k	59	17.05	6.412	.835	15.38	18.72	7	31
20k-50k	98	19.08	5.946	.601	17.89	20.27	7	35
50k to 1L	122	20.19	6.939	.628	18.94	21.43	7	35
greater than 1L	78	21.46	6.365	.721	20.03	22.90	7	34
Total	396	19.03	6.814	.342	18.36	19.71	7	35

Table 8: ANOVA table on Awareness and Income

ANOVA					
AWARENESS					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2076.741	4	519.185	12.480	.000
Within Groups	16265.833	391	41.601		
Total	18342.573	395			

One-way Anova tool was used to interpret if there exists any significant difference among the Income (less than 10k, 10k-20k, 20-50k,50k-1L, greater than 1L) and awareness on solid waste management among gated community residents in Chennai. The research finding shows that there exists significant difference between the Income groups and awareness on solid waste management among gated community residents in Chennai as F= 12.480 and p<0.05. Hence the null hypothesis is rejected. Therefore, it also states that Income have effect on the awareness on SWM among gated community residents in Chennai.

Table 9: Post Hoc Tests on Income

Multiple Comparisons						
AWARENESS Tukey HSD						
(I) monthly income	(J) monthly income	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
less than 10k	10k to 20k	-3.615	1.331	.053	-7.26	.03
	20k-50k	-5.646*	1.221	.000	-8.99	-2.30
	50k to 1L	-6.753*	1.186	.000	-10.00	-3.50
	greater than 1L	-8.026*	1.265	.000	-11.49	-4.56
10k to 20k	less than 10k	3.615	1.331	.053	-.03	7.26
	20k-50k	-2.031	1.063	.313	-4.94	.88
	50k to 1L	-3.138*	1.023	.019	-5.94	-.33
	greater than 1L	-4.411*	1.113	.001	-7.46	-1.36
20k-50k	less than 10k	5.646*	1.221	.000	2.30	8.99
	10k to 20k	2.031	1.063	.313	-.88	4.94
	50k to 1L	-1.107	.875	.713	-3.50	1.29
	greater than 1L	-2.380	.979	.109	-5.06	.30
50k to 1L	less than 10k	6.753*	1.186	.000	3.50	10.00
	10k to 20k	3.138*	1.023	.019	.33	5.94
	20k-50k	1.107	.875	.713	-1.29	3.50
	greater than 1L	-1.273	.935	.653	-3.84	1.29
greater than 1L	less than 10k	8.026*	1.265	.000	4.56	11.49
	10k to 20k	4.411*	1.113	.001	1.36	7.46
	20k-50k	2.380	.979	.109	-.30	5.06
	50k to 1L	1.273	.935	.653	-1.29	3.84

Relationship between Attitude and Awareness on Solid Waste Management among Gated Community Residents in Chennai

Table 10: Regression Variable Table

Variables Entered/Removed[a]			
Model	Variables Entered	Variables Removed	Method
1	awareness[b]	.	Enter
a. Dependent Variable: attitude			
b. All requested variables entered.			

Table 11: Regression Table

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.125[a]	.016	.013	3.36092
a. Predictors: (Constant), awareness				

Table 12: ANOVA table

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	70.441	1	70.441	6.236	.013[b]
	Residual	4450.536	394	11.296		
	Total	4520.977	395			
a. Dependent Variable: attitude						
b. Predictors: (Constant), awareness						

Table 13: Regression Coefficient Table

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	20.027	.489		40.924	.000
	awareness	.067	.027	.125	2.497	.013
a. Dependent Variable: attitude						

The above result indicates that awareness influence on the attitude of the residents on the solid waste management in the gated communities of Chennai region with $p<0.05$, $F(1,394)= 6.236$. The regression equation is $Y = 20.027+0.067X1$, means that for each unit of increase in the awareness (independent variable) there is 0.067 variation in the attitude (dependent variable). Therefore, the null hypothesis is rejected. There exists significant relationship between the attitude and the awareness on solid waste management among gated community residents in Chennai.

OTHER FINDINGS

- Only 50% of the total residents convey that their maids are aware of the segregation and recycling of solid wastes.
- Most of the residents use closed bins for waste storage. Also, the e-waste is not stored separately but mixed with other domestic wastes.
- The disposal of food wastes is done through compost methods, paper by recycle, plastics, metal, glass, packing materials, e-waste are disposed through tricycles.
- Only 50% residents educate their maid on SWM.
- Only 50% residents feel that their gated community workers were provided education and training.

Discussions & Recommendations

From the above analysis, it is clear that age groups, occupation, gender has no effect on the awareness on SWM whereas income has effect on the awareness on SWM among the residents of gated community in Chennai. The analysis also indicates that there is more awareness among the residents of higher monthly income. Household maids are not always educated about waste segregation at source and households with changing maids may not pay serious attention to the waste segregation as it involves educating them every time. Gated community workers have to be better trained and regularly monitored by the management of gated community on SWM. This will ensure any drawbacks and will enhance corrections. The result also indicates that there is a need for more awareness to the residents on recycling, composting, segregation on bio and non-bio degradable and on hazard materials. This awareness can bring some positive influence on their attitude and will make them get involved in environmental activities, gain knowledge on environmental issues, participate in various voluntary

programmes on waste management, help segregating waste at home and more conscious towards solid waste management activities.

For City where landfills are overflowing and where segregation of waste at source is not mandatory, waste management practices by the residents is the only hope and for this creating awareness on SWM is an essential agenda for the Government. For a successful solid waste management:

1. There needs to be innovative approaches by the urban local municipal bodies and joint actions by the communities too.
2. Successful implementation of any policy is possible with the cooperation of both Municipal bodies and residents of the community.
3. The awareness can be more effective if the Municipal bodies act on each region and its community in a decentralized way. Individual region concentration and regular activities can help in better awareness.

The community and municipal bodies can take following initiatives to promote awareness:

1. Communities can join together and create social events where there can be talk on the awareness on SWM along with other programmes.
2. SWM films and street dramas/shows can be played in public places like park and beach to create awareness. Municipal authorities can arrange and sponsor for such regular shows based on higher crowd density.
3. Distribution of stickers, Pamphlets & fliers in communities for residents can create individual awareness. The awareness can also be created in most visited government websites.
4. Government can tie-up with private players like mobile companies and include SWM taglines in their bills to reach the mass.
5. Government can think of SWM Programmes in larger crowd gathering events like award & musical functions, institutional programmes like business meets, trade shows, exhibitions and conferences. Municipal authorities can approach such larger crowd gathering events and sponsor for a slot for reaching the mass.
6. Regular Ads in Newspaper and Social Media in the way of articles can create better reach.
7. Municipal authorities can go for joint programmes like competitions with schools and colleges near the communities for reaching the younger generation.
8. Municipal bodies can call for regular meetings with Secretaries of each community and also form a council of representatives to send their policy messages to community residents. This way residents will be better informed on the rules of the Government on SWM.
9. Posters and implementation in Public places, libraries, Government offices and hospitals can give more visibility on the message as well as by action.
10. Corporation can convert vacant places in the neighbourhood of gated communities as composite yards and encourage residents to deposit degradable wastes in those pits. This segregated wastes in the compost pits are manure for future purposes. This effectively reduces some percentage of waste going for the landfills. This depends on more awareness on the segregation at source and using composite pits by the gated community residents.
11. Corporations can implement strict rules for gated communities with higher number of residents to have their own composite facility pits inside the gated community.
12. Gated community management who are collecting maintenance from the residents should take proper responsibility of waste management and make sure not to dump outside the gated community and affect other nearby residential houses.
13. Management of the gated community has to implement “various strategies to **reduce the generation of wastes** and create awareness programmes for **segregation of the waste at source**” for the residents of gated community.

CONCLUSION

Due to the increasing urbanization and higher income levels wastage accumulation has become more. Higher the number of people in a household also became a factor too in contributing the waste.

All these wastes are not sorted at source in most of the towns and cities in India and these wastes are sent for land filling and open burning in many cities. This has caused major environmental concerns and health issues. So, it becomes necessary to convert those wastes into resources by recycling them and this requires sorting at source in many communities in a decentralized manner with the initiation and cooperation of the municipal authority. This recycling of waste is useful for a country like ours with circular economy and this might boost more market for secondary products and generate newer job opportunities if the organization of SWM is with good management capacity with the support of public.

Gated Communities which is presently targeting the upper middle class and future for residential living style of all, due to the living space constraints in the city, needs to be designed keeping in mind the waste management factor in these communities. It is also clear that there is a need for a strong leaders/individual like Secretaries in managing the gated communities with an interest on environmental concerns and committed to implement newer actions for solid waste management. The management of gated community should be able to take expert knowledge, negotiate with Corporations and with builders for waste management facilities. Such gated communities can also initiate with the support of their management to clean up region outside their communities and do many more societal benefitting activities as a group of residents. This will not only create an image for gated communities' residents but this will also ensure a change for the community and beyond the community. For this to be successful, we need innovative management approaches to create awareness on SWM among the growing gated community residents in Chennai.

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