

# SOLID WASTE MANAGEMENT PRACTICES IN PRIVATE EDUCATIONAL INSTITUTIONS OF MYSORE, INDIA

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**Abstract:** Systematic field investigations were conducted using pre-tested questionnaire and standard methods to record the waste management activities followed in private schools and colleges in Mysore during 2022. Around 78.6% schools are practicing the waste isolation and 33.3% schools have classified the waste into biodegradable and non-biodegradable. Only, 28.6% schools have solid waste disposing facilities. Few schools (7.1%) have adopted measures to convert solid waste into manure. Moreover, 87.7% schools conduct awareness program of which 14.3% schools follow as per rules, regulations and acts prescribed by the pollution control board. Further, 64.3% schools have established green clubs to look after waste management activities using sign boards displayed (100%) in the premises of schools. Surprisingly, most of the schools (100%) didn't have liquid waste management and treatment plants. However, 44.4% colleges isolating waste into solid and liquid waste and 14.3% colleges have classified waste into biodegradable and non-biodegradable. Around 22.2% colleges have solid waste disposing facilities. Interestingly, 55.6% colleges have adopted measures to convert solid waste into manure obtaining approval and authorization from state pollution control board (SPCB). Further, 44.4% colleges are conducting awareness creating programs as per the rules, regulations and acts by establishing green clubs (22.2%) to look after waste management activities using sign boards displayed (100%) in the premises of colleges. Interestingly, 55.6% colleges implemented paper less policy. Further, 66.6 and 11.1% colleges followed liquid waste management and treatment installations respectively. Analysis of variance between the production of seven types of biodegradable waste indicated significant statistical difference ( $F=13.900$ ;  $P>0.05$ ) between school and colleges. However, analysis of variance between the production of seven types of non-biodegradable indicated no statistical significance ( $F=1.908$ ;  $P<0.05$ ) between school and colleges. Hence, solid waste isolation into dry and wet, classified them into biodegradable and non-biodegradable waste in schools and colleges was dissimilar. The facilities used to store and dispose the solid waste as per SPCB norms it was uneven between the schools and colleges. Moreover, analysis of variance of solid waste management activities varied considerably ( $F=3.519$ ;  $P>0.05$ ) between schools and colleges in Mysore. Further, awareness program conducted, pollution control measures and paper less policies implemented through green clubs in school and colleges was uneven. Hence, it was suggested to improve solid waste control practices in school and colleges to maintain cleanliness, hygienic, pollution free sanitary conditions to students throughout the year. Further, periodic analysis of solid waste management practices amidst educational institutes help upkeep pollution free environment.

**Keywords:** Solid waste management, private educational institutes, Mysore

## I. INTRODUCTION

In educational institutes, solid waste is produced by various man-made activities in urban areas. Timely collection and classification of solid waste into dry and wet waste requires scientific multi pronged approaches for safe disposal and management. It is a continuous process (Macwan *et al.*, 2003), attend regularly every day for safe disposal (Singhal and Pandey, 2000; Sharholi *et al.*, 2008; Gedefaw, 2015) is one of the most challenging task to educational institutions in urban areas (Joshi and Ahmed, 2016). Despite, several engineered skills and techniques used to tackle this burning issue; it becomes a Herculean task to administrators of many schools and colleges due to various reasons. Accordingly it is considered as one of the burning issues in many countries around the world. In India, it has been reported by Joshi and Ahmed (2016), Chavan and Patil (2017), Kshema and Basavarajappa (2018). Published reports on solid waste management practices followed in India and other parts of the world are depicted in Table 1. Most of the published reports indicated the solid waste analysis, transportation, recycling and management strategies followed at towns, semi-urban and urban centers. Very few published reports are available on solid waste disposal at educational institutes (Table I). Very few published reports are available on solid waste management in educational institutes. Anonymous (2018),

Nandhini and Basavarajappa (2018), Jayashree and Basavarajappa (2020) have reported the solid waste source, disposal and management at educational institutes at different parts of the world. In Karnataka, few published reports are available on solid waste management in few colleges and at University Campus in Mysore city (Nandini and Basavarajappa, 2019; Jayashree and Basavarajappa, 2020). Moreover, management of e-waste, plastic waste (Anonymous, 2018), bio-medical waste (Sashikala and Basavarajappa, 2018) are very much necessitated amidst every educational institutes. However, specific reports on solid waste management at private educational institutes are sparse. Moreover, Mysore is known for rich and vibrant history, culture and heritage, attracting thousands of tourists floating population who are visiting Mysore every day from different parts of India and other parts of the world. Proudly to say those more than three times, Mysore is identified as 'clean city of India' by government of India, New Delhi. However, still Mysore is facing difficulty to maintain the clean city status due to various reasons. There is a lacuna in waste management, not achieved up to the mark at many schools and colleges in Mysore. Due to several unknown reasons, many educational institutes are struggling hard to maintain cleanliness, hygiene and pollution free habitat midst educational institutes. Reasons might be multifarious; however, school and college going youths must be made aware about the consequences of unhygienic and poor sanitary conditions accompanied with improper solid waste management practices. This task necessitates the critical studies and data collection on solid waste management practices at school and colleges. Hence, the present investigation was conducted.

## II. MATERIALS AND METHODS

**Study area:** Mysore is located at the vicinity of Chamundi hills between 11°40' to 12°40' N. latitude and 75°57' to 77°15' E. longitude with an elevation 770 meters msl (Kamath, 2001). The city experiences tropical climate, where summer is languorously warm and winter is bracingly cool. Mysore city is housed with more than one million local populations (Anonymous, 2018) and becomes third most populous city in Karnataka. Although, literacy rate in Mysore is 82.8% and becomes one of the educational hubs in India by attracting students from different parts of India and abroad to provide world class quality education to the learning aspirants. Maintaining pollution free environment midst educational institutes is preliminary requirement.

**Methodology:** To record the solid waste produced from different educational institutes, total 23 educational institutes viz., schools and colleges were selected randomly from different places in Mysore. Each and every school and college was visited personally during January to April, 2022 to collect the data as per Jayashree and Basavarajappa (2020), Nandhini and Basavarajappa (2018). The solid waste available at primary and secondary sources related to their origin, production, collection, storage, isolation, transportation and disposal of waste was collected using pre-tested questionnaire from various schools and colleges management personnel by interviewing them. Solid waste segregation and disposal was collected as per Harsha (2012). Medical waste includes bio-medical and non-bio-medical waste was recorded as per Shashikala and Basavarajappa (2018). Domestic waste was recorded as per Megha and Basavarajappa (2018), Kshema and Basavarajappa (2018).

**Statistical analysis:** Collected data was compiled systematically and analyzed by using standard methods. Per cent occurrence, analysis of variance was made using the methods as described by Saha (2009).

## III. RESULTS

The waste management activities followed in schools and colleges in Mysore is depicted in Table II. Solid waste isolated into dry and wet waste. It was further classified into biodegradable and non-biodegradable waste that was uneven in schools and colleges. Further, facilities used to store, dispose of solid waste after categorization was also not uniformly practiced between the schools and colleges. Moreover, using bins and recycling measures followed as per the state pollution control board (SPCB) norms and authorization obtained by SPCB and Statutory Boards (SB's) to disburse the solid waste was also not even among the schools and colleges (Table II). Further, awareness program conducted to manage solid waste as per pollution control acts using sign boards and paper less policies implemented through green clubs in school and colleges was uneven (Table II). Furthermore, analysis of variance of activities followed to attend the solid waste disposal varied considerably ( $F=3.519$ ;  $P>0.05$ ) between schools and colleges in Mysore (Table II).

The waste management activities not followed in schools and colleges in Mysore is depicted in Table III. Solid waste was not isolated into dry and wet waste, not classified into biodegradable and non-biodegradable waste in schools and colleges was dissimilar. Further, not having required basic facilities to store, dispose of solid waste without any categorization was uneven between the schools and colleges. Furthermore, analysis of variance of activities not followed to attend the solid waste disposal varied considerably ( $F=9.025$ ;  $P>0.05$ ) between few schools and colleges in Mysore (Table III).

**Solid waste management activities adopted by schools:** Per cent occurrence of various management activities are followed in schools and colleges are shown in Table IV. Around 78.6% schools are practicing the isolation of waste into dry and wet waste. The isolated waste was further classified into biodegradable and non-biodegradable waste by 33.3% schools. Only, 28.6% schools have solid waste disposing facilities using bins (Table IV). Interestingly, few schools (7.1%) have adopted measures to convert solid waste into manure (Table IV). Moreover, 87.7% schools followed awareness

program of which 14.3% schools use rules, regulations and acts. Further, 64.3% schools have established green clubs to look after waste management activities using sign boards displayed (100%) in the premises of schools (Table IV).

**Solid waste management activities not adopted by schools:** Surprisingly, 21.4% schools didn't practice isolation of waste and 66.7% schools not classified solid waste into biodegradable and non-biodegradable waste. Moreover, 71.4% schools not having basic facilities to dispose the solid waste and 64.3% schools didn't have bins to collect solid waste. Interestingly, 85.7% schools not follow any measures to convert solid waste into usable manure. However, most of the schools (100%) didn't undertake any measures to recycle the plastic waste by most of the schools (Table IV). Unfortunately, 92.9% schools didn't aware about taking approval and authorization taken from the SPBC or SB's. Around 14.3% schools not practicing any awareness creating programs on solid waste management. Moreover, 85.7% schools didn't know follow any rules, regulations or acts to create awareness among the students. Further, 35.7% schools are not having green clubs to conduct awareness program about solid waste management. Surprisingly, most of the schools (100%) haven't implemented paper less policy (Table IV).

**No response from the schools:** Most of the schools (100%) didn't respond to different activities such as the categorization of waste while storage, liquid waste management and liquid waste treatment plant installed in the premises of schools. Moreover, using bins to collect, measures to convert solid waste into manure and approval or authorization taken from SPCB or SB's from few schools (7.1% each) (Table IV).

**Solid waste management activities adopted by colleges:** Per cent occurrences of various management activities are followed in colleges are shown in Table IV. In 44.4% colleges, classified waste into solid and liquid waste. Moreover, 44.4% colleges have isolated solid waste into dry and wet waste. Further, solid waste was further classified into biodegradable and non-biodegradable waste by only 14.3% colleges. Around 22.2% colleges have solid waste disposing facilities (44.4%) using bins (Table IV). Interestingly, few colleges (55.6%) have adopted measures to convert solid waste into manure by obtaining approval and authorization from SPCB and SB's. Further, 44.4% colleges are conducting awareness creating programs using rules, regulations and acts (44.4%) by establishing green clubs (22.2%) to look after waste management activities using sign boards displayed (100%) in the premises of colleges (Table IV). Interestingly, 55.6% colleges implemented paper less policy. Further, 66.6 and 11.1% colleges followed liquid waste management and treatment installations respectively (Table IV).

**Solid waste management activities not adopted by colleges:** Surprisingly, 55.6% colleges didn't classify waste into solid and liquid waste and it was followed by 55.6% colleges didn't practice isolation of waste into dry and wet solid waste. However, 71.4% colleges have classified solid waste into biodegradable and non-biodegradable waste. Unfortunately, most of the colleges (100%) didn't categorize the waste while storage. But, 66.7% colleges not having basic facilities to dispose the solid waste and 55.6% colleges didn't use bins to collect solid waste. Only, 33.3% colleges not follow any measures to convert solid waste into usable manure. However, most of the colleges (100%) didn't undertake any measures to recycle the plastic waste (Table IV). Unfortunately, 44.5% colleges didn't aware about taking approval and authorization from the SPBC or SB's. Around 55.6% colleges not practicing any awareness creating programs on solid waste management. Moreover, 55.6% colleges didn't know follow any rules, regulations or acts to create awareness among the students. Further, 77.8% colleges aren't having green clubs to conduct awareness program about solid waste management. Further, 44.4% colleges haven't implemented paper less policy. About 11.1% colleges adopted liquid waste management and 66.7% colleges have liquid waste treatment installation (Table IV).

**No response from the colleges:** Few colleges didn't respond to six activities such as the classification of waste into biodegradable and non-biodegradable, facilities used to dispose solid waste, measures to convert solid waste into manure, approval from SPCB or SB's, liquid waste management and liquid waste treatment plant respectively 14.3, 11.1 each and 22.2% each in the premises of colleges (Table IV).

**Biodegradable waste:** Analysis of variance between the production of biodegradable waste between schools and colleges is depicted in Table V. Seven solid wastes namely: paper, plant dry leaves, waste or unused food, plant twigs, used chalk boxes, fruit waste and used pencil scraps in schools, eight solid wastes such as paper, plant dry leaves, used paper wrapper, unused food waste, cotton, hospital waste, cotton bags and other miscellaneous wastes produced in colleges indicated statistical significance ( $F=13.900$ ;  $P>0.05$ ) between school and colleges (Table V).

**Non-biodegradable waste:** Analysis of variance between the production of non-biodegradable waste between schools and colleges is depicted in Table VI. Seven to eight solid wastes namely: plastic bottles, covers, pen/pencils, e-waste, medical waste, glass and metal waste indicated no statistical significance ( $F=1.908$ ;  $P<0.05$ ) between their occurrence in school and colleges (Table VI).

**Per cent occurrence of biodegradable waste:** Among the biodegradable solid wastes, highest (16.8 to 16.9) per cent of paper, dead plants and chalk box waste was recorded in schools. It was followed by 15.6 to 15.7% unused food, fruits and pencil scrapes waste was recorded in schools. Only, 2.4% plant dry leaves were considered biodegradable waste recorded in schools (Table VII). However, in colleges, highest (23.7%) paper waste was recorded and it was followed by plant dry waste and unused food waste (18.4% each), 15.8% used paper wrapper and cotton waste (10.5%) were recorded in colleges. Only 2.6% each hospital waste and unused cotton bags were recorded in colleges (Table VII).

**Per cent occurrence of non-biodegradable waste:** Among the non-biodegradable solid wastes, highest (19.7% each) per cent of plastic bottles, e-waste, medical waste and glass waste recorded in schools. It was followed by 18.2% metal waste and 1.5% each plastic covers and used/unused plastic pens and pencils were recorded in schools (Table VIII). However, in colleges, highest (18.4% each) plastic bottles, plastic pens and pencils waste was recorded and it was followed by waste plastic covers, e-waste, medical waste (16.3% each) and 10.2% metal waste recorded in colleges. However, only 2% each glass waste and used syringes as non-biodegradable waste recorded in colleges (Table VIII).

**Solid waste management:** Table IX shows the quantity of solid waste produced at schools and colleges in Mysore. More (49.9%) schools produced less than 10 kg solid waste per day and it was followed by 43% schools produced less than 50 kg solid waste per day. Only 7.1% schools produced highest (50 kg) solid waste per day. However, 11.1% colleges have produced more than 50 kg solid waste and it was followed by 22.2, 33.4 and 33.3% respectively produced 50, less than 50 and less than 10 kg solid waste in colleges (Table IX). Further, schools are depending mainly on municipality and corporation (50% each) for solid waste disposal, while colleges, depending on municipality, corporation respectively 20 and 70%. However, 10% colleges dispose solid waste outside without discharging either to municipality or corporation. Interestingly, in 71.4% of schools, solid waste is disposed every day and about 28.6% schools dispose solid waste once in a week (Table IX). However, solid waste is disposed every day by 77.8% of colleges and it was followed by once in a week and month by few colleges (11.1% each) (Table IX). Furthermore, 92.9% of schools didn't respond about the management of e-waste. However, only 7.1% schools pile up the e-waste and dispose once in a year (Table IX). Interestingly, 55.6% of colleges have separate cellar to dump e-waste and 22.2% of colleges pile up e-waste and dispose once in a year. However, 22.2% of colleges didn't respond about the management of e-waste (Table IX).

**Facilities available for solid waste management:** Facilities available with schools and colleges to manage solid waste in Mysore are shown in Table X. Surprisingly, 71.4% of the schools didn't have basic facilities to manage solid waste. Only 28.6% schools have only composting unit, where some amount of solid waste is managed before being disposed outside (Table X). However, composting units, sanitary land fills and organic waste converters facility is established respectively 44.4% and 11.1% each colleges (Table X). Around 33.4% colleges didn't have basic facilities to manage solid waste before being disposed outside (Table X).

#### IV. DISCUSSION

Solid waste disposal and management is a continuous process (Macwan *et al.*, 2003), require more attention for its regularly disposal (Singhal and Pandey, 2000; Huang *et al.*, 2006; Sharholy *et al.*, 2008; Gedefaw, 2015). Various types of solid wastes are produced from school and colleges and those wastes disposal require private or government agencies including local city municipality authorities (Megha and Basavarajappa, 2018; Shashikala and Basavarajappa, 2018; Kshema and Basavarajappa, 2018; Nandhini and Basavarajappa, 2018; Mamatha and Basavarajappa, 2019). Waste collection, isolation and segregation were not alike among schools and colleges. Majority of the schools and colleges didn't collect waste during morning hours; instead they did during evening hours. Moreover, solid waste is not properly segregated as dry and wet waste before disposal at many schools and colleges. Educational institutes like schools and colleges should adopt new methods of collection during morning hours i.e., before office begins, so that neatness and cleanliness could be achieved and clean environment could be maintained during working hours midst school and college premises. The solid waste have different characteristics (Sharholy *et al.*, 2007), should be classified first into dry and wet waste and accordingly few schools and colleges kept separately before its disposal. Unfortunately, the storage and disposal of different wastes produced in schools and colleges was not alike. Highest per cent of the schools and colleges need to use colour coded dust bins for proper waste storage. Certain non-biodegradable wastes especially metal, rubber, glass, plastic and electronic items need specific disposal sites and offer more scope for recycling (Brigden *et al.*, 2008; Sivaramanan, 2013). Recycling should be undertaken on scientific basis for non-biodegradable wastes. Similar type of suggestions were made and efforts were made in The Netherlands, Canada and in Kenya to recycle the available non-biodegradable waste (Dijkgraaf and Gradus, 2004; Ferrara and Missios, 2005; Wilfred and Moindi, 2008). Further, available bio-degradable waste can be used for composting (Harir *et al.*, 2015). In this regard, concerned authorities in schools and colleges should take initiation to make use the available bio-degradable solid waste for composting. Schools and colleges act as 'temples of learning', where more efforts should be made to educate and train the students during their leisure time on solid waste management (Jayashree and Basavarajappa, 2020). In this regard, more and more educative lectures and interactions should be arranged by inviting environmentalists, biologists, chemists, waste analysts, policy makers and environmental engineers to create more awareness among the youths at school and colleges. This type of activities helps develop better strategies for waste disposal in an eco-friendly way (Idris *et al.*, 2004; Rathi, 2006; Misra and Pandey, 2005; Dhane *et al.*, 2005; Pires *et al.*, 2011). It is need of the day for clean cities like Mysore. So, that schools and colleges can contribute much to the cities where hygiene and sanitation and pollution free environment is required to achieve clean and smart city status. Our observations are on par with the observations of Macwan *et al.* (2003), Dijkgraaf and Gradus (2004), Idris *et al.* (2004), Ferrara and Missios (2005), Misra and Pandey (2005), Dhane *et al.* (2005), Rathi (2006), Wilfred and Moindi (2008), Pires *et al.* (2011), Anonymous (2018), Moqbel (2018), Nandhini and Basavarajappa



(2018), Megha and Basavarajappa (2018), Shashikala and Basavarajappa (2018), Kshema and Basavarajappa (2018), Jayashree and Basavarajappa (2020).

## V. SUMMARY

The solid waste production was ranged in between 0.1 to 50 kilograms in different schools and colleges. The time of waste collection, storage and disposal of different wastes produced in schools and colleges was not alike. Total 52.8% of the schools and colleges didn't collect waste during morning hours. Majority of the schools and colleges require colour coded dust bins for proper storing of the waste. Around 50% of the schools and colleges were not properly segregated the waste before disposal. Total 13.33 grams non-biodegradable waste, 2.53 grams bio-degradable waste and 6.48 grams other type of waste produced every day at few schools and colleges. The paper, dry leaves and unused food wastes becomes important sources for bio-degradable waste can be used to produce organic manure. The plastic, metal electronic items are non-biodegradable waste can be recycled for reuse. Hence, there is a scope to make use bio and non-biodegradable wastes for economic advantages.

## VI. RECOMMENDATIONS

Priority should be given to isolate biodegradable and non-biodegradable waste at the place of its occurrence in every school and colleges. To store collected waste, proper colour coded dustbins placard with the bio-hazard mark should be used. More lectures should be organized to create awareness among youths. In this regard, school and colleges must take up this issue seriously on top priority basis every day. The municipalities and other agencies involved in solid waste disposal must collect solid waste every day from schools and colleges for disposal regularly.

### Mitigation measures

- Conduct lectures on solid waste management regularly at least once in a month.
- Conduct plantation in the premises of the school and colleges.
- Create awareness among the students on importance of cleanliness, sanitation and hygiene in the premises of the school and colleges.
- Use youth services during their free time for cleaning activities.

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## REFERENCES

- [1]. M. Agarwal, K. Jareda and M.A. Bajpai. A review on solid waste management for smart city. SSRG International Journal of Civil Engineering. 2016. Vol. 3. No. 5. p. 109-112.
- [2]. S. A. Ahmed and M. Ali. Partnerships for solid waste management in developing countries: Linking theories to realities. Habitat International. 2004. Vol. 28. p. 467-479.
- [3]. N. Ahsan. Solid waste management plan for Indian mega cities. Indian Journal of Environmental Protection. 1999. Vol. 19. p. 90-95.
- [4]. Anonymous. Ban of plastic waste at educational institutes. PTL, New Delhi. Prajavani. May, 20<sup>th</sup> 2018. p. 2.
- [5]. K. Brigden, I. Labunska, D. Santillo and P. Johnston. Chemical contamination at e-waste recycling and disposal sites in Accra and Korforidua, Ghana. Greenpeace Toxic Technology. 2008. Vol. 10. p. 2008.
- [6]. O. Buenrostro and G. Bocco. Solid waste management in municipalities in Mexico: Goals and perspectives. Resources, Conservation and Recycling. 2003. Vol.39. p. 251-263.
- [7]. I.D. Chavan and D.S. Patil. Zero waste management system: case study-Kumbarakoppal, Mysore. International Journal of Engineering Research and Technology. 2017. Vol. 6. No. 5. p. 768-770.
- [8]. A. D. Dhane, I.T. Sopan, A.B. Sanjay and W.D. Nilesh. Eco-friendly approach of urban solid waste management – A case study of Jalgaon city, Maharashtra. Journal of Environmental Biology. 2005. Vol. 26. No. 40. p. 747-752.
- [9]. E. Dijkgraaf and R.H.J.M. Gradus. Cost savings in unit-based pricing of household waste: The case of The Netherlands. Resource and Energy Economics. 2004. Vol. 26. p. 353-371.

- [10]. I. Ferrara and P. Missios. Recycling and waste diversion effectiveness: Evidence from Canada. *Environmental and Resource Economics*. 2005. Vol. 30. p. 221-238.
- [11]. M. Gedefaw. Assessing the current status of solid waste management of Gondar town, Ethiopia. *International Journal of Scientific and Technology Research*. 2015. Vol. 4. No. 9. p.28-36.
- [12]. C.K.N. Gupta and G.L. Shekar. Electronic waste management system in Bangalore – A review. *Research India Publications*. 2009. Vol. 1. p. 11-24.
- [13]. M. Harsha. Solid waste in Mysore city – A futuristic scenario. *Journal of Pharmacology and Scientific Innovation*. 2012. Vol. 1. No. 1. p. 79-83.
- [14]. A. I. Harir, R. Kasim and B. Ishiyaku. Exploring resource recovery potentials of municipal solid waste: A review of solid wastes composting in Developing countries. *International Journal of Scientific and Research Publications*. 2015. Vol. 5. No. 4. p. 1-8.
- [15]. Q. Huang, Q. Wang, L. Dong, B. Xi and B. Zhou. The current situation of solid waste management in China. *Journal of Matter Cycles Waste Management*. 2006. Vol. 8. No. 1. p. 63-69.
- [16]. A. Idris, B. Inane and M.N. Hassan. Overview of waste disposal and landfills/dumps in Asian countries. *Material Cycles and Waste Management*. 2004. Vol. 16. p. 104-110.
- [17]. B.S. Jayashree and S. Basavarajappa. Recording solid waste and management practices in Manasagangotri Campus, Mysore, India. *International Advanced Research Journal in Science, Engineering and technology*. Vol. 7. No. 8. p. 45-53.
- [18]. M.K. Jha, O.Ak. Sondhi and M. Pansare. Solid waste management – a case study. *Journal of Scientific and Research Publications*. 2003. Vol. 23. No. 11. p. 1153-1160.
- [19]. S.D. Joardar. Urban residential solid waste management in Indi: Issues related to institutional arrangements. *Public Works Management and Policy*. 2000. Vol. 4. p. 319-330.
- [20]. R. Joshi and S. Ahmed. Status and challenges of municipal solid waste management in India: A review. *Cogent Environmental Science*. 2016. Vol. 2. No. 1139434. p.1-18.
- [21]. U.S. Kamath. *Mysore District Gazetteer*. Bangalore Press, Government of Karnataka, India. 2001. p. 1-100.
- [22]. R. Kshema and S. Basavarajappa. Municipal solid waste source and disposal practices in residential areas of Mysore city, Karnataka, India – a case study. *World Journal of Advance Healthcare Research*. 2018. Vol. 2. No. 6. p. 52-61.
- [23]. J.E.M. Macwan, J. Shukla, P. Patel and B. Shah. Metropolitan domestic solid waste generation analysis in Indian context. *Journal of Indian Association Environmental Management*. 2003. Vol. 30. p. 158-161.
- [24]. R. Malvia, R. Choudhary and B. Dharam. Study on solid waste assessment and management in Indore city. *Indian Journal of Environmental Protection*. 2002. Vol. 22. No. 8. p. 841-846.
- [25]. M.C. Mamatha and S. Basavarajappa. Report on the solid waste source and disposal practices in commercial areas and public places of Mysore city, Karnataka, India – A case study. *World Journal of Advance Healthcare Research*. 2019. Vol. 3. No. 1. p. 65-73.
- [26]. T.R. Megha and S. Basavarajappa. Source of waste and its disposal practices at food supplying centers in Mysore city, Karnataka– A case study. *World Journal of Advance Healthcare Research*. 2018. Vol. 2. No. 4. p. 268-280.
- [27]. V. Misra and S.D. Pandey. Hazardous waste, impact on health and environment for development of better waste management strategies in future in India. *Environment International*. 2005. Vol. 31. p. 417-431.
- [28]. N.B. Muzamdar. Municipal solid waste management the Indian perspectives. *Environment Monitor*. 1994. Vol. 12. No. 2. p. 257-269.
- [29]. L.S. Nandini and S. Basavarajappa. Solid waste source and disposal practices in few educational institutes in Mysore city, Karnataka, India – A case study. *World Journal of Advance Healthcare Research*. 2018. Vol. 3. No. 1. p. 55-69.
- [30]. A. Pires, G. Martinho and N.B. Chang. Solid waste management in European countries: A review of systems analysis techniques. *Journal of Environmental Management*. 2011. Vol. 92. p. 1033-1050.
- [31]. S. Rathi. Alternative approaches for better municipal solid waste management in Mumbai, India. *Journal of Waste Management*. 2006. Vol. 26. No. 10. p. 1192-1200.
- [32]. T. K. Saha. *Biostatistics in theory and practice*. Emkay Publications, Delhi. 2009. p. 7-167.
- [33]. M. Sharholy, K. Ahmad, R.C. Vaishya and R.D. Gupta. Municipal solid waste characteristics and management in Allahabad, India. *Waste Management*. 2007. Vol. 27. p. 480-496.
- [34]. M. Sharholy, K. Ahmad, G. Mahmood and R.C. Trivedi. Municipal solid waste management in Indian cities – A review. *Waste management*. 2008. Vol. 28. p. 459-467.
- [35]. K. Sashikala and S. Basavarajappa. Hospital waste disposal practices at few health care centers in Mysore city, Karnataka, India – A case study. *World Journal of Advance Healthcare Research*. 2018. Vol. 2. No. 5. p. 191-197.
- [36]. A.V. Shekdar. Municipal solid waste management- The Indian perspective. *Journal of Indian Association for Environmental Management*. 1999. Vol. 26. p. 100-108.

- [37]. G.P. Shivashankara and H.P. Rekha. Solid waste management in suburban areas of Bangalore. Nature Environment and Pollution Technology. 2005. Vol. 4. No. 4. p. 495-500.
- [38]. J. Siddiqui, G. Pandey and S. Akhtar. A case study of solid waste management in Mysore city. International Journal of Application or Innovation in Engineering & Management. 2013. Vol. 2. No.11. p. 290-294.
- [39]. G. K. Singh, K. Gupta and S. Chaudhary. Solid waste management: Its sources, collection, transportation and recycling. Journal of Scientific and Research Publications. 2014. Vol. 5. No. 4. p. 347-351.
- [40]. S. Singhal and S. Pandey. Solid waste management in India: Status and future directions. TERI - Information Monitor on Environmental Sciences. 2000. Vol. 6. p. 1-4.
- [41]. S. Sivaramanan. E-waste management, disposal and its impacts on the environment. Universal Journal of Environmental Research and Technology. 2013. Vol. 3. No. 5. p. 531-537.
- [42]. P.R. Trivedi and G. Raj. Solid waste pollution. Edn. Encyclopedia of Environmental Science. Akashdeep Publishing House, New Delhi. 1992. p. 1-17.
- [43]. K.S. Wilfred and M.N. Moindi. Recycling of wastes as a strategy for environmental conservation in the lake Victoria Basin: The case of women groups in Kisumu, Kenya. African Journal of Environmental Science and Technology. 2008. Vol. 2. No. 10. p. 318-325.

Table I: Published reports on solid waste management practices in India and other parts of the world

Sl. No.	Solid waste	Place	References
1.	Solid waste pollution	India	Trivedi and Raj (1992)
2.	Indian urban solid waste management systems and resource augmentation	India	Shekdar et al. (1999)
3.	Solid waste management plan for Indian mega cities	India	Ahsan (1999)
4.	Urban residential solid waste management	India	Joardar (2000)
5.	Solid waste management - status and future directions	India	Singhal and Pandey (2000)
6.	Solid waste assessment and management in Indore	India	Malvia et al. (2002)
7.	Solid waste management	India	Jha et al. (2003)
8.	Solid waste management in municipalities in Mexico	Mexico	Buenrostro and Bocco (2003)
9.	Metropolitan domestic solid waste generation analysis	India	Macwan et al. (2003)
10.	Partnerships for solid waste management in developing countries: Linking theories to realities	India	Ahmed and Ali (2004)
11.	Overview of waste disposal and landfills/dumps in Asian countries	Asian Countries	Idris et al. (2004)
12.	Solid waste management in suburban areas of Bangalore	India	Shivashankara and Rekha (2005)
13.	Eco-friendly approach of urban solid waste management	Jalgaon city, Maharashtra	Dhane et al. (2005)
14.	Recycling and waste diversion effectiveness	Canada	Ferrara and Missios (2005)
15.	Chemical contamination at e-waste recycling and disposal sites	Ghana	Brigden et al. (2008)
16.	Recycling of wastes as a strategy for environmental conservation in the lake Victoria Basin - The case of women groups	Victoria, Kenya	Wilfred and Moindi (2008)
17.	Electronic waste management system – A review	Bangalore, India	Gupta and Shekar (2009)
18.	Solid waste management - A review of systems analysis techniques	European countries	Pires et al. (2011)
19.	Solid waste in Mysore city - A futuristic scenario	India	Harsha (2012)
20.	Solid waste management in Mysore	India	Siddiqui et al. (2013)
21.	Solid waste management, sources, collection, transportation and recycling	India	Singh et al. (2014)
22.	Assessing the current status of solid waste management	Gondar Town, Ethiopia	Gedefaw (2015)
23.	Solid waste management for smart city – A review	India	Agarwal et al. (2016)
24.	Source of waste and its disposal practices at food supplying centers at Mysore	India	Megha and Basavarajappa (2018)

25.	Hospital waste disposal practices at few health care centers at Mysore	India	Sashikala and Basavarajappa (2018)
26.	Ban of plastic waste at educational institutes at New Delhi	India	Anonymous (2018)
27.	Solid waste disposal practices at commercial areas in Mysore	India	Kshema and Basavarajappa (2018)
28.	Solid waste disposal practices at educational institutes in Mysore	India	Nandihini and Basavarajappa (2018)
29.	Solid waste disposal practices at Manasagangotri campus, Mysore	India	Jayashree and Basavarajappa (2021)

Table II: Waste management activities followed in schools and colleges of Mysore

Sl. No.	Name of the activity	Educational Institutes	
		School (n=14)	College (n=9)
1.	Isolation of waste into dry and wet	11	4
2.	Classification of waste into bio-degradable and non-biodegradable	3	2
3.	Facilities used to dispose solid waste	4	2
4.	Categorization of waste for storing	-	1
5.	Measures to dispose waste using bins	4	4
6.	Solid waste recycling measures adapted	1	5
7.	Approval or authorization by SPCB & SB's	-	3
8.	Awareness program conducted on solid waste	12	4
9.	Pollution control Acts used	2	4
10.	Green clubs established	9	2
11.	Sign board used	14	9
12.	Paper less policy implemented	-	5
Total		60	45
'F' value		3.519	

Note: SPCB: State Pollution Control Board; SB's: Statutory Boards.

\*Value is significant at 5% level.

Table III: Waste management activities not followed in schools and colleges of Mysore

Sl. No.	Name of the activity	Educational Institutes	
		School (n=14)	College (n=9)
1.	Isolation of waste into dry and wet	3	5
2.	Classification of waste into bio-degradable and non-biodegradable	6	10
	Facilities used to dispose solid waste	10	6
4.	Categorization of waste for storage	14	8
5.	Measures to dispose waste using bins	9	5
6.	Solid waste recycling measures adapted	12	3
7.	Approval or authorization by SPCB & SBs	13	4
8.	Awareness program conducted on solid waste	2	5
9.	Pollution control Acts used	12	5
10.	Green clubs established	5	7
12.	Paper less policy implemented	14	4
Total		100	62
'F' value		9.025	



Note: SPCB: State Pollution Control Board; SB's: Statutory Boards.

\*Value is significant at 5% level.

Table IV: Waste management activities followed at Schools and Colleges in Mysore

Sl. No.	Name of Activity	Per cent activity in					
		School			College		
		Yes	No	No response	Yes	No	No response
1.	Waste classification into solid and liquid waste				44.4	55.6	-
2.	Isolation of solid waste into dry and wet	78.6	21.4	-	44.4	55.6	-
3.	Solid waste classified into bio-degradable & non-biodegradable	33.3	66.7	-	14.3	71.4	14.3
4.	Categorization of waste for storage	-	-	100.0	-	100.0	-
5.	Facilities used to dispose the solid waste	28.6	71.4	-	22.2	66.7	11.1
6.	Using bins to collect waste	28.6	64.3	7.1	44.4	55.6	-
7.	Measures to convert solid waste into manure	7.1	85.7	7.2	55.6	33.3	11.1
8.	Measures taken to recycle the plastic waste	-	100.0	-	-	100.0	-
9.	Approval/authorization taken from the SPCB or SB's	-	92.9	7.1	33.3	44.5	22.2
10.	Awareness program conducted on solid waste management	87.7	14.3	-	44.4	55.6	-
11.	Rules/Regulations/Acts used to create awareness	14.3	85.7	-	44.4	55.6	-
12.	Established any Green Clubs	64.3	35.7	-	22.2	77.8	-
13.	Sign boards displayed regarding solid waste management	100.0	-	-	100.0	-	-
14.	Any paper less policy implemented	-	100.0	-	55.6	44.4	-
15.	Liquid waste management	-	-	100.0	66.6	11.1	22.2
16.	Liquid waste treatment installed	-	-	100.0	11.1	66.7	22.2
Total							

Note: SPCB: State Pollution Control Board; SB's: Statutory Boards

Data is based on Tables II and III.

Table V: Analysis of variance of biodegradable solid waste recorded at private Educational institutes in Mysore

Sl. No.	Name of waste	% Occurrence	
		School	College
1.	Used paper waste	14	9
2.	Plant dry leaves	2	7
3.	Used paper wrapper	-	6
4.	Unused food waste	13	7

5.	Used/unused Cotton	-	4
6.	Used hospital waste	-	1
7.	Used cotton bags	-	1
8.	Dead Plant twigs	14	-
9.	Used chalk box	14	-
10.	Fruit waste	13	-
11.	Used pencil scraps	13	-
12.	Miscellaneous	-	3
Total		83	38
'F' value		13.900S	

Note: \*Value is significant at 5% level.

Table VI: Analysis of variance of non-biodegradable solid waste produced at private institutions in Mysore

Sl. No.	Name of waste	% Occurrence	
		School	College
1.	Used plastic bottles	13	9
2.	Used plastic covers	1	8
3.	Used/unused plastic pens/pencils	13	9
4.	Used e-waste	13	8
5.	Used medical waste	13	8
6.	Glass waste	13	1
7.	Used syringes	-	1
8.	Metal waste	12	5
Total		66	49
'F' value		1.908 NS	

Note: NS: Value is not significant.

Table VII: Bio-degradable solid waste produced at private Schools and Colleges in Mysore

Sl. No.	Name of waste	% Occurrence	
		School	College
1.	Used paper waste	16.8	23.7
2.	Plant dry leaves	2.4	18.4
3.	Used paper wrapper	-	15.8
4.	Unused food waste	15.6	18.4
5.	Used/unused Cotton	-	10.5
6.	Used hospital waste	-	2.6
7.	Used cotton bags	-	2.6
8.	Dead Plants	16.9	-

9.	Used chalk box	16.9	-
10.	Fruit waste	15.7	-
11.	Used pencil scraps	15.7	-
12.	Miscellaneous	-	-
Total		100.0	100.0

Note: Date is based on Table V.

Table VIII: Non-biodegradable solid waste produced at private Schools and Colleges in Mysore

Sl. No.	Name of waste	% Occurrence	
		School	College
1.	Used plastic bottles	19.7	18.4
2.	Used plastic covers	1.5	16.3
3.	Used/unused plastic pens/pencils	1.5	18.4
4.	Used e-waste	19.7	16.3
5.	Used medical waste	19.7	16.3
6.	Glass waste	19.7	2.0
7.	Used syringes	-	2.0
8.	Metal waste	18.2	10.2
9.	Miscellaneous	-	0.1
Total		100.0	100.0

Note: Date is based on Table VII.

Table IX: Quantity of solid waste produced at private Schools and Colleges in Mysore

Sl. No.	Activity	Quantity (Kg)	% Occurrence	
			School	College
1.	Waste classification into solid and liquid waste	More than 50 Kg	-	11.1
		50 Kg	7.1	22.2
		Less than 50 Kg	43.0	33.4
		Less than 10 Kg	49.9	33.3
2.	Disposing solid waste to	Own	-	-
		Municipality	50.0	20.0
		Corporation	50.0	70.0
		Disposing outside	-	10.0
3.	Solid waste disposal once in a	Day	71.4	77.8
		Week	28.6	11.1
		Month	-	11.1
4.	Managing e-waste using	Separate cellar	-	55.6
		Piling and disposing once in a year	7.1	22.2
		New devices	-	-
		No response	92.9	22.2



Table X: Facilities with private Schools and Colleges to manage solid waste in Mysore

Sl. No.	Facility	% Occurrence	
		School	College
1.	Composting Unit	28.6	44.4
2.	Bio gas plant	-	-
3.	Incinerators	-	-
4.	Sanitary land fills	-	11.1
5.	Both composting unit & organic waste converter	-	11.1
6.	No facility	71.4	33.4
Total		100.0	100.0