SOLID WASTE MANAGEMENT FOR SUSTAINABLE DEVELOPMENT

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Abstract

Solid Waste Management steps towards sustainable development. The concept 5Rs: Refuse, Reduce, Reuse, Repurpose and Recycle are the latest visionary concepts for confounding waste problems of the environment around the globe. As a part of Swachh Bharat Mission (Gramin), the 5R concept is applied to improve the situation of cleanliness through Waste Management activities and create the villages as Open Defecation Free (ODF) in the countryside. Recently socio-culturally accepted and economically affordable technologies have been utilized for solid waste management practices. The main objective of this article is to briefly describe the latest, effective and environment friendly technologies and methods for Solid Waste Management with special emphasis on the recommendations for controlling the waste production.

Keywords: Solid Waste Management, Sustainable Development, Biodegradation, Sanitation

Introduction

Rapid increase in urbanization and Industrialization becomes very significant for developing countries like India having large numbers of population. With respect to population, India overtakes China with about 1.41 billion population (Worldometer, Elaboration of data by the United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2019 Revision) [1]. On the contrary, India is sharing only 5% of world's area accounting 3,185,263 km^2. West Bengal is one of the states of India having geographical area of 88,752 sq. km. and population of 9,13,47,736 as per 2011 Census. Out of the total population, 31.87% lives in urban areas and 68.13% lives in rural areas (I&CA, Govt. of WB). Rate of Waste generation has been increased due to population explosion, rapid growth of industries and uncontrolled urbanization with improved living standards. In the past due to lack of technological options, public awareness, and financial assistance it was difficult to manage the adverse effect of waste generated around villages and cities. Government of India introduced the rural sanitation programme in 1954 as a part of the First Five Year Plan to overcome this problem. In 1986, the Central Rural Sanitation Programme had taken initiative to improve the quality of life of the rural people and also to provide privacy and dignity to women. The Government of India started a flagship programme named Swachh Bharat Mission, 2014 [2].Under this mission, SBM-Gramin launched with the objective of bringing improvement in cleanliness, hygiene and the general quality of life in rural areas.

As the Sanitation, Health, and human well-being are positively correlated, each dimension get affected by another. In order to improve the quality of life of the rural population, water supply and environmental sanitation need to be improved. Both solid and liquid waste management

come under environmental sanitation. Proper management of waste is now becoming a challenging task to achieve universal sanitation coverage. The objective of solid waste management in rural areas is to collect the waste at the source of generation, recover the recyclable materials, and process the organic waste to compost and secured disposal of remaining waste in such an economical way that protects the environment and human health too. A few SWM units in Tamil Nadu, Kerala, West Bengal, Gujarat and Rajasthan are running successfully [3]. There are 3342 Gram Panchayats under 341 Blocks in West Bengal. These GPs have a lot of practical suggestions to share with other GPs and SBM facilitators who are earnest about creating a system to manage solid waste at the Gram Panchayat level (NIRD&PR, 2016). [4]

Objective of the Study

The present study mainly deals with the following-

- To find out different biological methods applied for SWM.
- To highlight the challenges associated with SWM practices
- To give further recommendations and suggestions for improvement of the SWM system.

Solid Waste and Classification

Waste can be defined as any unwanted or unusable material that is discarded after productive use. Non-liquid waste material arising from domestic, agricultural and industrial activities and from public services which can neither flow in water streams and nor escapes into atmosphere immediately in gaseous form is called as solid waste. As the paper mainly focuses on solid waste in rural area so a brief classification of solid waste is depicted here-

- Based on Source-
    - Household Waste
    - hazardous or toxic waste
    - biomedical waste
    - Agricultural waste (Crop residues, crop processing waste etc.
- Based on Composition-
    - Biodegradable Waste- can be decomposed by biological process and recycled (vegetable peel, food, farm waste, animal dung and so on).
    - Non-biodegradable Waste- cannot be broken down naturally. It is further classified into two types-
        - Recyclable Waste- having economic value and can be recovered(paper, plastic, glass, metal etc.)
        - Non-Recyclable Waste- does not have economic value (tetra packs, thermocol etc.)

Traditionally the most common method of solid waste disposal in rural areas is open dumping. In this case the heaps of waste are dumped at outskirts of villages and further used as manure for agricultural purposes. Second most harmful method used is open burning. Other common methods are dumping waste in nearby water bodies and disposal of waste in agricultural fields. All these non-scientific traditional methods are harmful for the environment. So to minimize

environmental degradation and accelerate sustainable development, the latest and innovative technologies of waste management are being adapted. [5]

Basic Principles of SWM

- Collection of waste material from different sources
- Segregation and sorting of waste
- Reuse of recyclable materials
- Processing of waste material at household and community level
- Latest technological interventions for waste processing and energy recovery.
- Use of the processed waste (compost/ biogas etc.)
- Disposal of Waste residues

Conditions for selecting Technology for Solid Waste Management

Technological advancement has been implemented in every step of SWM i.e. from collection to disposal [6]. But there lies certain criteria for choosing technology for SWM, which are as follows-

- Availability of skilled personnel and financial assistance
- Characteristics and quantity of waste generated
- Availability of open land in and around the village
- Geophysical condition of the area including topography, soil structure and ground water conditions

Technological Application

Latest and innovative technologies for waste management from storage, collection, recycling, processing, energy recovery and final disposal [7] are discussed below-

Collection and Transportation

Underground collection system, Web based Geographic Information System, Waste bin monitoring system using Global System for Mobile, and Waste compactors or Compact garbage collecting trucks are the latest technologies for collecting and transporting waste materials.

Segregation and sorting

This is the step where the wastes can be sorted depending on their properties, so that the recyclable materials can be segregated. Multi-compartment bins, 3-coloured bins, optical sorting, mechanical biological treatment, automatic bottle sorting systems are the new ventures.

Recycling

After sorting, the degradable, non-degradable, recyclable materials like paper, plastic, metals, glass can be processed by de-inking Technology for paper recycling, remanufacturing of broken glass pieces etc.

Processing

Composting, Shredding, Autoclaving, melting technology etc. is introduced to minimize the volume of segregated waste and generate the by-products. Composting method is being mostly applied in case of rural wastes as they are mainly organic in nature. It can be done in two ways i.e. aerobic and anaerobic conditions. Microorganisms reduce or oxidize the organic compounds into carbon dioxide, nitrite, and methane gas under certain temperatures. Final product, free from odour and pathogen, may be used as fertilizers. There are several methods of composting the wastes-

NADEP method

This method is named after Narayan Deotao Pandharipande of Maharastra(Pusad) (N.D. Pandharipande 2008). In this method a rectangular shaped brick made tank with perforated wall and a thatched roof is used. The ingredients like agro-wastes, animal dung and soil are added in layers. Culture of nitrifying bacteria is sprinkled over for about 3months and about 22-50 litres of water are to be sprinkled twice a week. As the final product i.e. Organic manure is of economical use and helps improve sanitation in villages, the NADEP method of composting is believed to be best practices. [8]

Bangalore method

This process is also called the Hot Fermentation Mechanism of composting. Biodegradable material such as mixed plant residues, animal dung and urine, earth, wood ash, weeds, stalks, stems, fallen leaves, prunings, chaff, fodder leftovers, so on, are collected and stacked in a pit and allowed to decompose for 4 to 6 months.

Indore method

In this method, organic wastes are cut into small pieces and spread in layers of 10-15 cm thickness either in pits or in heaps of 1m wide, 1m deep and of convenient length. Cow dung and earthy matters are mixed with this and moistened by sprinkling sufficient water.

Vermicomposting

In this method earthworms are utilized to decompose the organic wastes and after degradation and digestion, convert it into nitrogen, phosphate, potassium enriched granules which can be used as manure.

Bio gas formation

Biogas is a mixture of gas produced by methanogenic bacteria while acting upon biodegradable materials in an anaerobic condition. Biogas plants are becoming the most eco-friendly system by providing sustainable energy sources in rural communities. Animal dungalong with human wastes can be effectively used for biogas formation. Thus toilet linked biogas plants have additional benefits in terms of improving sanitation. Biogas can be utilized as domestic fuel and by-product slurry can be used as manure in agricultural fields.

Energy Recovery

Waste can be moulded into wealth by producing energy which may be utilized in economical purposes. Non-biodegradable elements can be subjected to advanced thermal treatment

technologies like gasification, pyrolysis etc. Bio-conversion is a process where food waste can be used to produce biofuel through different fermentation processes.

Pyrolysis

Pyrolysis is an effective waste-to-energy concept that refers to thermal destructive distillation of the solid waste in absence of air to recover its constituents and energy. Waste fluidized bed reactors, plasma gasification, plasma pyrolysis and vetrification, Refuse Derived Fuel has been utilized for making waste useful.

Incineration

A thermal waste treatment process in which the unprocessed waste is burnt at about 850ºC is commonly known as Incineration. The disadvantage of this process is that it releases compounds containing sulphur, nitrogen and halogens deteriorating air quality. To overcome the problem, scrubbing, filtering are used to dilute concentrations to acceptable level prior to release into the atmosphere.

Disposal

Two most common ways of disposing waste materials are landfills and deep well injection slurry through which it can avoid issues regarding leachate leaking, water contamination, and landfill gas explosion etc. Bioreactor Technology, Landfill gas recovery technologies, Microturbine Technology, Fuel cell Technology are the modern technologies that mainly follows waste to energy principle. [9]

Discussion

Government has taken various initiatives to improve waste management services, but there is still a long journey to travel to achieve the objectives of effective rural solid waste management. Gram Panchayat and Various NGOs play a significant role in spreading awareness among the public and involve citizens for better waste management practices. Public Private Partnership (PPP) model has been practiced for various services such as collection, transportation, treatment, development of landfill sites, operation and maintenance of units etc [10].

Barriers to improve Waste Management

There is a lack of trig in SWM management & availability of qualified Waste Management professionals is limited. However, there is a lack of budget to cover the cost associated with developing proper waste collection, storage, treatment, and disposal. Lack of strategic SWM plan waste collection /segregation to disposal & govt finance regulatory framework are major barriers for achieving effective SWM in India. Insufficient environmental awareness combined with low motivation has inhibited innovation & adoption of sophisticated technologies that could transform Waste Management in India. Public attitude to wastes are also a major barrier in improving SWM.

Recommendation for Improvement

Rural Local bodies need to be responsible for a perfect waste management system. An independent authority is needed to regulate SWM with clear regulation & enforcement. Finance to SWM companies and fund finding for infrastructure must be raised from waste producers through a waste tax [11].A minimal charge per person per day would generate a large amount annually and this level of funding would probably be sufficient to provide effective Waste Management throughout the country. Waste segregation at source will allow much more effective value extraction and cycling separately inorganic & biodegradable waste would have significant benefit and should be the responsibility of waste producer

Conclusion

Population growth and development of megacities is making SWM a burning problem nowadays. There are major issues associated with public participation in Waste Management and a lack of responsibility towards waste in the community. People should be aware of the nature and management of the waste. As this is a fundamental requisition to develop proper and sustainable waste management. Waste Management must ensure maximum resource extraction from waste combined with safe disposal of residual waste through the technological invasion for landfilling and energy production. India faces challenges related to waste policy, technology selection and availability of appropriate trained people in the WM sector. Until fundamental requirements are met, India will continue to suffer from poor WM and the associated impact on public health and the environment as well.

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