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RESEARCH ARTICLE

STATUS OF EXISTING SOLID WASTE MANAGEMENT INITIATIVES IN DELHI SCHOOLS.

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Abstract

A significant increase in the trend of generating municipal solid waste has been recorded around the world. This can be attributed to increasing population, changing lifestyles, globalization, economic growth and pollution. The objective of writing this paper was to study and understand the composition of solid waste generated in the selected educational institutions and the prevailing practices related to its effective management and disposal. Twenty-six schools from nine zones of Delhi participated in the study over a period of one year. Data obtained through survey revealed seven main categories of solid waste produced in schools; namely – paper, plastic, metal, glass, organic, textiles and e-waste. It was found that 50.77% of the total waste generated in schools was sent to MCD *Dhalao*'s and 49.23% was been taken care through different mediums like selling it to *kabadiwalas* (rag picker), collaborating with NGO, recycling/composting and using waste material for 'best out of waste' activities.

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Introduction:-

There are few things in life that no one can stop like life and death. Another addition to this could be solid waste which is a by product of all human activities. Though considered irrelevant, it is something that is affecting the life of all living organisms on planet Earth. However, with better management, there is a scope to alter our actions to ensure a healthier living environment and better future for the future generations to come.

EPA (Environmental Protection Agency) defines solid waste as any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and from community activities [1]. Nearly everything we do leaves behind some kind of waste. It also states that solid waste is not limited to waste products that are physically solid. Many solid wastes are also found in liquid, semi-solid, or contained gaseous states [2]. A common man's definition of waste is 'anything that is undesirable or not useful'. However scientifically speaking there is no such term as waste in the world that we live in. Almost all the components of solid waste have some potential to be reused, converted or treated in a scientific manner [3].

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Historically, the disposal of solid waste did not pose a serious threat to the environment because the population was small and the availability of natural resources like abundance of clean water and land for assimilation of solid waste was relatively large [4].

In the city of Delhi, the rate of solid waste is increasing exponentially with growing population. Delhi is spread over a large area (1486.44 square km) and caters to a population of approximately 179.5 lakhs [5]. There are 5 municipal corporations; namely – North Municipal corporation of Delhi (North MCD), South Municipal corporation of Delhi (South MCD), East Municipal corporation of Delhi (East MCD), New Delhi Municipal Corporation (NDMC) and Delhi Cantonment Board overseeing collection, segregation, disposal and treatment of solid waste generated in the city (Table 1). Out of the 9,500 tonnes of waste generated daily, only 8,000 tonnes/ day is collected from 280 wards and sent to three main landfill sites situated across the capital [6].

Table 1:-Existing infrastructure of solid waste management in Delhi

	PLANT LOCATION	CAPACITY
Composting Sites	Okhla Bawana	200 tonnes 1000 tonnes
Waste to Energy	Okhla Gazipur Narela- Bawana	2000 tonnes, 16 MW 1300 tonnes, 14MW 2000 tonnes, 24 MW
Construction and Demolition Facility	Shastri Park (500 tonne) Burari (2000 tonnes)	400 tonnes 2000 tonnes
Landfills/Dumpsites for waste disposal	Ghazipur Okhla Bhlasawa Bawana	70 Acres (Oversaturated) 56 Acres (Oversaturated) 40 Acres (Oversaturated) Integrated waste management plant in 100 acres

Source: [5]

According to the present data available, Delhi has a capacity to process about 40% of its total waste generated through three incineration plants and 2 central composting units [6]. All studies on composition of solid waste have revealed that about 65% of the total waste generated includes treatable materials like organic, plastic and metal waste which are treatable but the technologies and equipments available are not sufficient to handle the quantum of waste generated [7].

Swachh Bharat Abhiyan was launched on October 2, 2014 throughout the length and breadth of the country to address the problems related to sanitation and solid waste management [8]. To initiating a healthy competition among towns and cities, **Swachh Sarvekshan Survey** was introduced in 2016 to assess sanitation services, management of solid waste by municipalities and awareness generation among citizens [9]. The results of Swachh Sarvekshan Survey under **Swachh Bharat Abhiyan** (2016-19) revealed that NDMC is the only municipality in Delhi that has been able to stay on the top of the table scoring between ranks 4th to 7th over the years [9]. All other municipalities have been ranked much lower in the survey based on their cleanliness and solid waste management initiatives (Table 2) [10].

Table 2:-Results of Swachh Sarvekshan Survey (2016-18)

	Sarvekshan Survey 2016	Sarvekshan Survey 2017	Sarvekshan Survey 2018	Sarvekshan Survey 2019
Time:	May-June 2015	Jan – Feb, 2017	Jan - Mar, 2018	Feb-Mar 2019
Participation:	73 Cities & towns	500 Cities and towns	4203	4237
Cleanest City (No. 1)	Mysore (Karnataka)	Indore (MP)	Indore (MP)	Indore (MP)

Cleanest City (No. 2)	Chandigarh	Bhopal (MP)	Bhopal (MP)	Ambikapur (CG)
Cleanest City (No. 3)	Tiruchirappalli (TN)	Visakhapatnam (AP)	Chandigarh	Mysore (Karnataka)
Delhi Ranks	North MCD – 43 rd South MCD – 39 th East MCD – 52 nd NDMC – 4 th	North MCD – 279 th South MCD – 202 nd East MCD – 196 th NDMC – 7 th	North MCD – 206 th South MCD – 32 nd East MCD – 341 st NDMC – 7 th	North MCD – 282 th South MCD – 138 th East MCD – 101 st NDMC – 5 th

Source: [10]

Even though the scenario has improved considerably in the last few years, the results suggest a further scope of improvement which can only be achieved if all the stakeholders involved in generating solid waste work together towards developing a cleaner surrounding. One such stakeholder that plays a vital role in city's solid waste management initiative are the educational institutions.

Today, about 25% of Delhi's population is enrolled in 5760 schools across the city [11]. Economic developments, increasing urbanization, improving living conditions and increasing enrolments in city schools has led to increase in the quantity and complexity of solid waste generated in schools [11].

After home, schools are the next most important place for students where they spend a considerable time of their day and learn through set curriculums and indoor and outdoor activities [4]. Therefore, the purpose of the study was to describes the initiatives taken up Delhi schools to collect, segregate and dispose different categories of solid waste generated in schools effectively.

Methodology:-

In NCT (National Capital Territory) of Delhi, a study was conducted to find out the composition of solid waste and existing practices adopted for its management by the schools. 26 schools from nine zones of the city (namely – North, South, East, West, North-East, North-West, South-West, Central and New Delhi) formed part of the study. A few meetings were arranged with school principal and teacher coordinators of the environmental club to collect data and information regarding management of solid waste.

The tools comprised of a questionnaire for teacher-coordinators to gather information about the prevailing practices in place and equipments installed for managing solid waste. An observational checklist was also developed to identify the composition of solid waste generated in different areas of the institution and verify the information provided during questionnaire.

The research was conducted over a period of one year where schools were visited numerous times. The data from the survey was collected and tabulated for analysis.

Result and Discussion:-

The city of Delhi generates maximum waste in the country and efficient solid waste management has been ignored over the years even after the implementation of *Swachh Bharat Abhiyan* and Municipal Solid Waste (Management & Handling) Rule, 2016. Nonexistence of efficient systems is usually blamed upon lack of sufficient funds and manpower.

The study was an attempt to understand the efforts made by schools across the city to reduce their waste as a part of environment conservation programme. The profile of selected schools in Delhi and their environment club activities showed that schools produce considerable amount of solid waste on a daily basis which is mostly found in unsegregated state. Further analysis of waste in selected institutions revealed the following categories of solid waste commonly found.

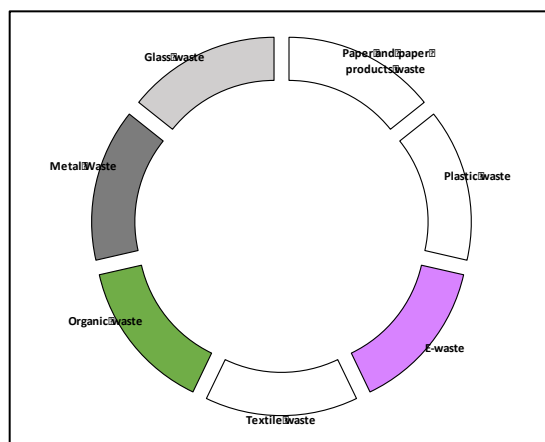


Figure: Categories of school solid waste

Most of the waste generated in schools was usually sent to MCD dumping sites or *dhalao*s without source segregation. While some schools were making attempts to utilize waste in one way or another, their efforts were limited to specific categories of solid waste produced.

The evaluation of solid waste management practices adopted/ practiced by selected schools is discussed in the following section.

Paper and paper products:

Paper waste included newspaper, cardboards and other classroom paper like loose sheets, assignments and notebooks. More than 70% of the schools were recycling classroom paper and newspapers using different ways such as reprocessing paper in recycling plants, collaborating with outside organizations and selling to *kabadiwalas* (Table 3).

Table 3:-Waste management practice related to paper waste

S.No.	Practice	No. of schools (n=26)			Remarks
		Paper	Newspaper	Cardboard	
1	Paper Recycling	14 (53.8%)	9 (34.6%)	1 (3.8%)	Most schools had paper recycling plants where the paper waste generated in the schools was recycled. Some schools had collaborations with organizations like Jaagruti, DA- Tara and CSE for recycling paper waste including newspapers on kind basis. The paper waste generated was exchange for printable paper and stationary items.
2	Best out of Waste	1 (3.8%)	0	1 (3.8%)	Only one school was creating recycled products from waste paper like photo frames and stationary boxes.
3	<i>Kabadiwalas</i>	4 (15.4%)	14 (53.8%)	8 (30.7%)	More than 50% of the schools sold newspaper to <i>kabadiwalas</i> from where it found its way back to paper recycling industry.
4	MCD <i>Dhalao</i>	7 (26.9%)	3 (11.5%)	16 (61.5%)	Less than two-third of the schools were dumping cardboard waste into landfills rather than recycling.

Most schools had paper recycling plants installed in their campus for processing paper and newspaper, however many of these units were non-functional. Some schools had collaborated with outside organizations / NGOs (Non-Governmental Organizations) like Jaagruti, DA-Tara and CSE for recycling paper and paper products.

The mode of exchange with *kabadiwalas* (ragpickers are known by this name in India) was primarily monetary in nature and recycling of paper products with other organisations was largely done in kind where the amount of paper collected from institutions was measured and exchanged for recycled printable paper, office stationery, examination sheets or other items requested by the schools.

Metal waste:

Aluminium and steel are two common metals found in school setting. Most of the aluminium generated in schools was found in the form of foil paper used for wrapping food. Other items included tin cans and food coverings (Table 4). Steel on the other hand was only found as big equipment's like bins, cloth stand, etc. Only one institution was found to be a part of the recycling chain where aluminium products were sorted, collected and then sent to government authorized dealers for recycling. All other schools were either selling it to *kabadiwalas* or dumping it at the MCD *dhalao*.

Table 4:-Waste management practice related to aluminium waste

S.No.	Practices	No. of School (n=26)	Remarks
1	MCD <i>Dhalao</i>	14 (53.8%)	More than 50% of the schools did not segregate their metal waste and sent it to <i>dhalao</i> that finally ended in landfill sites.
2	<i>Kabadiwalas</i>	11 (42.3%)	Handful of schools were making attempts at segregating metal products like cans, waste bins and containers which were then sold to <i>Kabadiwalas</i> who traded it back to industry.
3	NGO	1 (3.8%)	Only one school segregated aluminium waste and had collaboration with an NGO for recycling.

Organic waste (food and garden waste):

Organic waste forms a substantial part of solid waste in schools as students brought lunch boxes which contributed to food waste like leftovers and fruit peels (Table 5). Food waste was usually found mixed with other waste which was discarded without segregation. Regarding garden waste, most schools were involved in composting on campus, and the manure produced was used in the garden/fields only. While many schools were using the traditional method of aerobic composting by digging pits, some had also procured equipment like *mulchy-bulchy* bag, *rolly-polly* and environment-friendly composters.

Table 5:-Waste management practice related to organic waste

S.No.	Practices	No. of schools (n=26)		Remarks
		Food Waste	Garden Waste	
1	Composting	9 (34.6%)	20 (76.9%)	Majority of schools were composting their organic waste using different forms - · Aerobic Composting (In presence of oxygen) · Anaerobic Composting (in absence of air) · Composting equipment's like Aga's, mulch bags and roly- polly
2	MCD <i>Dhalao</i>	17 (65.4%)	6 (23.1%)	The unsegregated waste was to send it to MCD <i>dhalao</i> s for disposal.

Glass:

Glass waste is usually produced in lesser quantities in schools and mostly found in labs (as lab equipment) or on rare occasions in canteens (as glass bottles and containers). A limited number of schools were trying to recycle glass which were generally found mixed with other waste (Table 6). Six schools were selling it to *kabadiwalas* and only one school had collaborated with an NGO for segregating and recycling of glass waste.

Table 6: Waste management practice related to glass waste

S.No.	Organizations	No. of School (n=26)	Remarks
1	MCD Dhalao	19 (73.1%)	Most schools were not sorting glass from other wastes and sending it to landfill sites.
2	Kabadiwalas	6 (23.1%)	A few schools were collecting and selling glass waste to <i>kabadiwalas</i> for money, who was responsible for selling it back to the industry for recycling.
3	NGO	1 (3.8%)	Only one school had collaborated with the NGO Chintan for segregation and recycling of glass bottles.

E-waste:

More than 50% of the schools (16 in number) were segregating and recycling e-waste in collaboration with NGOs and other private organisations. Only one school was selling e-waste to the *kabadiwalas* who were trading it further to scrap recycling industry (Table 7).

Table 7:-Waste management practice related to electronic waste

S.No.	Organizations	No. of School (n=26)	Remarks
1	Recycling	14 (53.8%)	Schools were recycling e-waste in collaboration with authorized recyclers. The waste was collected and sorted in school and then regularly and sent to authorized recyclers.
2	MCD Dhalao	9 (34.6%)	One-third of the schools discarded waste into local waste bins which would eventually end in landfills.
3	Kabadiwalas	3 (11.5%)	handful of schools were selling e-waste to scrap dealer in exchange for money.

Plastic waste:

All plastic items including plastic bottles, wrappers and containers generated in different areas of the school were not collected or sorted in most of the schools. Only two schools were using some plastic waste for creating products out of waste or selling it to *kabadiwalas* (Table 8).

Table 8:-Waste management practice related to plastic waste

S.No.	Organizations	No. of School (n=26)	Remarks
1	MCD Dhalao	24 (92.3%)	More than 90% of schools were not segregating their plastic waste and throwing it directly into landfills.
2	Best out of Waste	1 (3.8%)	Only one school was making use of a part of its plastic waste to develop recycled products like chandelier, sofa seats and lamps.
3	Kabadiwalas	1 (3.8%)	Only one school was segregating the plastic waste and selling it to Scrap dealer in exchange for money.

Textile waste:

Textiles included uniforms, lab coats and cleaning fabrics used in various parts of the school. They did not form a significant part of the waste generated in schools as its disposal is the responsibility of the students and families owning the items (Table 9). However, half of the selected schools made efforts to collect old uniforms and lab coats in good

condition from students and gave them to students in need or donated to organisations working for the welfare of children. The other half were throwing their textile waste into landfill.

Table 9:-Waste management practices related to textile waste

S.No.	Organizations	No. of School (n=26)	Remarks
1	MCD <i>Dhalao</i>	13 (50.0%)	Half of the schools were directly throwing their textile waste into landfills.
2	Donated	13 (50.0%)	The other half collected old uniforms and lab coats from students and laboratories respectively and gave them to students in need.

Assimilation of solid waste management practices in schools

The collective analysis of solid waste practices adopted by selected schools in the study revealed that almost equal percentage of waste products generated in schools were disposed and reused and recycled (Table 10). 50.77% of the total solid waste from selected educational institutions were either being recycled through paper recycling plant or composting (25.77%), sold to *kabadiwala's* (18.08%), sent to NGOs (5.77%) or reused for creating products (1.15%). The study suggests that waste materials like cardboards, newspaper, garden waste and e-waste were usually recycled as they are easy to segregate and requires less time and labour.

Table 10:-Quantum of solid waste management practices adopted by schools

Solid waste categories	Recycling	Best out of waste	<i>Kabadiwala</i>	MCD <i>Dhalao</i>	NGO
Paper waste - Paper	14	1	4	7	
Paper waste - Newspaper	9		14	3	
Paper waste - Cardboard	1	1	8	16	
Metal waste			11	14	1
Organic waste - food waste	9			17	
Organic waste - garden waste	20			6	
Glass waste			6	19	1
E-waste	14		3	9	
Plastic Waste		1	1	24	
Textile waste				13	13
Total	67	3	47	128	15
Percentage	25.77%	1.15%	18.08%	49.23%	5.77%

The result suggests that the other half (49.23%) was sent to MCD *Dhalao's* without segregation as it mainly included all categories of solid waste materials which were mixed together and considered difficult to segregate at source by schools. The selected educational institutions were not involved in source segregation of waste especially in areas like classrooms and canteen where most of the solid waste was generated and discarded directly.

Conclusion:-

Keeping in line with the *Swachh Bharat Abhiyan* Mission, schools across Delhi are making small but noticeable difference by adopting sustainable practices to maintain cleanliness and imbibe good behaviour among students who are the 'change makers'. Though not enough, it is a beginning to a great revolution started around the world to make a conscious effort by changing habits and adopting environment cognizant behaviour. The study revealed that schools are not proactive in segregation of solid waste at source. However, with a small initiative from school authorities and students, it is possible to develop a successful source segregation programme to reduce the overall amount of solid waste reaching in landfills. This will not only help schools reduce their waste generation but also benefit the city by reducing the load on already overfilled waste disposal sites.

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