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Development of Landscaped Landfills using Organic Waste for Sustainable Urban Waste Management

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Abstract

Uncontrolled dumping of waste on open dumps or landfills has become one of the most common methods of disposing waste. Globally, such dumps/landfills have remained as an anomaly in urban landscapes due to its heterogeneous nature and the environmental degradation it causes. This paper considers open dumps/ landfills as specific example cases upgradable to 'landscaped landfills' so that landfills transform to be a more sustainable disposal option. Such an approach can be devised only by knowing the quality and quantity of the waste that are disposed in landfills and the background environmental conditions of a particular region. A landfill dominantly of organic/biodegradable character can become a good source of nutrients in developing the soft elements of landscape. In developing a landscaped landfill, the environmental risks associated such as leachate generation, groundwater contamination, greenhouse gas emission and soil stability are major concerns to be addressed. For a long term use of conventional landfills converted into 'landscaped landfills' the principles of environmental remediation techniques like phytoremediation, bioremediation and bio reactor landfills have a pivotal role to play.

The research work aims at the disposing organic/biodegradable waste on any land or designated open dumps /landfills and simultaneously using the same land for green productive purpose in a cyclic fashion thereby making it a sustainable waste management strategy. The paper discusses the practical issues in converting a landfill into landscaped landfill by doing an onsite experiment using organic kitchen waste considering parameters like the number of households, their expected production of organic waste and suitable worked out land area for dumping, digesting and assimilating waste. In an attempt to streamline the process of planning landscaped landfills, the paper describes a strategy and methodology to convert landfills into a fitting component of typical urban landscapes through enhancing its environmental significance and visual quality for sustainability.

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1. Introduction

In developing countries, rapid economic growth and urbanisation has improved the living standards, and has led to a significant increase in the amount of waste generated [Kumar,.S et.al. 2009]. In India, in most cases, no segregation of waste at source happens or if it happens then biodegradable and non- biodegradable waste is mixed up at the disposal units which are usually open dumps or landfills. This leads to deterioration of land and its resources and eventually gives rise to environmental degradation and health impairment. Moreover, landfills which were located in the outskirts of a city earlier has now shifted and become part of urban landscape which is often ignored. The non-availability of land in these urban areas for a designated land for new dumps has further enhanced the need for rehabilitation or remediation of the existing dumpsites. In an Indian context as most of the landfills refer to open dumps sites (which are not sanitary landfills in most cases), the terminology used in this paper also mean the same.

A proper waste management strategy can be devised only by knowing the quality and quantity of the waste disposed. At a global level, biodegradable waste constitutes 70% of the total waste [EEA report.2009]. It is found that biodegradable waste which is a major source of nutrients can influence the natural vegetation of a landfill site. Vegetation on landfills plays a major role in controlling soil erosion and removing contaminants besides imparting aesthetic value. Additionally it avoids the possibility of such sites becoming areas of degraded environmental quality. The current paper looks into a framework were organic waste dumping on landfills/open dumps acts as a source for landscape development while conserving the space for further disposal. In order to develop landscape out of landfills, it needs to be established that the nutrients as available at such sites due to biodegradable waste being dumped regularly can sustain appropriate variety of plant growth in required pace.

Municipal government is responsible for the waste collection, transport and disposal in most cities. It is observed that most often the authorities are unable to cope with the increasing demands in a formal waste management system. This demands a decentralised system for waste management. As an attempt to simultaneously develop and conserve urban landscape following the structure and principle of landscape design the paper initiates a waste management strategy from a neighbourhood/community level. An onsite experiment is done where the organic waste from the households in the neighbourhood are segregated, collected and brought to an identified vacant/unused land area within a neighbourhood where it is processed, maintained and transformed to a green space. A preliminary result of this study is presented in this paper so that it can be used by a larger user group thereby creating ‘landscaped landfills’ as a best practice to ensure long term usage for open dump site/landfill site.

2. Review of Literature

2.1 Waste composition and its disposal

Researches show that the waste composition dictates the waste management strategy. In India, the major portion (51%) of waste is organic in nature in spite of the change in composition due to lifestyle of the people *[Asnani. P. U. 2006,*Ranjith, K. A. 2012*]*. As the paper deals only with organic waste, their existing disposal and treatment methods only are discussed further.

Every country has different rules and regulations for disposing solid waste. About three quarters of the countries around the world uses open dumps/landfills for disposing waste [Rushbrook, P.2001]. European environmental agency (EEA) has formulated landfill directive which encourages waste to be diverted from landfills and closing it. It also promotes alternative waste management options such as recycling, composting, mechanical biological treatment and incineration. Among these, mechanical biological processing or simple composting of MSW is suggested as a best option in tropical region where landfill emissions are reduced to a larger extent [Ranaweera,R.M.R.P . 2001].

The waste handling rules in India, MSW management rules 2000 also mandates that landfill should be the last option for solid waste management and only non-biodegradable wastes should be sent to landfills[MoEF. 2000]. This is mainly in regards to the diverse nature of the waste mixture that goes to landfills and also, landfills are

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