RESEARCH ARTICLE

Awareness and Attitude of Students towards Municipal Solid Waste Management to Achieve Sustainable Development Goals - A Case Study

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Abstract

The generation of large volumes of municipal solid waste is a major issue of concern. As municipal authorities struggle for its appropriate management, it has been realized that the issue cannot be addressed through technology alone and that public participation is a key factor for success, especially concerning waste segregation, reuse, and recycling at source. It has also been realized that students can play a major role in taking this forward in society and contribute towards achieving long-term sustainable development goals. However, this is possible only if they are aware, have the necessary knowledge, skills, and attitude, and are motivated to adopt environment-friendly practices. The present study was conducted at Pushpa Gujral Science City, Punjab, with school students, both, from rural and urban areas, who visited Science City during the study period to assess their perception, understanding, and behaviour towards environment and sustainable development, with a focus on municipal solid waste management. A questionnaire-based approach was adopted. The study indicates that though awareness levels are adequate, especially among high and higher secondary school students, however, adoption of appropriate practices and participatory action is urgently required. Though 80% of respondents agreed to the collective responsibility of government and public for municipal solid waste management (especially w.r.t. reduction in the volume of waste generated and source segregation), however, >10% believed that they could not contribute at the individual level. This points out the need for an attitudinal change. Further, 10% of the urban students also informed that they had initiated waste segregation at the household level but it was discontinued because the garbage collectors remixed the waste in their waste collection carts. The family structure had no significant impact ($p>0.05$) on household-level waste management practices. Knowledge about Sustainable Development Goals among students is also abysmally low (4%). The study has brought out that certain government programs have percolated to the grassroots to some extent which has contributed towards improving awareness levels. No significant variation was observed among urban and rural students. The study points out the need for further generation of data across various economic groups to help to design intensive targeted programs.

Keywords: Awareness, Municipal solid waste, Students, Sustainable Development Goals.

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Introduction

The 2030 Agenda for Sustainable Development was adopted by the UN General Assembly in 2015. It has been universally identified as an agenda "of the people, by the people and for the people". The agenda is the result of a global consultative process involving all stakeholders (i.e. governments, non-governmental organizations, industry, and society at large) and sets forth seventeen Sustainable Development Goals (SDGs) and 169 Targets. Though most of the Goals are interlinked, Goal 11 of the SDGs specifically seeks to "make cities and human settlements inclusive, safe, resilient and sustainable". One of the key factors in achieving this Goal is the effective management of Municipal Solid Waste (MSW), which can be achieved only through adequate public education and effective peoples' participation.

The Ministry of Environment, Forests and Climate Change (MoEFCC), Govt. of India, has notified the Municipal Solid Waste (Management and Handling) Rules, 2000, under the Environment (Protection) Act, 1986 (amended and Re-notified in 2016). The Rules define municipal solid waste (MSW) to include domestic, institutional, and commercial waste (except industrial, biomedical, and hazardous waste and chemicals, e-waste, lead-acid batteries, and radioactive waste). The generation of large volumes of Municipal Solid Waste across countries is found to be directly proportional to economic development and associated lifestyle changes and has a positive correlation with rapid industrial growth and rural to urban migration. However, its management, besides being technical, is an attitudinal issue as well.

Research on assessment of MSW generation and its impact was initiated at the global level by WHO (1976, 1996), World Bank (2006), Karak *et.al.* (2012), Wilson *et.al.* (2015), whereas studies specific to Asia were conducted by Hoornwerg and Thomas (1999) and Dass (2007). Sporadic studies on MSW in India were initiated in the early nineties by Shekdar *et.al.*, (1992),

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Khan (1994), Dayal (1994), Jalan and Srivastava (1995), NEERI (1996), Gupta et.al.(1998), Shekdar (1999), Ahsan (1999), Joseph (2002), Jha *et.al.*(2003), Kumar *et.al.* (2004) and Ahmed and Ali (2004), but most of these studies focussed on assessment of waste types and quantities generated.The Ministry of Urban Affairs, Govt. of India had estimated in 2000 that about 0.1 million tonnes of solid waste were being generated in the country every day in the late nineties, out of which about 90% was dumped in open areas without segregation or treatment. Further, the contribution of metropolitan cities was the highest (MoUD, 2000). Important studies were also undertaken by Sharma and Shah (2005), Sharholy *et.al.* (2005), Rathi (2006), Central Pollution Control Board (2006-07), Dhere *et.al*.(2008), Goel (2008), Kumar *et.al.*(2009), Rajput *et.al.* (2009) and Yadav and Devi (2009). Annepu (2012) compiled data on State-wise generation of MSW and reported that among the four geographical regions of the country, Northern India generated the highest amount (30%) of the total waste generated in India (40,500 TPD or 14.8 million TPY) and Eastern region generated the least (only 17%) amount (23,500 TPD or 8.6 million TPY).In the past 15 to 20 years where waste generation increased by >10 fold, however, its collection and treatment lagged. As per MoEFCC (PIB, 2016) only 75-80 percent of the total waste generated is collected, out of which only about 25 percent is processed and treated. The latest data from the Ministry of Housing and Urban Affairs (MoHUA, 2020), in its "Swachhata Sandesh Newsletter-2020", indicates that presently 1.48 lakh metric tonnes of solid waste is generated per day from 84,475 wards in the country. Out of this, the maximum solid waste is generated in Maharashtra State (22,080 MT/D from 7,322 wards) and the minimum is reported from Sikkim (89 MT/D from 53 wards). The municipal waste generation in Delhi is also very high, being 10,500 MT/Day from 294 wards.

To address the above situation, several studies have focused on MSW management through appropriate treatment technologies and disposal methods. These indicate that 90% of MSW in most cities in India is directly disposed of on open lands without any pretreatment (Sharholy *et.al.*, 2008; Narayana, 2009; TERI, 1998; Kansal, 2002; Bhalla *et.al.*, 2012) and its unplanned disposal in low-lying areas or open dumps contributes to filth and unhygienic conditions around residential areas (Srivastava *et.al.*, 2015). As per the MSW Rules, municipal authorities must take appropriate and adequate measures to manage municipal solid waste. This has led to several actions by the municipalities but the continuous increase in the quantity of MSW generation due to increasing population, as well as, changing lifestyles, is posing new challenges. Research has been undertaken to understand the problem scientifically and look for technologically sound solutions to address itbut an important issue of public participation has been largely ignored.

It has now been accepted that technology alone is not sufficient to address the problem and public behavior is a key factor. However, very few studies (primarily by Scott, 1999; Momoh and Oladebeye, 2010; Shigeru, 2011; Asuamah *et.al.,*2012, Banga, 2013; Adeyemo and Gboyesola, 2013; Adogu *et.al.,* 2015; Al-Khatib *et.al.,* 2015; Twumasi, 2017; and Choon *et.al.*, 2017) are focussed on assessment of people's attitudes and awareness.

It has also been recognized that if long-term goals of sustainability are to be achieved, children and youth are a key target group. Studies focused on perception and participation of students (children/youth) in Municipal Solid Waste Management are few and include those by Shobeiri *et.al.*(2007), Ifegbesan (2010),Tartiu (2011), Ayodeji (2012), Vivek *et.al.* (2013) and Khan *et.al.* (2018).These point out that increased awareness may improve the practice of waste management. Hasan (2004) is of the opinion that informing people about the negative consequences of illegal dumping and improper waste management can help improve attitudes and that this education should begin at the school level.

Further, very few studies have been conducted on specific cities and towns in the state of Punjab. These include studies by Jerath *et.al. (*1995 and 2014) and Jain *et.al.(*2007) in Mandi Gobindgarh, Garg, and Prasad (2003) for Chandigarh and Bhalla *et.al.*(2012) for Ludhiana. However, none of these studies look at behavioral aspects or are targeted to students.

This motivated Pushpa Gujral Science City, a leading Science Communication facility in the country, to assess the existing level of awareness of school students about Municipal Solid Waste and the need to manage it.

Present status of MSW management in Punjab: Punjab is a small but relatively affluent State with a high population density (550 individuals / Km^2). The per capita income is Rs.1,55,996/ year. The migration of a large number of people to western countries, either permanently or temporarily, has led to a more westernized lifestyle, leading to a higher generation of municipal solid waste. The total MSW generated amounts to 4100 TPD out of which wet waste generated is 50%, recyclable /dry waste is 30% and commercially non-recyclable waste amounts to 15% (Source: Punjab Municipal Infrastructure Dev. Company, Local Govt. Deptt. , 2019).

In the past, the State had adopted a cluster approach for MSW management. It was divided into 8 clusters, each comprising a major town to function as a nucleus with other peripheral towns. It was envisaged to collect and transport the waste to a centralized integrated processing unit in each cluster for further processing, recycling, and disposal in PPP mode. Being primarily top-driven, the experiment was found economically and environmentally unviable and the cluster approach was shelved in 2017. It was realized that public participation would be a key factor to ensure effective management. The Punjab State Solid Waste Management Policy, 2018 was put in place under which the State has adopted a decentralized approach (PMIDC, Local Govt. Department., 2019). Action Plans have been prepared for towns based on their waste generation potential (i.e. towns generating <35 TPD, between 35-50 TPD, and 50-500 TPD or more).These plans emphasize the participation of communities to ensure source segregation and management of wet waste (through decentralized composting) and further segregation of dry waste at the municipal level into recyclable waste (to be sent to recycling units), combustible waste(to be sent to waste processing site for the production of Refuse Derived Fuel) and remaining inert waste (to be sent to a landfill site). Since a major focus of the Policy is on public participation (including of youth and children) through awareness and outreach, a gap assessment exercise was required to understand the variance between information, attitudes, and practices in waste management. It is in this context that the present study was undertaken with a focus on school students.

Materials and Methods

Student participation in waste management needs to be assessed for inputs and impacts (through participation in waste management implementation).They must be sensitized to their responsibility towards environmental protection and sustainable development.

A group of 10 students from 50 schools each (500 students) from Punjab visiting the Science City were randomly selected to represent both, rural and urban, as well as, public and private school students representing different social strata. Each student was given a questionnaire (with instructions to refrain from filling in the name of their school and their names in the interest of securing honest responses) in English/Punjabi (regional language). The questionnaire was divided into five components to assess their level of awareness about the environment in general and SDGs and MSW in particular; extent of their knowledge about the subject and source of information (formal / non-formal) and their attitude, as well as, practices adopted (if any) for waste generation, source segregation, 3Rs (reduction, recycling, and reuse), management of wet waste, as well as, their role in further disseminating information amongst their peers, family, and society (Table 1). For a better assessment of understanding and insight of the students about the subject, the questionnaire had both, choice-based and descriptive/open-ended questions, as well as, some repetitive questions. Each section was divided into 12 parts. The students were divided into two groups i.e. 6^{th} to 8^{th} class (Middle School) students and 9^{th} to 11^{th} class (High and Higher Secondary School) students.

Results and Discussion

Out of the total 500 students who received the questionnaire, only 308 students (n=308) responded (62%). Follow-up with the non-responders indicated that they were either not interested, or were not comfortable being assessed.

Of the 308 responses received, 134 were 6^{th} to 8^{th}class students (43.5%) and 174 were 9^{th} to 11^{th} class students (56.5%). Further, 61% of students were from rural areas whereas 39% of students were from urban backgrounds. The respondent and school background are presented in Figs. 1 & 2. All students uniformly reported that they saw garbage dumped in their locality and along the streets while travelling to school or market reflecting the regretful state of affairs both, in urban and rural areas.

Results indicated that though Environment and Solid Waste Management was a part of regular Science / Social Science curriculum, only 86% of the senior category students had participated in awareness programs or competitions (leading to self-learning) on Environment which covered Solid Waste Management also, and only 4% students were aware of Sustainable Development Goals. Senior group students were also aware of concepts of waste reduction, recycling, and segregation and were more eager to know about environmental problems ($p<0.05$) than junior students. Besides regular school books, their sources of information were talks and competitions in schools. Many government school students credited their teachers and eco-clubs or nature clubs for providing information, as well as, visits to Science Centres (the state government runs a program titled '*Vigyan yatra*' for the visit of school students to Science City), participation in school activities, print and electronic media. The study also brought out that many government schemes like, National Green Corps program, Children Science Congress, WaSH program, and Swachh Bharat Abhiyan were gradually reaching the masses as mentioned by some students in their remarks. A majority of students (84%) from urban private schools also credited websites and social media for information.

Concerning attitude, both senior and junior group appreciated the threat to the environment towards improper waste disposal ($p>0.05$) but did not know about the linked SDG. While 80% agreed that waste management was a collective responsibility of government and public, 10% believed that they could not contribute as individuals and 2%(6 respondents) felt it was the sole responsibility of the government.

With respect to the practicing of waste segregation at the household level, there was no significant difference in both groups ($p>0.05$). Most households did not segregate wet and dry waste (excluding old clothes, paper, and used bottles/ plastic which had a resale value). However, in rural areas composting of wet waste was a more common practice, primarily as a part of the tradition. In urban areas, at least 10%of students informed that even if they had started waste segregation, it was discontinued by them because the garbage collectors re-mixed the waste in their waste collections carts. Family structure (joint/nuclear) had no significant impact ($p>0.05$) on household-level solid waste management practices though, in general, recycling of

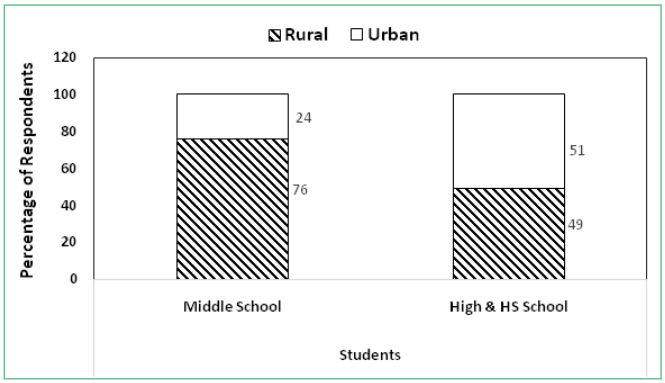

Fig. 1: Social Background (Rural / Urban) of students responding to questionnaire to assess awareness, attitude and action for MSW

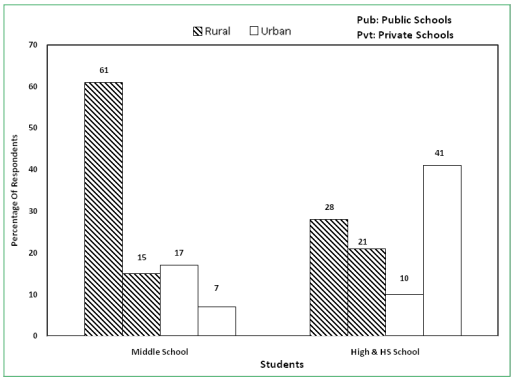

Fig. 2: Respondent Students from Public / Private Institutions concerning awareness, attitude and action on MSW

certain items was better in joint families vs. nuclear families. An overwhelmingly large number of students (92%) reported about their participation in tree plantation activities whereas only 56% reported participation in rallies under "*Swachh Bharat Abhiyan*" primarily from rural schools. Further, 32% of students reported participation in waste to craft activities, primarily from urban areas.

The results also indicated that there is a lack of awareness about e-waste and its disposal/management. E-waste is one of the fastest-growing segments of solid waste in India and it is estimated that in 2020about 3 million tons of e-waste was generated (Source: India.mongabay.com, accessed on 14.01.2021). An ASSOCHEM-KPMG study (www.assochem.org, 2017) has reported that out of the total e-waste generated, households generate approximately16% and with the increased influx of mobile devices, this is expected to increase significantly. This also calls for enhanced outreach activities for children on this segment of MSW.

As a follow-up to the study, modalities for outreach were also discussed informally with school teachers and communicators. Although primary learning of basic issues comes from the school system, it is easier for children to learn to recycle through interactive exhibitions/models as in Science Cities/Centres pan India, as well as, through games, songs, and role play. Some educational resources could be craftwork out of waste, videogames, and cartoons to promote recycling through story telling.

Conclusion

Awareness about municipal solid waste, its components, and characteristics, as well as, sensitization towards waste segregation is a prerequisite for people's participation in its management. Public perception of environmental degradation due to municipal waste is mainly created by visible contamination of their surroundings. Education and awareness have a direct impact in sensitizing and molding attitudes even though there are many barriers to raising awareness. These include the multiplicity of stakeholders, their levels of understanding, and financial and human resource constraints. Students can play an important role in molding public attitudes and disseminating information in society. This case study indicates that even though students are aware of the environmental impacts of municipal solid waste, they are not motivated enough to participate in its management (especially segregation and regular composting of biodegradable waste), irrespective of their rural or urban background. Students' knowledge of the concept of sustainable development and SDGs is also limited. There is thus, an urgent need to sensitize young minds to these issues and streamline their energies to achieve visible results. The challenge is to assess and understand the ground realities. The present study is for a limited area with a limited group of subjects and lacks information on attitudes and practices within different economic strata. More such studies are required with students from different economic backgrounds as a target group to help design strategies to enhance student and public participation in municipal solid waste management and develop policies/ programs for scientific communication about the subject. The study also brings out the importance of intensive targeted programs and assessment of their impacts for achieving sustainable development goals.

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Table 1. Questionnaire to assess student awareness, knowledge, attitudes and practices adopted on municipal solid waste management

Note: This questionnaire has been given to you as a part of your visit to Science City.
Please do not mention your name or the name of your school.

S.No.	*Questions*			
Part I	*General Information (Please tick)*			
1.	Class	6-8 / 9-11		
2.	Is your school a government or private school?	Government/Government aided/Private		
3.	Area of location	Urban / Rural		
4.	Family Type	Joint / Nuclear		
5.	Number of people in your family	4/5-8/>8		
6.	Medium of instruction in school	Punjabi / Hindi / English		
7.	Is there a nature club / eco club in your school	Nature Club / Eco Club		
8.	Are you a member of nature club / eco club? (If yes, since when)	Yes / No New Member / <1year/>2 year		
9.	Have you participated in any program of the club?	Yes / No		
10.	Have you participated in tree plantation activities?	Yes / No		
11.	How many times have you visited Pushpa Gujral Science City or any other Science Centre or Science Museum?	1 / >1 / >5		
12.	How many times have you attended any program/ competition organised by Science City?	1 / 2 / >2		
S.No.	*Questions*	*Yes*	*No*	*Remarks (Please fill only if applicable)*
Part II	Awareness about Environment, SDGs and MSW			
1.	Do you know definition of environment? (if yes, mention in remarks)			
2.	Have you read about ecology?			
3.	Have you studied / heard about municipal solid waste? If yes, mention about municipal solid waste in remarks.			
4.	Have you heard/read about Sustainable Development Goals?			
5.	Do you see garbage/solid waste near your home?			
6.	Do you see solid waste on road to school / market?			
7.	Is there a dumping ground near your locality?			
8.	How does municipal solid waste contribute to air and water pollution?			
9.	Can municipal solid waste contribute to climate change? If yes, how?			
10.	What is sustainable development? How many sustainable development goals have been fixed?			
11.	Can municipal solid waste contribute to spread of diseases? How?			
12.	What is carbon footprint?			
Part III	*Knowledge about municipal solid waste and source of information*			
1.	Have you heard about various types of municipal solid waste? (if yes, mention a few types found at (i) school; (ii) home)			School Home
2.	Where do you dispose of solid waste generated in (a) school (b) home	School Home		
3.	Do you discuss municipal solid waste at home?			

4.	Do you know about different coloured waste bins? Please mention colours of bins and type of waste in remarks column.		
5.	Do you know what is wet waste? If yes, mention a few.		
6.	Do you know what is non-biodegradable waste? If yes, please mention a few.		
7.	Do you generate e-waste at home? (if yes, mention a few)		
8.	Does a waste collector visit your locality? How often does a waste collector visit your locality?		Everyday / Sometimes / Once a week / Never
9.	Have you attended any program organized by your municipality / NGO on solid waste management?		
10.	Have you participated in any other program on municipal solid waste management? (if yes, where)		
11.	Have you read or heard any talk about waste management technologies? If yes, please name a few technologies.		Paper / Seminar / Radio / T.V. / Video
12.	What is Refuse Derived Fuel?		
Part IV	*Attitude*		
1.	Should waste be segregated? If yes, why?		
2.	Is waste segregated at home? If yes, who does it?		You / mother / all / No one / garbage collector
3.	Do you talk to your friends / neighbours about waste segregation		
4.	Would you be willing to collect waste in your locality?		
5.	 Have you seen this symbol? If yes, what does it mean and from where did you learn about it?		Teacher / Books / Papers and Magazines /Eco clubs / Science Centres / Any other
6.	Do you like to read / watch a video / hear a talk about waste management. If yes, what is your favourite mode? (Tick as many as applicable)		Visit to Science City / Centres Science Books / magazines Newspaper Radio Google Social media / Youtube
7.	What can you do to reduce waste at home?		
8.	What can you do to reduce waste at school?		
9.	What are 3Rs? Write two lines.		
10.	Write about their role in keeping your surroundings clean and preventing environmental degradation.		
11.	How can you help in achieving sustainable development goals?		
12.	Who is responsible for waste management in your area? (Please Tick)	You Families Government Both Government and People	
Part V	*Practice Adopted*		
1.	Do you have separate waste bins for different types of waste at home? (if yes, please give some information)		
2.	Do you throw plastic carry bags with food waste?		
3.	Do you throw empty chips packets with food waste?		

4.	Do you throw used cells with paper waste?		
5.	Do you throw broken plastic toys with paper waste?		
6.	Are baby diapers / napkins thrown with food waste in your home? (if applicable)		
7.	Do you compost waste at home? If yes, what do you do with the compost?		
8.	Do you know what is vermicomposting? (if yes, what worms are used?)		
9.	Have you participated in waste management competitions in school? If yes, please write the name of the last event.		
10.	Have you participated in waste awareness campaigns in your mohalla / village? How?		Rally / Role Play / School drama / any other
11.	Have you made any craft out of waste? Give example		
12.	Do you know about any programs related to solid waste management? If yes, please name some programs about which you know.		
Part VI	Any other information which you wish to share		