



SUSTAINABLE WASTE MANAGEMENT IN SCHOOLS: A CASE STUDY IN PURBA MEDINIPUR DISTRICT OF WEST BENGAL

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Abstract: Waste management system has become an important concern for all globally and nationally. Poor solid waste management practices in schools can lead to significant environmental consequences like pollution of air, soil, and water. In this study, we try to examine the different dimensions of the solid waste management in educational institutions. Effective waste handling also depends on the institutional capacities and how they implement the process. Educational institutions generate large enough amount of waste to justify individual attention. Minimising waste generation by focusing on management practices at the source can save disposal sites, space, reduce illegal dumping, create employment opportunities and therefore cut down on pollution potential from solid waste.

Educational institutions are one of the most important and vital social institute for the community. These institutions have significant impact on surrounding community. Also, solid waste management practice in school and colleges can bring about behavioural change in students which they can apply in their home and therefore in community. Waste management in educational institutions has major social, financial, and environmental impacts. A more coordinated effort between schools, local governments, and communities could lead to a significant reduction in waste generation, better waste disposal practices and educational opportunities for students about sustainability and environmental responsibility.

KEYWORDS - Solid waste, institutional capacities, educational institutions, sustainability, behavioral change, community.

1. INTRODUCTION

Waste disposal has become a serious global problem. Disposing waste out, does not solve the problem but increase the same for whole community. Therefore it is important to have a proper Solid Waste Management (SWM) system all over the world. Waste management system has become an important concern for all globally and nationally. Waste management goals are explicitly or implicitly in more than half of the 17 higher-level Sustainable Development Goals (SDGs). Managing waste is essential for better world.

As per official estimates, India produced 127 million kg of municipal solid waste per day in 2011-12. The actual amount could be much more. The World Bank estimates that solid-waste generation in India will rise by 243 percent between 2012 and 2025. According to the Central Pollution Control Board (CPCB), 70 percent of the total solid waste in the country is collected and only 12 percent is treated. Segregation at source, collection, storage, treatment and scientific disposal of waste are insufficient.

The Solid Waste Management Rules 2016 emphasize on segregation of waste into three categories at the source:

1. Wet or Biodegradable wastes like kitchen or garden waste etc.
2. Dry or non- Biodegradable wastes like paper, plastics, metals etc.
3. Domestic Hazardous waste like expired medicines, used batteries, paint drums, bulbs etc.

Dumping of mixed waste is the practice followed in the developing countries like India. These practices create problems related with health, environment, climate change, poverty, food and sustainable production and consumption. India is likely to face a waste disposal problem in future. If managed properly, the waste can be a source of livelihood. This emphasizes the strategic importance of waste management. Managing waste properly is essential for building sustainable and livable cities. But it remains a challenge for many developing countries.

Solid waste management in educational institutions is required in order to achieve the sustainable goals. These institutions have to face the challenge of waste management in order to protect the environment. Environmental assessment is one of the criteria for educational institutions for better ranking. Educational institutions are forced to look at their waste management system in order to achieve the sustainable development goals.

2. OBJECTIVES OF THE STUDY

The main objectives of this paper is to get broader understandings on various aspects of solid waste management practiced in different educational institutions of Patashpur - I, Purba Medinipur District, West Bengal. These are as follows:

1. To identify the solid waste management practices existing in educational institutions.
2. Whether the solid waste management system is sustainable environmentally, socially and financially.

3. SOURCE OF DATA AND METHODOLOGY USED

The research tries to present the findings on solid waste management system in education institutions of Patashpur - I, Purba Medinipur District of West Bengal. It tries to point out the aspects that can be added to improve institutional solid waste management and contribute to the improvement of solid waste management system in general. This study uses qualitative research method. Case study strategy is the most appropriate approach as it allows for the use of multiple methods such as questionnaire, interviews to all the stakeholders to explore the solid waste management system in schools.

The research involves collection of primary data through structured questionnaires from selected 25 school administrators. Our present study includes analysis of primary data collected from a sample of 25 randomly selected schools of Patashpur I CD Block. Selected 25 schools include 11 primary schools, 4 junior high schools (middle schools), 6 high schools and 4 higher secondary schools.

The secondary data obtained from various sources have been used for understanding the problems, rules and laws pertaining to waste management in educational institutions. The collected data has been divided into broad categories for better analysis according to the objectives of the study.

4. AREA OF THE STUDY

The study area of the present study is Patashpur - I Block of Purba Medinipur, West Bengal. Patashpur I is a community development block that forms an administrative division in Egra subdivision of Purba Medinipur district in the Indian state of West Bengal.

5. RESULTS OF THE STUDY

5.1 Waste Management Practices

The waste management hierarchy is a widespread element of national and regional policy and is often considered the most fundamental basis of modern SWM practice. The hierarchy ranks waste management operations according to their environmental or energy benefits. All countries follow the similar hierarchy as that shown in figure, with the first entries having higher priority than those below them. (UNEP, 2004)



Solid Waste Management Hierarchies (UNEP, 2004)

In low developed countries, different aspects of this hierarchy are already in place, since traditional practices revolving around waste prevention, reuse, and recycling are in use and prevalent. At the same time, it should be taken into consideration that all waste management practices have costs, as well as benefits. This means that the hierarchy cannot be followed blindly since, in many different situations, the cost of an activity may exceed the benefits, when all social and environmental considerations are taken into account. (UNEP, 2004).

SWM system refers to the entire chain, comprising: (1) waste segregation and storage (2) primary collection, (3) transport of waste, (4) treatment and recycling of waste, and (5) final disposal.

The study gives us a clearer understanding of the waste management system in educational institutions. 48% of all schools (primary, junior high, secondary, and higher secondary) have a waste management system with segregation of waste at the source. The figure indicates that nearly half (52%) of schools lack effective waste segregation practices. Only 36% of schools report using separate bins for degradable and non-degradable waste. The average number of bins used across schools is 3.8 bins. The highest number of bins (on average 7.25) is found in higher secondary schools (Table - 1), while the lowest (on average 2 bins) is found in junior high schools. The relatively low percentage of schools using proper bins for waste segregation (36%) reflects poor waste management practices. Only 4% of waste collection personnel across all schools are trained, with 25% of personnel in higher secondary (H.S.) schools receiving training (Table - 3). In primary and junior high schools, no personnel are reported to be trained. Only 20% of waste collection personnel use protective items such as masks, gloves, and boots. The rest of the personnel may be exposed to harmful waste, putting them at risk of various health issues.

Table-3 shows that only 12% of schools are using contracted services for waste collection. This is more common in H.S. schools (25%) compared to primary schools (9%) While contracted services may be more efficient, only a small percentage of schools are using them, particularly in the lower grade levels (primary and junior high schools). On average, schools spend approximately 16 minutes daily collecting and disposing of waste. This indicates that waste collection is seen as a relatively minor task in terms of time commitment.

Table - 1: Waste Management System

Sl. No.	Type of School	Schools with Waste Management System (%)	Segregation of Waste (%)	Average no. of Bin	Different Bin (%)	Amount of Waste (Kg. /Mon.)
1.	Primary	55.00	64.00	2.10	50.00	15.15
2.	Jr. High	00.00	00.00	2.00	00.00	08.00
3.	Secondary	67.00	50.00	6.17	50.00	46.67
4.	H. S.	50.00	25.00	7.25	25.00	63.75
5.	All Schools	48.00	48.00	3.8	36.00	28.74

Source: Primary data collected from field survey

The additional data further deepens our understanding of the waste management practices in schools, particularly in relation to the 4Rs strategy (Reduce, Reuse, Recycle, Refuse) and the methods for dealing with waste, including composting and landfill disposal. Only 20% of schools report reusing their waste, with higher secondary (H.S.) schools leading at 50% (Table - 2). This suggests that while some schools are finding ways to reuse waste materials, the practice is not widespread. 26% of the total waste is reported to be recycled. Although this is a positive figure, it indicates that a significant portion of waste is still not being recycled. There is a potential for improvement by encouraging schools to segregate waste better and provide additional resources to support the recycling process. There's no direct data on "refuse" (i.e., reducing the amount of waste coming into the school in the first place), but the data on recycling and reuse suggests that there is room for greater emphasis on reducing waste generation at the source, possibly through policies around single-use plastics, packaging, and other disposable items.

The percentage of schools actively composting waste is very low, at 8% on average. Primary & Junior High schools have 0% reported composting activity (Table - 2), which indicates a need for intervention in these education levels. 25% of H.S. schools report regularly composting organic waste. This is a step in the right direction, as composting not only helps reduce waste but also provides an opportunity to teach students about sustainability and the benefits of organic waste recycling.

A significant 40% of schools report disposing of both degradable and non-degradable waste in open landfills located on the school premises. The average size of these landfills is 9.73 square feet (Table - 2), which indicates a small-scale waste disposal system. Given the small size of the landfill, schools may be accumulating waste faster than they can dispose of it, leading to further environmental impacts. This is a concerning practice as it leads to long-term environmental damage, particularly when waste is not segregated and biodegradable materials are mixed with non-degradable waste. Many schools also report burning of waste in open areas, which poses serious health risks and environmental harm, as burning waste releases harmful toxins into the air.

Only 40% of schools are satisfied with the current waste management practices, which reflect widespread dissatisfaction with the existing system. This dissatisfaction is more pronounced in junior high schools (only 25% satisfied) compared to higher secondary schools (with 75% satisfaction) (Table - 4). This suggests that the waste management practices might not be meeting the needs or expectations of all schools, particularly in lower-grade institutions. 56% of schools are not willing to pay other stakeholders for solid waste management, reflecting a concern about the financial burden. However, all higher secondary (H.S.) schools (100%) are willing to pay for external waste management services.

There's a clear opportunity for local government bodies to increase their engagement with schools on waste management. Only a small proportion (28%) of schools have been invited to discuss waste management systems (Table - 4), and expanding this outreach could lead to more coordinated efforts and better-informed decision-making at the school level.

5.2 Sustainability

5.2.1 Environmental Sustainability:

Sustainable waste management aims to minimize the amount of solid waste that is disposed of in landfill. Waste has major social, financial, and environmental impacts. Waste management is necessary for reducing environmental impacts, conserving natural resources, and promoting eco-friendly practices. A proper waste management practice reduces pollution of air, water, and soil, protecting ecosystems. By implementing waste management practices, reducing waste generation, and promoting recycling, we can create a more sustainable future. Poor solid waste management practices in educational institutions can lead to significant negative environmental consequences. In terms of environmental impact, poor waste management in schools contributes to pollution of air, soil, and water. When solid waste is improperly disposed in landfills, it can create unsanitary conditions that attract pests. This waste can include organic materials that decompose and produce bad effects. The presence of improperly managed waste can contaminate soil and groundwater posing risks to environmental quality.

Burning of waste, a common practice in some areas with inadequate disposal facilities, releases harmful pollutants such as particulate matter, carbon monoxide, and dioxins into the air, leading to air pollution. The leaching of chemicals from disposed waste into soil can affect local ecosystems and biodiversity, disrupting natural habitats. Plastic waste, which if not recycled or disposed of improperly, creates a threat to environments.

Table No. 2: Waste Recycling and Solid Waste Management

Sl. No.	Type of School	Waste Recycling			Solid Waste management		
		Schools reusing waste (%)	Waste Recycling (Kg./month)	Schools composting organic waste (%)	solid waste is disposed (kg/day)	Schools with landfill within the campus (%)	Area of Landfill (sq. ft.)
1.	Primary	20.00	00.00	00.00	1.34	36.00	12.60
2.	Jr. High	00.00	00.00	00.00	5.50	00.00	00.00
3.	Secondary	17.00	83.33	17.00	3.53	50.00	05.21
4.	H. S.	50.00	37.50	25.00	4.30	75.00	21.50
5.	All Schools	20.00	26.00	08.00	2.95	40.00	9.73

Source: Primary data collected from field survey

In our study, it has been reflected (Table - 2) that only 20% of schools report reusing their waste, with higher secondary (H.S.) schools leading at 50%. About 26% of the total waste is reported to be recycled. Although this is a positive figure, it indicates that a significant portion of waste is still not being recycled. There is a potential for improvement by encouraging schools to segregate waste better and provide additional resources to support the recycling process. Primary & Junior High Schools have 0% reported composting activity, which indicates a need for intervention in these education levels. Engaging students in hands-on activities such as composting organic waste for use in school gardens not only reduces waste but also teaches valuable lessons about resource conservation and soil health.

A significant 40% schools report disposing of both degradable and non-degradable waste in open landfills located on the school premises. This is a concerning practice as it leads to long-term environmental damage, particularly when waste is not segregated and biodegradable materials are mixed with non-degradable waste. The average size of these landfills is 9.73 square feet, which indicates a small-scale waste disposal system but still highlights the issue of inefficient waste management. Given the small size of the landfill, schools may be accumulating waste faster than they can dispose it, leading to further environmental impacts. Many schools also report burning waste in open areas, which poses serious health risks and environmental harm, as burning waste releases harmful toxins into the air.

A high 92% of schools agree on the need to ban plastic, showing strong awareness of the environmental impact of plastic waste. The percentage of schools actively composting waste is very low, at 8% on average. This is concerning given the significant environmental and educational benefits of composting organic matter. Organic waste, when properly composted, can contribute to soil fertility and

reduce the amount of waste sent to landfills. If more schools adopted composting practices, they could not only reduce waste but also create valuable resources that could benefit school gardens.

While there is awareness of the importance of solid waste management in schools, the practices related to reuse, recycle, compost, and refuse are still underdeveloped. Schools, particularly those at the primary and junior high levels, need greater support to improve waste management practices. A more coordinated effort between schools, local governments, and communities could lead to a significant reduction in waste generation, better waste disposal practices, and educational opportunities for students about sustainability and environmental responsibility.

5.2.2 Social Sustainability:

Educational programs focused on waste reduction and recycling can empower students to adopt sustainable behaviour both within and beyond the school environment. Socially sustainable waste management in schools involves managing waste in a way that is not only environmentally friendly but also socially acceptable. Promotion of social norms that value waste reduction, reuse, and recycling is important for social sustainability. Community composting programs that involve students, teachers, and community members are necessary for proper management of waste. Implementation of recycling programs is critical that involve students and staff in collecting and processing recyclables.

Proper waste-to-resource initiatives, such as converting food waste into animal feed or compost is crucial for sustainability. Partnership development initiatives with local community groups and organizations to support waste management are necessary. Only 12% of schools report using contracted services for waste collection. This is more common in H.S. schools (25%) compared to primary schools (9%). Local bodies or governments should support schools in establishing contracts with waste management companies, especially for those schools that lack the capacity or resources to manage waste internally. These services could be offered at a subsidized rate or with support for smaller schools. Only 4% of waste collection personnel across all schools are trained, with 25% of personnel in higher secondary (H.S.) schools receiving training (Table - 3).

In primary and junior high schools, no personnel are reported to be trained. This low training rate is concerning because properly trained personnel are crucial for effective waste management, particularly in ensuring safety and efficiency in waste collection and disposal. Only 20% of waste collection personnel use protective items such as masks, gloves, and boots. The rest of the personnel may be exposed to harmful waste, putting them at risk of various health issues. The lack of protective equipment exposes waste collection staff to potential health risks, especially when dealing with hazardous or contaminated waste.

Table - 3: About Waste Collection

Sl. No.	Type of School	Waste Collecting Personnel			Waste Collection	
		Trained (%)	Personnel with protection (%)	Schools with contacted services (%)	Time spent (minute per day)	Resources spent (Rs./month)
1.	Primary	00.00	27.00	09.00	22.00	320.00
2.	Jr. High	00.00	00.00	00.00	8.75	00.00
3.	Secondary	00.00	17.00	17.00	12.50	00.00
4.	H. S.	25.00	25.00	25.00	18.75	450.00
5.	All Schools	04.00	20.00	12.00	16.20	200.00

Source: Primary data collected from field survey

Furthermore, partnerships with local governments, NGOs, and community organizations can provide support and resources for implementing effective waste management strategies, including waste collection drives and community clean-up efforts. Only a small proportion (28%) of schools have been invited to discuss waste management systems by local authorities., and expanding this outreach could lead to more coordinated efforts and better-informed decision-making at the school level. About 44% of schools organized their own waste management programs, which is promising.

However, there is a significant opportunity for local government bodies to expand their involvement in these efforts, ensuring that all schools are equipped with proper knowledge and resources for waste management. A high 92% of schools agree on the need to ban plastic, showing strong awareness of the environmental impact of plastic waste. Despite the overwhelming support for banning plastic, the actual implementation of such a ban may require additional efforts, such as awareness campaigns, provision of alternatives, and enforcement strategies. Only 40% of schools are satisfied with the current waste management practices, which reflect widespread dissatisfaction with the existing system. This suggests that the waste management practices might not be meeting the needs or expectations of all schools and community.

Sustainable waste management practices in particular educational institution can serve as models for other schools and communities. Programs like the Green Schools Initiative in various countries have demonstrated the positive impact of environmental education on practical waste management solutions. Schools play a significant role in shaping the attitudes and behaviours of future generations towards waste management.

5.2.3 Financial Sustainability:

Financial resources in schools are crucial to ensure the long-term viability of waste management practices. Concerning the financial aspects of waste management, schools must give importance to cost recovery and cost reduction. Costs saving strategies include reduction of waste generation, increase recycling rates and use cost effective waste management technologies. Educational institutions are encouraged to sell recyclables, create composting programs, and partner with local organisations to generate revenue through waste management services. About 56% of schools are not willing to pay other stakeholders (Table - 4) for solid waste management, reflecting a concern about the financial burden.

However, all higher secondary (schools (100%) are willing to pay for external waste management services. The average financial spending on waste management is 200 rupees per month across all schools, with higher secondary schools spending the most (450 rupees) and junior high schools and secondary schools reporting zero spending.

Table - 4: Contracted Services and Satisfaction Level

Sl. No.	Type of School	Invited to discuss waste management by local bodies (%)	Schools agreed to need for ban plastic etc. (%)	Schools satisfied with the current practices (%)	Schools that Organized programmes to educate students (%)	Schools ready to pay to other stakeholders for solid waste management (%)
1.	Primary	27.00	82.00	45.00	36.00	45.00
2.	Jr. High	00.00	100.00	25.00	50.00	00.00
3.	Secondary	33.00	100.00	33.00	33.00	33.00
4.	H. S.	50.00	100.0	75.00	75.00	100.00
5.	All Schools	28.00	92.00	40.00	44.00	44.00

Source: Primary data collected from field survey

The low financial allocation for waste management suggests that schools may not view waste management as a priority, or they may lack the necessary funds to invest in better waste management infrastructure and practices. Only 20% of schools report reusing their waste, with higher secondary (H.S.) schools leading at 50%. Only 26% of the total waste is reported to be recycled. Although this is a positive figure, it indicates that a significant portion of waste is still not being recycled. There is a potential for improvement by encouraging schools to segregate waste better and provide additional resources to support the recycling process.

The percentage of schools actively composting waste is very low, at 8% on average. About 25% of H.S. schools reported regularly composting organic waste. This is a step in the right direction, as composting not only helps reduce waste but also provides an opportunity to teach students about sustainability and the benefits of organic waste recycling. No Primary & Junior High schools within our study area have reported composting activity, which indicates a need for intervention in these education levels. Schools at these stages could benefit from simple composting setups, training on how to compost organic waste, and educational materials that highlight the value of composting. If more schools adopted composting practices, they could not only reduce waste but also create valuable resources that could benefit the school financially.

A composting program can serve as a hands-on educational tool for students while reducing the amount of organic waste sent to landfills. Support from local government bodies in the form of educational campaigns, materials, and perhaps even funding for waste management infrastructure could play a crucial role in enhancing practices. Schools, especially those with limited budgets, should be provided with financial support or grants for waste management. This could include assistance for purchasing bins, composting materials, and other waste management tools.

6. LIMITATIONS OF THE STUDY

The study conducted with baseline data collected from 25 schools of four different categories within Patashpur - I CD Blocks of Purba Medinipur District. A sample of only 25 schools was not adequate to represent the total population of the schools of Patashpur Block. There is scope of further study with large sample that may reflect better results. Nevertheless an attempt has been made hereby to have a baseline data for future studies.

7. CONCLUSIONS

In India, SWM is governed by the Solid Waste Management Rules, 2016. The new rules have mandated source segregation of waste into bio-degradable, dry and domestic hazardous waste. These rules also empower local bodies to impose a spot fine for non-compliance. An efficient waste management is an essential requirement for the quality of educational services. The SWM system in schools of Patashpur I, in Purba Medinipur District of West Bengal is unsystematic and inefficient with lack of awareness, inefficient infrastructure, lack of funding and support from the government bodies. Addressing these issues through targeted programs, policy changes, and resource allocation could significantly improve waste management practices in schools.

Governments or local authorities could fund and organize training programs for schools, especially targeting junior high and primary schools. Schools shall plan a system of waste segregation, collection, disposal, transport, recycling, etc. which are essential for social, financial and environmental sustainability by inculcating the value of waste as a resource in the students. Encourage schools, especially at the primary and junior high levels, to utilize contracted waste collection services. This can help improve the efficiency of waste disposal and ensure better management.

Local authorities can facilitate the establishment of affordable, contracted waste collection services for schools or offer subsidies to lower-income schools. Schools could start the composting bio degradable waste within the campus, thus providing education to the students. Increase the time and attention devoted to waste management by integrating waste collection tasks into regular school activities and promoting student involvement in waste management practices (e.g., waste management clubs or eco-initiatives).

Schools should be encouraged to review and allocate more funds to waste management, possibly through adjustments in school budgets or receiving external financial support from the government bodies. There are several areas for improvement in the waste management systems across schools. This study helps to coordinate the effort between schools, local governments, and communities to significantly reduce waste generation, better waste disposal practices, and educational opportunities for students about sustainability and environmental responsibility.

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