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REVIEW ARTICLE

SOLID WASTE MANAGEMENT- A REVIEW

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ABSTRACT

Waste management is been a vital environmental issue since last few decades. It has been seen that the generation of waste increases with increasing population, industrialization & urbanization etc. This paper is a review of waste management system, its elements & disposal system of waste. The necessities of waste management system, bad effects of mismanagement, various issues are raised in previous studies are mentioned in the paper. It has seen that the waste management system should adopt by Proper collection, storage, processing, transport & disposal of waste so that the impacts of waste can be minimised & the quality of life can be improved.

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INTRODUCTION

Waste management is worldwide phenomenon, rising population, industrialization & urbanization are responsible to produce tremendous amount of waste. Today, the urban areas of Asia generate about 760,000 tons of municipal solid waste per day, which is equal to about 2.7 million m³ per day. In 2025, this amount will raise to 1.8 million tons of waste per day, which becomes 5.2 million M.cu per day. These estimates are conservative; the real values are probably double of this amount. (What a waste, solid waste management in Asia, 1999) Local governments in Asia at present spend about US \$25 billion per year on waste management of urban area. This amount is used to collect more than 90 percent of the waste in high income countries & it is about 50 to 80 % in middle income countries, and only 30 to 60 percent for low income countries in 2025, Asian governments should look forward to spend at least double this amount on solid waste management activities. (What a waste, solid waste management in Asia, 1999) Calculated value of solid waste generation by 300 million people from urban India is 38 million tons per year. The collection & disposal of municipal solid waste is one of the vital problems of urban life, which has assumed great significance in the recent past.

With the rising urbanization as a result of intended economic growth and industrialization, problems are becoming delicate and there is need for immediate and rigorous action. The proper disposal of urban waste is not only totally necessary for the preservation and development of public health but it has a huge potential for resource recovery. It has estimated that around 1,00,000 MT of Municipal Solid Waste is generated daily in the nation. The Per capita generation of waste from major cities is ranges from 0.20 Kg to 0.6 Kg. usually the efficiency of collection ranges between 70 to 90% in metropolitan cities while in several smaller cities it is below 50%. It is estimated that the ULB's spend around Rs.500 to Rs.1500 per ton on solid management activities like storage, collection, disposal etc. About 60-70% of this amount is used for street sweeping of waste, 20 to 30% for transport of waste and approximately less than 5% on final disposal of waste, which undoubtedly shows us that there is very less consideration is given to organized and safe disposal of waste. The Landfill sites are not yet been recognized by many towns and in several municipalities, the landfill sites have been exhausted and the particular local bodies don't have resources to acquire new land for land filling. Due to less availability of disposal sites, the collection efficiency also gets affected. (Manual on Municipal Solid Waste Management, 1998)

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Though national data is not available, many urban areas have been studied by CPCB. If we consider some of major cities like Mumbai, Chennai, Bangalore, and Kolkata that producing

5320, 3036, 1669, 2653 Tonnes per day respectively (Source: <http://cpcb.nic.in>).

Due to change in habitats of people some researcher's forecasted that between 2000 and 2025 the waste composition of Indian garbage will undergo drastic change. It has been seen that the consumption of inorganic waste is increasing day by day. & still we don't have permanent, effective, & green solutions over these problems.

Solid waste is directly concern with health of people living nearby, poorly maintained land fill sites are responsible to ground water pollution because of leachate production, open dumping of S.W. Causes breeding of flies, mosquitoes, cockroach, rats, & other pests, these pests are responsible for spreading of diseases; also open dumping cause's significant air pollution in surrounding area. Direct handling of solid waste can result in various types of infectious and chronic diseases with the waste workers and the rag pickers being the most vulnerable. Proper solid waste Management reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. A number of processes are involved in effectively managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal.

1.1 Necessity of solid waste management

- Due to growth in population & urbanization the generation of solid waste has increased significantly.
- Solid waste has many bad influences over development of city or village.
- Diseases, odour pollution are the major threats arise due to solid waste.
- Major countries in India are producing more than 1000 tonnes per day of solid waste. Major part of this waste is treated by land filling which has its own influences over land & environment.
- Proper SWM provides facility of collection, segregation, transportation, & treatment of waste.
- This reduces odour pollution & risk of diseases, also good management improves the aesthetics of the city.
- Though SWM is complex to execute but with modern eco-friendly techniques & disciplinary work. It is possible to achieve needful.

2.0 Mismanagement and health effects

The report of WHO by expert committee (1971) has mentioned various health effects of solid waste some of them are given following. (World Health Organization Technical Report Series)

- Solid waste varies significantly throughout the world because It depends largely on climate, living standard, & further social factors, as society becomes industrialized the percentage of commercial, industrial, , agricultural waste increases, this adds new potential threats to human health & safety World Health Organization Technical Report Series

- Most wastes are heterogeneous & it May vary seasonally so there is no single fixed approach to the problems, though two different categories exist universally, fermentable& non fermentable, the second one degrades very slowly which become problem. World Health Organization Technical Report Series
- Generally solid waste should not contain some fecal matter or urine in it. The mixture of such material with solid waste makes it difficult to collect properly, however these conditions are present in many developing countries due to variation in way of life style. Such things also increase chances of spreading of diseases in society. World Health Organization Technical Report Series
- Harm from waste is also due to inflammability of waste, the nuisance of flies breeding will be more in area as well as role of rodents, flies, and rats is great in disease spreading.
- Many times open waste dumps provide a amount of food for rodents, these can grow their population, It has seen that the rodents like rat, mice, are responsible to plague, histoplasmosis, murine typhus etc.
- Incomplete combustion of solid waste can produces undesirable pollutants like particulate matter, sulfur dioxide, hydrocarbons, nitrogen oxide which can cause dangerous health effects on those who inhale it.
- Rain water when passes through waste sites there are chances of contamination due to bacteria present in waste, In general normal permeable soil does not contain bacterial load more than dozen but waste can contaminate water significantly & subsequently increases the chances of diseases spreading.
- The study of WHO reveals that the infection of worms & related organisms was three times that in control group. Although it is certain that vector insects & rodent can transmit diseases but it is always difficult to understand the relationship between sources of infection & population affected.

3.0 Issues over India

Since second half of 19th century solid waste management remain as very strong issue over a world. In country, there are several issues raised, a few of them mentioned By Ranjith Annepu in his article on: -Solid Waste Management – India's Burning Issue. He says, for the first time in the history of India, in the year 2012 has seen several public complaints against poor waste management in the country. A fight for the right to clean environment and environmental justice led the people to large scale demonstrations, counting an indefinite hunger strike and blocking roads leading to local waste handling services. Inadequate waste management has also initiated a Dengue Fever occurrence and creep up further epidemics. In present-day, waste managing is the only other merging factor leading to community demonstrations all across India, afterward corruption and fuel prices. Public nervousness resulted in some jurisdictional action and the government's remedial response, but the waste problems are still unsolved and if this continues for too long without any long term planning and policy it will lead to crisis. (Solid Waste Management, 2014).

These several issues are clear suggestions that tell us “while moving forward with industrialization, urbanization, towards development, we must pay attention towards what we are generating & how it will react with nature & if we can't find solution to these problems then nature will not so long tolerate this” (Solid Waste Management, 2014)

Mr. Abhimanyu Sing (2014) has studied the waste management status & health effects in Agra city, according to his study, Increasing urbanization and industrialization in Agra city are responsible to increase the generation of waste. Proper management of waste by the government organization has not been operative and is a bit poor in the urban center. The amount of uncollected waste is likely to increase day-to-day with increasing urbanization. Among the possible consequences, it is clear that the two clear options for effective solid waste management is either centralized or decentralized. However, to achieve financial solid waste management, so there is a need to systematically analyses through the strengths and weaknesses of the community as well as the municipal corporation founded on which an effective decentralized system can be progressed with the contribution of various stakeholders in Agra city. Sensitization of the community is also vital to achieve the above objective. The public can be altered by awareness campaigns and educational measure. We need to act fast as the city is already a breeding ground of many infectious diseases most of which are caused by inefficient waste management. To avoid any epidemic, to make the city healthy, economic, and environmentally sustainable, there is an urgent need for strategic waste management plan and a strong implementation for the same (Abhimanyu Singh *et al.*, 2014)

By M.N. Akhtari (2014) Solid waste management is certainly not a stand-alone system. Systems analysis is one of the ways for looking at its complexity and linkages with surrounding. In this study, an approach has been tried by control point defining the basic complications in waste disposal. This resulted in a broad analysis that primarily, identified the links between the solid waste streams and their surroundings, and moreover, illustrated the magnitude of environmental consequences related with the whole system. Another important issue is the large impact of untreated waste on the environment. In few cases, this impact is more dominating the total picture of an enhanced waste management system. The decrease of untreated waste through better measures and an improved waste collection system was identified to be the key if significant change is attempted to. It has found that, utilizing of solid waste in CEC Industry is helps full in reducing the impact of solid waste on environment. There is a remarkable scope for setting up industries for recycling and using such huge quantity of solid wastes as resources in the production of construction materials. Already, Fly Ash has become significant raw material for various industrial applications. Also it widely used in manufacturing of cement, bricks, cement products and roads construction etc. The alternative building materials obtained from industrial, and mining solid wastes have plenty of scope for introducing new building components that will also satisfy economical aspect of construction to some extent. Finally, the way of looking at solid waste management with a broader perspective, is a prospective approach to achieve more just analysis and introduce a rational, operative and integrated policies and programs;

attempting to greatly avoid influences from related-systems, and taking into account the potentials of energy and materials from waste rather than simply see it as a local burden. Improved awareness of decision makers may lead to altering national industrial and socio-economic development policies and linked government programs in favor of refining solid waste management systems in developing countries (Akhtari 2014)

By Sara/Bergqvist (2006) According to his study there is a plan for waste controlling in Industrial division, Mable. The current plan is basic & but the implementation is not up to the mark; the waste is not collected on a regularly and there is no sufficient of waste workers. Some of The main reasons for the reduced waste management are a poor practice among the people, lack of priority among, politicians, & corruption, poverty. The main health problems caused due to poor waste management are diarrhea, malaria and injuries. The society needs to take responsibility for the people by prioritizing the common properties. Sustainable and long lasting solutions on this area are grounded in fighting poverty & corruption. Common goods like infrastructure & education is a requirement for an operative health promotion work. Health promotion work should be based upon authorization with regards taken to the people's economic and social conditions. Respect must be given for individual and cultural means. A highlight wants to be put on educating women to fight the inequalities and to improve the hygiene. If investments are done in these areas then there will be great improvements to attain people's health and in development of the nation. (Sara/Bergqvist and Lisa/Wieslander, 2006)

4.0 Solid waste management

The word solid waste management includes any waste that is neither gaseous nor liquid state, however containerized gaseous as well as gaseous waste are also included in the term. The major category of solid waste includes municipal solid waste, agricultural waste, industrial waste, ash from thermal power plant, & hazardous waste. (SudhaGoel, 2008) There are six functional elements of solid waste management. Study of these elements illustrates the relationships involved in each element & development of frame work. It has been observed that there are following six elements for SWM. (Solomon Cheru, 2011)

4.1 Generation of waste

The Process of consumption of product results in the materialization of waste in urban areas. Furthermore, other processes for Instance Streets weeping, park cleaning; waste-water treatment, air pollution control measures etc. also yield solid waste in areas. (Manual on Municipal Solid Waste Management, 1998)

Waste generation incorporates events in which materials are identified as useless, and are either thrown away or collect together for disposal. This component is very important since all activities that lead to identification and understanding of solid waste generation rate, volume, composition, area specific differences of waste generation and their likely changes overtime are belong to this integral of solid waste management

So, this functional element is a dynamic stage for obtaining accurate information that is vital to monitor existing management system and to make, financial, controlling and institutional decisions. (Solomon Cheru, 2011)

4.2 On site Handling, Storage and Processing

This element of waste management organizes activities related with handling, storage, and processing of wastes at point of generation. Handling of Waste includes activities associated with management of wastes till they are placed in storage containers for collection. It also includes movement of loaded containers to point of collection. Storage includes stock up of wastes immediately after generation. There are two kinds of storage activities at source. The first one is temporary storage done at house level as a part of their hygiene. The second one is communal solid waste storage system in public solid waste containers prepared by municipality. While processing at source includes activities such as waste composting and splitting-up of solid wastes for reuse & recycling. All of these mechanisms are essential for protection of public health and aesthetics and environment (Solomon Cheru, 2011)

4.3 Collection:

Collection consist of the process of picking up the wastes from collection points, loading it in to a vehicle& transporting it to processing facilities, transfer stations or disposal site. In most municipal solid waste management systems, cost of collection is a significant portion of total cost (Solomon Cheru, 2011)

4.4 Sorting, Processing and Transformation of Solid Waste

It is the fourth functional element, usually sorting, recovery of materials & processing, and transformation of solid waste take place primarily in sites away from the source of waste generation are covered by this functional element. Sorting of mixed wastes typically occurs at a materials recovery facility, combustion facilities, transfer stations, and disposal sites. Separation of bulky is often done in Sorting, separation of waste constituents according to size using manual separation, screens, and separation of ferrous and non-ferrous metals (Manual on Municipal Solid Waste Management, 1998)

4.5 Transfer and Transport

These activities are connected with handover of wastes from public storage facilities to collection vehicle and the succeeding transport of wastes to disposal site. Transfer states to movement of waste or materials from primary collection vehicle to a secondary, larger and more efficient transport vehicle. Sometimes location of final disposal site is at a long distance from collection point, transfer stations may be used. With respect to transfer stations, "there are two types of operation direct and storage discharge. In storage discharge refuse is first emptied from collection trucks in to a storage pit. Whereas in direct discharge station, each refuse truck empties directly in to larger transport vehicles" (Solomon Cheru, 2011) Transport on the other hand covers all types of vehicles under process to transport solid waste from its generation point to

transfer station and then to treatment or disposal site. "All vehicles in operation are considered, counting manually driven small carts, mechanically driven cultured transport vehicles, then special vehicles for hazardous, bulky, and recyclable wastes. Generally properly design transfer and conveyance system highly reduces cost of collection (Solomon Cheru, 2011)

The typical waste collection rates are directly related to income levels. Low-income countries have low collection rates, around 41%, whereas high-income countries have higher collection rates averaging 98% (Daniel Hoornweg and PerinazBhadra-Tata, 2012).

4.6 Processing and Recovery

This functional element include all techniques, equipment's and facilities used both to improve the efficiency of other functional elements and to recover useful materials, modification of products, produce energy, & compost from solid wastes. Also process & recovery provides several advantages. Firstly, this process reduces total volume and weight of waste material that requires proper collection & segregation facilities. Reduction of volume also helps to protect land resources. On the other side, it also reduces total transportation cost of waste to its final disposal site (Solomon Cheru, 2011)

The processing and recovery has been carried out from the beginning separation and processing of wastes at the source. However segregation of wastes usually occurs at transfer stations & disposal sites. The waste separation is done by manual separation, mechanical separation and ferrous and non-ferrous metals are separated etc. Subsequently they enter in small and large scale industries for recovery. The most commonly used biological transformation process is aerobic composting and, the most frequently used thermal transformation process is incineration (Solomon Cheru, 2011)

4.7 Reuse and Recycle

Reuse includes cleaning and using the materials again after use. It also means the use of a thing, or product for more than one time, the use may be in its original fore or modified new form. This method is adopted to decrease the pollution, to create opportunity of jobs local people, and saves money by minimizing the treatment process. "Reusing is more efficient and better than recycling and composting methods because cleaning and reusing materials in their present form avoids the cost of energy for remaking them in to something else". (Solomon Cheru, 2011)

Recycling is also an evident solution of solid waste problem. It is a significant way of collecting waste materials and turning them in to useful things that can be resold in the market. Such materials can be reprocessed in primary and secondary process. In Primary recycling the original waste material is again made back in to the same material. In secondary recycling, waste materials are made in to various products that may or may not be recyclable for instance, cardboard from waste newspapers". (Solomon Cheru, 2011)

4.8 Disposal

This is final functional element in solid waste management system. Disposal activities are associated with final dumping of solid wastes directly to a landfill site. Nowadays disposal of wastes by land filling or land spreading is commonly adopted by municipal agencies. But, in most developed countries this method is banned allowing only sanitary landfill for final disposal. since sanitary landfill is an engineered facility used for disposing of solid wastes on land without occurrence of nuisances or hazards to public health and environment” “Though it is the most common technology utilized over the world, conventional and environmental unfriendly methods such as open-burning, open-dumping, and non-sanitary landfill can still be used as disposal method” (Solomon Cheru, 2011) Generally data of Waste disposal is very difficult to collect. Several countries don't collect such data at the national level, making comparisons across income levels and regions difficult. Furthermore, where such data is available, the methodology of how disposal is calculated is not finalized. For example, some countries only give the percentage of waste that is dumped or sent to a landfill, the rest comes under 'other' disposal. Sometimes, recyclable & compostable material is separated before the waste reaches the disposal site and is not included in waste disposal statistics. (Daniel Hoornweg and PerinazBhada-Tata, 2012)

5.0 Conclusion

Solid waste management is one of the difficult threats in front of world, the change in habitats of people, rapid development are responsible for large generation of waste, in India cities like Delhi & Mumbai are generating more than 5000 MT of waste per day. This waste is creating problems to public health, drainage, aesthetics, of the cities, so there is intense need for efficient waste management systems in the city as well as villages. The system should adopt Proper collection, storage, processing, transport & disposal of waste so that the impacts of waste can be minimised & the quality of life can be improved.

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