# A REVIEW OF WASTE GENERATION, CHARACTERISATION AND SOLID WASTE MANAGEMENT PRACTICES USING BOTTOMS-UP APPROACH IN EDUCATIONAL BUILDINGS.

**Prachi Talsania[1] & Nainesh Modi[2]**
[1]Research Scholar in the department of Botany, Bio informatics and Climate change and impacts management.
[2]Department of Botany, Bioinformatics and climate change and impacts management, School of science, Gujarat University.

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***ABSTRACT:*** *Most of the environmental problems could happened by anthropogenic pollution, which not only damage natural processes, but also its outcomes is also dangerous. In order to motivate waste minimization, reduce, re-use and recycling, have been introduced in different higher education. Solid waste management is one of the most challenging problem for sustainable development. Aware youth can fight with these problems by adapting or mitigating the roots of the solid waste problems because in higher educational institutes major part of the youth is present. 3R initiative of solid waste management can used as bottoms up approach in higher educational buildings (HEB).The purpose of the study is; study the quantity of waste generated, waste characterisation and solid waste management using bottoms up approach in universities.This review paper included different studies about waste generation, characteristic and waste management practices in different higher education.*

***Key Words:*** *waste minimization, Higher education buildings, 3R initiative, Sustainable development.*

## I. INTRODUCTION

The health of the environment has affected due to unsustainable waste disposal and management since the dawn of civilization. It is an important problem in today's world. (Global Waste Management Market Report, 2007). Due to a rapid increase in the production and consumption process, societies generates as well as rejects solid waste materials regularly from various sectors. The considerable amount of waste thus generated or rejected is called solid waste. (MoEF, 2000).

The direct dumping of waste without any treatment, any separation leads to too many obstacles of environmental pollution create growth in health and environment related problems (Shobha and Rasappan, 2013). Developed countries are generating more than the developing country because of their higher waste per capita and also because of their higher consumption rates.

The composition of solid waste is different from country to country as well as city-to-city(Kumar *et al*., 2009). The collection of waste is one of the major problems in waste management practices. The average collection efficiency for solid waste in Indian cities is about 72.5% and around 70% of the cities lack adequate waste transport services (Teri, 1998). As institution are committed to practice sustainable development, the management of solid waste has recently become an important aspect of sustainability goal (John Babington Chibunna *et al*., 2012).

Most of the people educated by such university are also the same people who develop and manage society's institutions. Responsibilities to increase awareness about the knowledge, technologies and tools which will create an environmentally sustainable future rely on these people. (C. Armijo de Vega *et al*.2003).

The estimated quantity of waste generation was 12 billion tonnes in the year2002 globally out of these 11 billion tonnes was industrial waste and 1.6 billion tonnes was Municipal Solid Waste. The heterogeneous behaviour of waste generated leads to complexity in recycling and utilization (A. Pappu *et al*., 2007).

Waste generation and characterisation in different educational buildings of the world

First step towards enhancing the sustainability of waste management system is to understanding the characteristics of an institution's solid waste management (D.P. Smyth *et al*, 2010).

Table: - 1 waste generation in different universities

| Sr. no | Name of university | Paper (%) | Plastic (%) | Food waste (%) | Residual waste (%) | Glass (%) | Construction and demolition (%) | Reference |
|---|---|---|---|---|---|---|---|---|
| 1 | central university college | 32.75 | 10.75 | 7.25 | 12 | -- | -- | Dery FA *et al*, 2018 |
| 3 | autonomous university of Baja California | 74.4 | 17.9 | 144.3 | 51.5 | 9.9 | 3.9 | C. Armijo de Vega *et al*, 2008 |
| 5 | Campus of the university of Tabriz | 14.45 | 19.23 | 45.3 | 10.84% | 8.87 | 0.69 | Sepideh Taghizadeh *et al*, 2012 |
| 6 | University of Lagos Akoka campus | 24 | 24 | 15 | 2 | 6 | -- | A.E. Adeniran *et al*.,2017 |
| 7 | Bahi dar institute of technology | 608 | 305 | 408 | 224 | 63 | 279 | Aragaw, T. A. *et al*, 2016 |
| 8 | University Technology PETRONAS | 40 | 15 | 30 | 14 | 1 | -- | Malakahmad *et al*, 2010 |
| 9 | The Turitea campus of Massey University | 10 | 33 | 40 | 22 | 1 | -- | I.G. Mason *et al*.,2004 |
| 10 | The University of Nairobi | 54.22 | 25.90 | 9.64 | 1.20 | 7.83 | -- | Aseto S., 2016 |
| 11 | The University of Lagos, Obafemi Awolowo University and University of Ibadan | 4 | 5 | 59 | 7 | 1 | -- | Amori, A. A., *et al*, 2013 |

During the 2007-2008, academic year at the Prince George campus of university of Northern British Columbia waste generation and composition was carried out. The results showed that more than 70% waste wasrecyclable, could have been reduced and composted. The university's waste generation rate was 59.20 g/user/day (Smyth *et al*., 2010).

University of Tabriz studied the quantity and composition of solid waste generation to implement the management strategies during the academic year 2009-2010. Organic waste was of the biggest proportion after plastic and paper (Taghizadeh, S. *et al*, 2012).

In Nigeria, the University of Covenant took same steps like the University of Tabriz. From the study, they obtained that the biggest fraction from the waste is food waste followed by polyethylene bags and plastic bottles (Okeniyi, J. O., & Anwan, E. U., 2012).

At the University of Southampton, the results showed positive impact of introducing appropriate infrastructure, service provision and techniques to encourage positive behavioural change. In each kitchen, providing recycling binsincrease the recyclingrate by 25% (N. Zhang *et al*., 2011).

## II. SOLID WASTE MANAGEMENT USING BOTTOM-UP APPROACH

Bottoms up approach is the one of the important approach for sustainable solid waste management. From ground level to the higher level, this approach can help in management of solid waste. Solid waste management starts from waste sources. Second step waste collection, Third Step waste transportation, Fourth Step waste treatment and the last stage is waste disposal.

To apply bottoms up approach to the Solid waste Management, the basic need of the segregation of the waste from the source. Because, the major problem with the management of the solid waste is unsegregated waste. When the waste reaches to the disposal site it will get mixed very intricately and without segregation treatment, it will not give any useful product.

Therefore, if the waste segregated from the source it will lead to proper management of the waste. In the second stage when the collected waste is segregated in two segments like dry and wet waste. In the third step, the waste is transported to the waste disposal site. Then after waste has treated at the disposal site by different technologies.

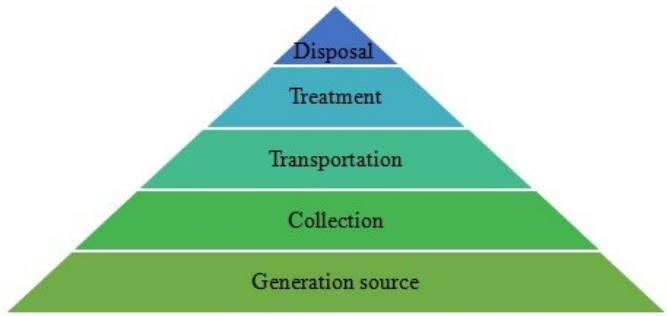


*Figure 1:- Bottoms up approach*

## III. BOTTOMS UP APPROACHES IN DIFFERENT UNIVERSITIES IN THE WORLD

3R concept means Reuse, Recycle or Recover the solid waste. This idea can be used in waste treatment in to the HEB. This initiative gives positive effect to avoid producing solid waste in HEB. In The Asian Institute of Technology (AIT) campus, they used 3R initiative for reducing solid waste. AIT campus increased their recycling rate by 1.8 to 12% (Tangwanichagapong, S. *et al*, 2017).

Another initiative for bottoms up approach in HEBis to develop a syllabus for increasing awareness. By providing lessons and practical/ presentations to the students and other staff of the higher educational buildings awareness can be increased. For increasing campus awareness about sustainability and recycling, the instructor of Francis Marion University developed a recycling course for the students and for the teacher's goals of using problem based learning approaches in the classrooms (Pike, L. *et al*, 2003).

By introducing different programs related to waste minimization or waste recycling in to the HEB is one of the bottoms up approaches. An academic organization in southern Mexico released waste management programme for the minimization and recycling pf organic waste. The amount of waste sent to the final disposal site has reduced by two thirds, as well as increasing environmental awareness among the institution's members (*L. Maldonado, 2006)*.

At Massey University, from the survey conducted with a written questionnaire focused on how was the recycling participation, improvement of source separation performance and on general attitudes within the university towards recycling (*T.C. Kelly et al,* 2006*)*.

How to implement a "Zero waste" programme on the campus was described by the university of Massey New Zealand (Mason *et al*, 2003).

The Azcapotzalcocampusof the UniversidadAu-tó-nomaMetropolitana(UAM-A) introduced an integral Urban solid waste management programme, "Segregation for a better UAM Environment". This program was organized for the fulfilment of three objectives, one is raising the awareness in the UAM-A on the solid waste problem, second was theinvolvement of community in solid waste separation and third wasto sync with local environmental legislation regarding to the solid waste management (*R. Es-pinosa et al., 2008)*.

In Malaysia, at the University Kebangsaan Malaysia solid waste management programme was carried out in order to encourage waste minimization, re-use, recycling and reduce. The aim of this study was to assess the attitudes and concerning behaviour for solid waste management. Moreover, the result was that 60% students had positive attitude towards the solid waste management (*Asmawati Desa et al.,* 2012).

Higher educational institutes in London, UK using qualitative research approach, with the help of semi-structured interviews is apply for the greening of the campus. The institutions are not "zero waste" green campus and overall environmental quality of these institutions is relatively poor in respect to recycling. For sustainable bottoms up approach, barriers have to be removed from theHEB. Four barriers are financial- lack of financialresources, awareness- lack of environmental education, cultural- a non-environmental attitude prevailing at campus, urban- the lack of space for storing waste (Dahle, M., & Neumayer, E. , 2001)

## IV. CONCLUSION

Solid waste management is gigantic problem for the society. There are huge mountains of waste at every dumpsite. In HEB major part of the people are young and educated. Therefore, for any initiative to be taken in to the society, people can understand the problems and take step towards the "Zero waste" goal. Some initiative like 3R concept, Awareness programmes, waste reduction courses in the educational building were discussed in the review paper. Food waste was a major part of the total waste generated from cafeteria/kitchens from higher education institutions. Therefore, it is important to reduce or recycle food waste for better solid waste management.

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