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# Ecological Revitalization of Contaminated Site: Solid Waste Dumping Ground

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**Abstract:** ***In India, vast areas of land remain unused due to high contamination and these land parcels continually degrade natural resources around them. 37% of total land area of India comes under contaminated land and hence revitalizing such areas is necessary. Solid waste dumping grounds are a major source of soil and water contamination. Untreated waste creates unhygienic conditions and pollutes the environment in innumerable ways. Although the construction of a landfill site would minimize the problem, there is a need to improve the conditions of the site already contaminated and for this, the concept of ecological revitalization comes handy. The paper discusses the impact of Deonar solid waste dumping ground, Mumbai, on ecosystem of the area and suggests measures to improve the situation.***

**Keywords:** Ecological revitalization, contaminated site, solid waste dumping ground, site remediation, dumpsite rehabilitation

## 1. Introduction

Ecological revitalization refers to the process of returning land from a contaminated site to one that supports a functioning and sustainable habitat (Environmental Protection Agency, 2009). It aims to improve the aesthetics of a place along with recharging the natural resources in that area. This is a very common process in the United States and has been used for variety of terrains. Contaminated site may be in form of a dumping site, industrial site, eroded land on coasts, or dying wetlands. Contaminated lands can be put to sustainable use through ecological revitalization. One of the processes used widely for ecological revitalization is 'site remediation'. Remediation means removal of pollutants from environmental components like soil, water and air. Remedial actions are generally based on assessments of human health and risks to environment and there are various techniques for remediation of contaminated sites (IAEA, 2013).

Former or current dumping sites with no scientific measures to treat waste are one of the major components of contaminated properties. In India, 40% soil contamination in urban areas is due to dumpsites. 62 million tonnes of garbage is generated annually in India out of which major proportion is of plastic waste and hazardous waste. Only 68% of this waste is collected and just 18% is treated(MoUD, 2016). Rest is left untreated in large dumping grounds causing numerous problems. India dumps around 0.6 tonnes of plastic waste into oceans every year(R. Nagendran, 2006). These sites also have low groundwater tables, poor soil quality and terrible air quality. The major issue in such areas is that these problems are not limited to the landfill site only, but the same problem persists in the areas surrounding the landfill site because the pollution (land, air) due to untreated solid waste is so high that the scale of impact is large.

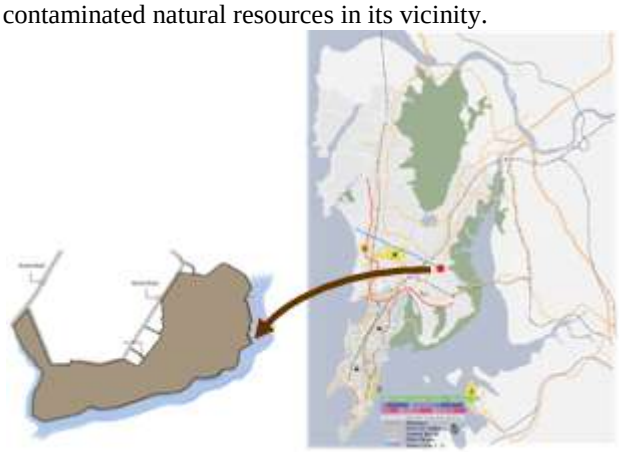
Poor institutional measures also affect the degree of contamination in urban areas to a great extent. There are very few cities in India which have mechanism for scientific disposal of solid waste. In majority of citiesany large parcel of land is used for dumping which eventually leads to ecological degradation. No measures are taken to revive the natural resources of suchcontaminated sites and hence huge parcels of land remain degraded. The dangers of land contamination, ground as well as surface water pollution, and air pollution due to the mismanagement of landfill sites are becoming more and more apparent. Improper decomposition of waste results in the unsanitary conditions of dump sites. In India, most toxic solid waste is also mixed with municipal waste and disposed of without treatment. This causes contamination of soils and water with heavy metals such as mercury, arsenic, lead and chromium (Bethany, 2017). These toxins also adversely affect the marine life of the region. During the wet season water percolates into the refuse, carrying the dissolved organic matter and metals. The liquid that finally appears at the bottom of the refuse contains high concentrations of organic, toxic compounds and micro-organisms called leachate. Due to such percolation of toxic water, ground as well as surface water gets polluted and land contamination takes place.

Soil contamination not only presents a social and sanitary issue, but also has an economic concern. This is because it implies major costs related to reduced productivity and low monetary evaluation of the contaminated site. Contaminated sites also reduce the value of nearby land parcels. Real estate declines in these areas and development patterns hamper. Since the area becomes unfavorable for residents to live in, informal sector finds solace in such lands. For instance, large communities of rag pickers can be found near dumping grounds. Eventually this leads to formation of slums near such sites which further aggravates the problem. And hence to avoid the atrocity of untreated solid waste on natural resources, contaminated sites need to be looked upon. Such sites affect both people as well as biodiversity of the region. Thus, it is important to revive the natural resources of the area by revitalizing these sites and hence maintain those conditions thereafter.

## 2. Study Area: Deonar Dumping Ground, Mumbai

Deonar dumpsite is located in Mumbai and is Asia's largest dumpsite and India's one of the oldest dumpsites, with area of 132 hectares. It receives more than 2000 metric tons of waste daily which is 23% of waste generated in the city. The height of dump is as high as 35 metres and this dumpsite has caused adverse impacts on its surroundings since years. Because of its location near water creek (Vashi creek) the

water resources have been contaminated. The soil and air quality are degraded as well and this often leads to large scale fires causing damage to surrounding areas. Recurrent fires at the site have caused conditions which are unfit for habitation. The groundwater quality and soil quality of this dumping site has deteriorated over years and reached its minimum(Sarkar, 2016). This dumping ground has also caused health hazards in nearby areas and reduced the quality of life of citizens. Diseases caused due to such surroundings include skin diseases, nausea and vomiting, eye irritation, headache, and in extreme cases nervous system damage, cancer (including leukemia) and kidney damage. There is a need to remediate the site because of contaminated natural resources in its vicinity.



## 3. Literature Review

In developing countries, due to burgeoning population and rapid urbanization, enormous quantities of solid wastes are generated daily which have led to environmental degradation. Approximately 7.6 million tons/day of municipal solid waste is generated in developing countries. No treatment of wastes is done and these are disposed in open dumps, creating health and environmental risks. Open disposal of MSW remains the predominant waste disposal option in developing countries due to reduced initial costs and lack of technical expertise and equipment for treatment of waste(R. Nagendran, 2006).

**Dumpsite Rehabilitation**

Dumpsite rehabilitation is a process followed worldwide to upgrade open dumping sites to sustainable landfill sites. In this process, an existing dumping site is excavated and is either reused or disposed in an environmentally friendly manner. This excavated waste may be moved or relocated to higher portions of the site or placed in areas to enable an adequate gradient for the closed site. Usually dumpsite rehabilitation is done due to one of the following reasons:

- Presence of marketable material in the dump that can be excavated and sold or put to use
- Stipulated requirement by the regulator/government body of the dumping ground to close and rehabilitate the site
- High levels of contaminated natural resources in the region due to open dumping

The process of rehabilitation may be carried out in phases depending on the threats of dumping site and financial aspects as well.(Joseph, 2008)

## 4. Sustainable Landfill Sites

Sustainable landfill sites improve the ecological conditions of the area and help in management of solid waste in coming years. Although operation of these landfills is an issue due to high costs of construction and operation and monitoring of gases and leachate; certain models can be adopted for making the process work efficiently. In this process, control and use of products is optimal and adverse impact on environment is hence minimal (R. Nagendran, 2006). This concept is also adopted in many national and international case studies.

**Dumpsites to Sustainable Landfills**

1) **Tunisia, Africa**: Cities in Tunisia, Africa are facing environmental problems due to inefficient disposal of generated solid wastes. With the high rate of urbanization, residential land use zones have reached the dumpsites which leads to direct exposure to health hazards. This situation caused the government of Tunisia to launch a development program to prohibit crude dumping and construct sanitary landfills. It has been suggested to convert certain parts of the dumping site, El Yahoudia in Tunisia, to a green park and to start an ornamental plant nursery. These are the zones of high contamination which cannot be rehabilitated. The other zones are proposed for rehabilitation. For this, geographical studies are done along with chemical analysis. It is proposed to set up a system of drainage channels for runoff collection, and to seal the leaks of the actual cover to reduce leachate in monsoons. This will greatly reduce the negative impact on water and soil conditions (M. Ferchichi, 2004).
2) **Dhaka, Bangladesh**: Landfill upgradation was also done in Matuail dumping site in Dhaka, Bangladesh. The major components of sustainable landfill adopted were:(Yousuf, 2009)
   - Leachate collection systems
   - Gas vents
   - Improvement of drainage system
   - Systematic operation of waste disposal facilities by daily covering
   - Weighbridge operation
   - Changes in slope of the site
   - Proper access by roads
   - Semi-aerobic landfill system
3) **Chennai, India**: Certain studies were conducted in Chennai where two dumping sites, Kodungaiyur and Perungudi, were responsible for ecological degradation of the area. The studies aimed at converting these contaminated dumping grounds to sustainable landfill sites focus on:
   - Study of dumpsites for resource recovery through landfill mining
   - Bio-rehabilitation of MSW dumpsites

   Along with this, certain recommendations were made which will help in smooth functioning of waste management systems.
   - Following a disposal plan to restrict waste tipping into small areas

- Installation of systems for the collection of landfill gas and diversion of rainwater
- Keeping the site access roads in good condition
- Protection of the disposal sites from scavengers/public by building access gates
- Maintenance of records
- Environmental monitoring

4) **Pune, India**: One of the dumping sites in Pune, an abandoned stone quarry, was at the risk of high groundwater contamination and hence measures were taken for its ecological restoration. The preliminary design included closure of the existing dumpsite, designing a landfill above the capped site adequate to handle one year's MSW, and designing in parallel another landfill adjacent to the capped site to serve the Pune Municipal Corporation for next 5 years. It was found that the topography of the site didn't allow the waste heap to be stable. Hence necessary changes were made to the slope of the site and the waste was also compacted. Then measures were taken to prevent infiltration of rain water and soil erosion. Drains were also provided on the slopes for runoff collection and gas vents were provided to release gases that could be formed within the capped landfill.

## 5. Recommendations

The measures to be taken can be divided into two parts, primary measures and secondary measures. The former is related to those measures which will be done on or near site directly, while the secondary measures are the ones which indirectly affect the contaminated site. Site remediation is the first measure to be adopted on the site, for this the site should be divided into different zones and then actions should be taken. It is recommended to prepare an action plan for the same and take measures accordingly. An ornamental nursery can be established in a certain zone of the site which will also help in generating some revenue for the municipalities. It is very important to manage the current heaps of waste and also to take measures for future waste generated as well. Since the site is in extremely poor condition, it would be beneficial to stop further dumping of wastes on site until scientific measures are adopted for its decomposition. A landfill site should be created nearby the existing site and dumping on the new site should continue with scientific methods of disposal.

Deonar dumping ground has highly affected the natural resources and hence these should be taken care of. Bioremediation is a process to clean a contaminated site by introducing microorganisms to consume and break down environmental pollutants. This process can be applied on the site to improve the conditions of natural resources. Also, measures should be taken to improve the water quality of Vashi Creek. An efficient drainage system is required to avoid leachate flow in monsoons. Mumbai receives high amount of rainfall and hence a proper drainage system is required to manage the conditions in monsoon.

The secondary measures would includemanaging the solid waste generation techniques. Segregation at source level should be ensured to avoid mixing of toxic wastes with household waste. This will help in proper disposal of wastes and hence contamination on site would reduce.The three dumping grounds of Mumbai should be efficiently managed to reduce load on a single dumping site. Strict enforcement of segregation of solid waste will also improve the situation of the site.

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