

Solid waste management at landfill sites of Nepal

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Abstract

The waste management practice in sanitary landfill sites (SLF) is a deciding factor for the assessment of environmental impacts such as littering, odor, groundwater, surface water and soil contamination. This article focuses on the types of waste coming to landfill and existing waste management practices followed at sanitary landfill sites of Nepal. The study was carried out at Sisdoles, Pokhara and Karaute Danda sanitary landfill site of Nepal. The waste composition was performed and minute particles were sent to lab to test the composition. Waste management practice was observed at field and by interviewing key informants. The organic composition of waste were found high as 61.86%, 49.12% and 65.81% at Sisdoles, Pokhara and Karaute Danda landfill sites respectively. The presence of heavy metals like lead, chromium and nickel reveals that the landfill is contaminated with industrial wastes as well. The waste management practices at Karaute Danda landfill site was better compared to other two sites, where sorting, composting and selling of recyclable and reusable wastes are done.

Keywords: Waste management practice, sanitary landfill sites, recyclable, reusable wastes.

Introduction

With the enactment of local self-governance act in 1999, municipalities are the responsible authorities for the management of solid waste generated in the municipalities. Most of the municipalities are opting for open dumping near river banks or on open areas. Though the government of Nepal is promoting the concept of 3R, solid waste disposal to landfill is considered an important and most likely SWM strategy (Thapa *et al.*, 2009). This has led to building up plans of few more landfill sites in urban areas in near future. At present, there are only three operating sanitary landfill sites and they all are only for collecting municipal and household wastes (Thapa *et al.*, 2009).

Sisdoles landfill site: The landfill site (excluding the waste processing plant of 5 ha) covers a total area of 15ha, out of which the actual landfill area cover 2 ha, site protection/ buffer zone covers 12 ha, and the rest 1 ha is covered by other facilities for waste management. The landfill consists of two valleys. The first valley is 11200 sq. meters with a volume capacity of 166085 cum and second valley is 9501 sq. meters with a volume capacity of 108910 sq. meters (source: Kathmandu Metropolitan City).

Pokhara sanitary landfill site: The total area of the landfill site is 10 ha, with 4 ha for landfilling, 1.5 ha for leachate treatment facility. 3.75 ha of buffer zone, internal road and other infrastructure and 0.75 ha of composting unit, yet to be commenced. The terrain longitudinal slope along east to west is of about 2% and about 3% along north to south (source: Pokhara municipality).

Karaute Danda sanitary landfill site: The total area of landfill site is 20 ha. Only 1 ha land has been utilized for waste management while rest of the land is used for fruits and tree plantation. The landfill site shall not be considered a sanitary landfill site as the landfill site is not engineered, though there is the provision of waste

segregation house, composting unit and collection house of plastic and paper. No liners and perforated pipes are used at the landfill site (source: Gorahi municipality).

The various impacts caused due to improper waste management at landfill site includes: fatal accidents, infrastructure damage pollution of the local environment, offgassing of methane generated by decaying organic wastes, harbouring of disease vectors such as rats and flies, particularly from improperly operated landfills, which are common in Third-world countries, injuries to wildlife, and simple nuisance problems(Wikipedia).

Methodology

Sampling: For the composition Study, 7% of the vehicles coming to the sites were considered and sample of about 50 kg from each vehicle was taken. The samples were put on the plastic mat so that no wetting effect was observed. The fractional minute particles remained after the composition was sampled for lab analysis at Vishwas lab, Kathmandu.

Data acquisition from concerned authorities: Different data were acquired from different concerned authorities of both landfill sites and municipality office. The population and growth rate, information of landfill's waste management practice such as soil cover, compaction were acquired from landfill's supervisors and municipality office.

Composition study of the waste: Composition study of the waste was done using the *waste reduction method*. In this method, the waste sampling waste is divided into four quarters, from which, the diagonal are taken and remaining diagonal is removed. Then it is thoroughly mixed. Again the similar process is done, on which the composition study is conducted. The wastes were segregated as organic waste, plastics, paper, glass, rubber/leather, textile, metal, construction and demolition waste and others (having less economic value).



Data analysis and interpretation: The quantification survey was conducted assuming the density of the waste to be 300 kg/m³ for un-compacted vehicle and 550 kg/m³ for compacters data from municipality were used to calculate the per capita waste contribution to the landfill. Apart from that composition surveys, data and lab results of leachate, minute fractional particles of composition were also analyzed and interpreted.

Results and discussion

As per our quantification and composition survey conducted at the site, the results are shown in Table 1. The figures in Table 1 show that the percentage of organic content of solid waste is relatively greater in all three landfills with the least percentage of 49.12 at Pokhara SLF. Glass, plastics, rubber and leather and textile were relatively higher in composition at Pokhara SLF. This may be due to the majority of tourists at the city consuming more packed foods. Organic, plastic and paper content of the waste are higher at all the landfill.

Table 1. Composition of solid waste at Sisdoles, Pokhara & Karaute Danda LFS

	Sisdoles LFS	Pokhara LFS	Karaute Danda LFS
Total waste disposal (Ton/day)	353.5	61.9	6.96
Waste contribution to landfill (kg/person/day)	0.3	0.255	0.12
Organic (%)	61.86	49.12	65.81
Plastic (%)	12	12.71	8.42
Paper (%)	10.34	9.67	12.24
Glass (%)	3.31	5.6	3.06
Rubber & leather (%)	0.83	4.17	0.37
Textile (%)	5.28	7.59	3.83
Construction & Demolition Waste (%)	3.98	4.5	4.59
Metals (%)	0.21	1.14	0.15
Others (%)	2.2	5.5	1.53

The laboratory results of minute fraction after composition survey is shown in Table 2. The lab analysis of the minute fraction confirms that there is the presence of nickel, chromium, lead and copper. Since there is no provision of proper checking of wastes entering at LFS, all the wastes were directly filled at the site. Besides the municipal solid waste, wastes from the hospitals and some industries were also entering the site. Even in our limited volume of composition survey; we found syringes, medicinal expired tablets and bottles, industrial throw-outs in large volumes in all landfill sites. This can be a serious threat to the workers regarding safety. Similarly, some scavengers are found to be working at Sisdoles LFS and Pokhara LFS near the operating compactors, which can lead to accidents.

At Sisdoles and Pokhara LFS, the waste is unloaded from the vehicles at the site and covered with the soil. The land filling type is area method. There is no practice

of sorting of the waste. Certain wastes like paper, plastic, glasses and metals having economic value are sorted and sold by locals, with no economic gain for landfill sites. At Karaute Danda LFS, the waste is sorted after unloading from the vehicle at the transfer station built at the landfill area itself. The paper and plastics are separated that is sold in the market since 2009. The practice of composting has been started. The compost from the landfill site is sold for Rs. 300 per 10 cu.ft (280 litres) load. Plastic and rubber are sold for Rs.13/kg (Ghorahi municipality, 2008 data) becoming the source of income for the Ghorahi municipality for solid waste management. There seems to be dominant problem of litter and odor at Sisdoles LFS, there is a slight problem at Pokhara but there is very less dominant litter and odor problem at Karaute Danda LFS (Table 3).

Conclusion

The composition of waste coming to LFS was seen mostly to be consisting of organic waste averaging 60.07% so the provision of segregation and reuse of organic waste by composting and anaerobic digestion and recycling of paper and plastic can be the source of revenue and aid in increasing life of landfill site. The waste consists of 10.27% of paper, 12.04% plastics and some amount of metals. The study revealed that practice till date of waste management at site is well managed at Karaute Danda landfill site in terms of waste segregation and earning by selling the reusable items but the manual sorting of the waste can lead to the health hazard of the scavengers. Though the municipalities are claiming to be accepting only the municipal and HH waste but the lab analysis and field analysis verified that there is still contamination of medical and industrial wastes in all landfill site. This can also lead to ground water and surface water contamination, soil contamination and also can be a serious health threat to scavengers. Though the practice of landfill mining has started in many countries, dumping of all the waste can be considered as dumping the resource of the nation.

Table 2. Laboratory results of minute fractions of solid waste at landfills

Parameters	Observed values (%)		
	Sisdoles	Pokhara	Ghorahi
Moisture (%)	35.3	23.6	28.6
Organic matters (%)	22.43	9.12	18.32
Total nitrogen (%)	0.87	0.63	0.73
Total phosphorous (%)	0.192	0.077	0.153
Lead (µg/g)	16.72	18.99	25.92
Cadmium (µg/g)	3.24	<1.25	<1.25
Nickel (µg/g)	16.47	14.99	14.95
Chromium (µg/g)	5.74	4.06	4.98
Copper (µg/g)	185.70	185.0	343.51
Potassium (µg/g)	164.72	389.73	164.47

Table 3. Waste management practices at three landfills.

Parameters	Sisdole LFS	Pokhara LFS	Karaute Danda LFS
Sorting at site	No	No	Yes
Provision of composting	No	No (in future plan)	Yes
Provision of selling reusable & recyclable waste	No	No	Yes
Land filling type	Area	Area	Area
Provision of spreading	chain dozer	Chain dozer	Manually
Provision of compaction	Yes	Yes	No
Soil cover provision	Yes	Yes	Yes
Soil cover	2-4 inch	2-4 inch	2-4 inch
Littering problem	Dominant	Slight	No
Odor problem	Dominant	Slight	No
Industrial contamination	Yes	Yes	Yes
Medical contamination	Yes	Yes	Yes

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