Rehabilitation of Dumpsite Landscapes of Urban Areas in Sri Lanka

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A dissertation presented to the University of Moratuwa,
for the Master of Science in Landscape Design, 2009

Dedicated to my loving parents

and my family.

This is to declare that the dissertation presented to the University of Moratuwa, for the Master of Science in Landscape Design has been composed by me.

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Abstract

The rate of urbanization in Sri Lanka is estimated to be of the order of 2-2.5 percent per annum and it is expected that by year 2015, 45 percent of the population will be urban dwellers (CFE, 2003). Massive scale waste dumpsites are by-products of urbanization and disposal of wastes is a major and growing urban environmental issue. The attitude on waste and how to handle it will depend on the level of social and economic development of a country. The efficiency of solid waste collection and the final disposal will greatly determine the basic appearance or the beauty of the particular urban environment.

Many of the natural or the man made landscapes in urban and suburban environments such as wetlands and road side reservations have been totally changed and degraded due to waste disposal. Some of these changes are irreversible or otherwise with very high environmental cost in bringing it back to its original condition. Many Urban Local Authorities are unable to re-correct the damage due to environmental, financial and technical factors. Finding suitable disposal sites is also very critical as the land values in many of the urban areas are very high. Many urban local authorities are now looking for alternative sites for waste disposal such as wetlands, low-lying areas, and forest reserves, though they are environmentally sensitive, or otherwise trying to rehabilitate the existing and abandoned dump sites. However once a disposal site has come to its full capacity level, the site is required to be rehabilitated and put to another usage. This study will look into the role of a landscape designer in planning and designing a dump site at the early stages to achieve a good result of a final landscape and will study the ultimate use of a solid waste disposal site whether it had been used as a landfill or sanitary land fills or as an open dump site, as a forest plantation, industrial park, vehicle park, or as a recreational space or sport fields. The study will also look in to the different aspects and options in rehabilitation of dumpsite landscape.

Acknowledgement

I express my gratitude to Architect Mrs. Shirani Balasuriya, Senior Lecturer and Course Coordinator of the Landscape Design M.Sc Programme, Faculty of Architecture, University of Moratuwa for her constant guidance and endless encouragement throughout this study.

I also wish to express my deepest gratitude to Dr. John Byrom, for his voluble advices, patience reading of my dissertation, correction and guidance extended throughout this study.

My sincere thanks to Architect Mrs. Sherine Amendra and Mr. Susira Udalamatte, Lecturer, Faculty of Architect, University of Moratuwa for their advices and guidance to improve this study.

Gratitude is expressed to Mr. S.A.G.L. Subasinghe, Governance and Institutional Development Manger, United Nation Office for Project Services, Mr. Chatura Malwana and Ms. Sankaja, Oficers of Pilisaru Project, Ministry of Environment and Mr. Mahesh Jalthota, Assistant Director, Central Environmental Authority for their valuable support given to make this study a success.

Sincere thanks to Ms. Malkanthi Perera, Landscape Unit of Faculty of Architect, University of Moratuwa and My colleagues Indrani, Rohini, Chamith, Wasantha, Wasawa and Sanath for their willing support and encouragement throughout this study.

1.0 Introduction

Throughout history, mankind has used the earth's basic resources as the means of improving his quality of life. Until quite recently in the history of mankind, the renewable resources like plants and animals and non-renewable resources like minerals were used freely and heedlessly as they were considered limitless and his surrounding environment, considered a bottomless sink, used for the dumping of waste materials and the by-products of development activities. The world has at last realized that there are limits to the self–cleansing capacity of the biosphere, and that these limits are being exceeded in many areas.

Developing countries, especially in Asia are being transformed from rural villages to a world of cities and towns. Thus the rapid population growth and urbanization in these developing countries have led to the generation of enormous quantities of municipal garbage and consequential environmental degradation. Recent projections indicate that more than half the population of the developing world will be living in urban areas by the year 2020 (Pilapitiya, 1995). The rate of urbanization in Sri Lanka is estimated to be of the order of 2.0 - 2.5 percent and it is expected that by year 2015, 45 % of the population will be urban dwellers. Thus use of natural resources in Sri Lanka has been no different in kind, though lower in scale, compared to the industrialized countries (CFE, 2003).

Massive scale solid wastes are by-products of urbanization, and disposal of these wastes is a major and growing national public health and urban environmental issue. The attitude on waste and the way it is handle will depend on the level of social and economic development of a country and the efficiency of solid waste collection. Final disposal will determine the basic appearance or the beauty of the particular urban landscape. The general appearance of a city is the mirror of its development, and is a serious concern, particularly in capital cities, which are often gateways to countries for foreign diplomats, businessmen, and tourists. Poor visual appearance of these cities (see figure 1.1) caused from present haphazard disposal practices will create negative image discouraging industrial development opportunities including tourism and official visits.

Figure 1.1 A mountain of uncollected garbage in Pettah, Colombo the Commercial Hub in the Island. ***Source : Daily Mirror Wednesday, April 01, 2009***

Therefore, a safe and reliable final disposal of municipal solid wastes that reduces its impacts to the public health and the surrounding environment is an important component of an integrated waste management system and a good indicator of a sustainable urban development. However, the open dumping of municipal solid wastes, which is a primitive stage of waste disposal, is practiced by about three-fourths of the countries and territories in the world (Rush brook, 2001). The open dumps or dumpsites cause degradation of the environment since they are susceptible to open burning, groundwater pollution and exposed to scavengers and disease vectors. Problems of shortage of cover, lack of leachate collection and treatment, inadequate compaction, poor site design, and rag-picker invasion are common (Sardinia, 2005). Many of the natural or the created landscapes in urban and suburban environments such as river banks, urban wetlands, urban forests areas and road side reservations have been changed and many have been totally degraded due to haphazard waste disposal. Some of these changes are irreversible or otherwise will have very high environmental cost to bring back to their original condition.

1.1 Practical and Research Problem

Many Urban Local Authorities are unable to handle the problem of solid waste disposal due to environmental factors and to financial and technical inability. Lack of a proper solid waste management system and the huge amount of waste generations at present day, make it difficult to handle the problem. Finding a suitable disposal site is again a very controversial issue due to lack of suitable lands and very high land values in urban areas. Urban local authorities are now looking for alternative waste disposal sites such as abandoned paddy fields, marshes, low-lying areas, and forest reserves, though these are environmentally sensitive. Growing concerns about public health, environmental quality and the risks associated with existing dumps make it almost impossible to site new landfills in many parts of the country and in the world as well. However once a waste disposal site has come to the level where it cannot receive any more waste that is to its full capacity level, the site is required to be abandoned, rehabilitated and used for another usage. This calls for an integrated approach for sustainable management of dumpsites and their rehabilitation. Assessing the relative health and environment hazards posed by dumpsite landscapes existing throughout a country may prioritize, plan and initiate dumpsite rehabilitation. Identifying the environmental risk factors of concern will allow a community to target its efforts to minimize both the risk potential of the landfill and the cost. The inputs of a team of technical experts are therefore, very important and will determine the final results of dumpsite rehabilitation process.

Figure 1.2 Haphazard waste collections in city area of India

Figure1.3 Haphazard waste Disposal in the city area of India. ***Source: MSW in Asia, AIT***

1.1.1 The objective of the study

The study will look into the role of technical experts including a landscape designer, in planning and designing a dump site at the early stages for a good result of a final landscape and the ultimate use of a dump site landscape whether it had been used for landfill, sanitary land fill or an open dumping site, to a forest plantation vegetation, eco park, industrial park, vehicle park, or as a recreational space or sport fields. The study will also look in to the different aspects and options of sustainable municipal solid waste management in rehabilitation of dumpsite landscapes.

1.1.2. The methodology of the study

The approaches of sustainable solid waste management and experiences of dump site rehabilitation both in local and foreign countries will be studied. Three cases, namely the Rehabilitated landfill site at Navinna, in Maharagama, the Bluemendhal landfill site in Colombo, a dump site to be rehabilitated, and the World Cup Park in South Korea which has been successfully rehabilitated, will be studied and discussed.

1.2 Trends and conditions of Municipal solid wastes generation in the world

Management of municipal solid wastes is one of the most pressing environmental concerns confronting any society. Uncontrolled municipal solid waste poses a difficult and complex issue for societies and their living environments. Especially the developing world is faced with difficulties that arise out of a Municipal Solid Waste stream that is quantitatively large and qualitatively heterogeneous, reflecting the myriad of consumer products manufactured in modern industrial society. Municipal solid waste is largely generated in densely populated areas, where its management is most constrained. While the problem cuts across a wide range of human activities and interests, it represents a uniquely familiar environmental problem, in that it is one environmental problem that every single human being contributes to in the course of daily living. (Noble, G. 1995)

It has been estimated that the global burden of municipal solid waste amounted to two third of a kilogram of waste per person per day. It is widely accepted that industrialized countries account for a disproportionately high share of the world's waste production relative to their share of the world's population. Analysis across countries over time reveal that the generation of municipal solid waste is positively related to variations in per capita income and to size among countries with compatible per capita income (Noble, G. 1995). Although the developing countries spend between 20 – 70% of their municipal revenues on solid waste management, they often are unable to provide a state of the art technology for proper management of municipal solid wastes for creation of a clean and aesthetically pleasing urban environment. Waste generation rate in low income countries ranges between 0.4–0.8 kg/person /day whereas in fully industrialized nations the same varies between is 0.7-2.8 kg/person/day.

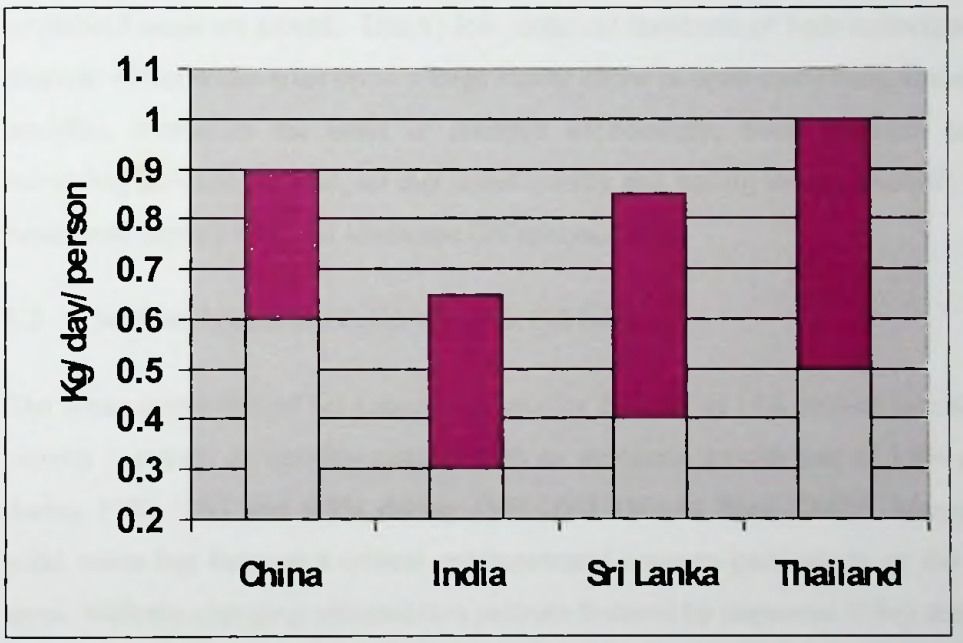

Figure 1.4: Per Capita municipal solid waste generations in the Asia, 2002
Source: Municipal Solid Waste Management in Asia,* AIT *(2006).

Furthermore, in developing countries, the moisture content of the Municipal solid waste is 2-3 times greater with a high amount of organic matter (especially food items), containing smaller size particles on average.

Solid waste management practices for collection, processing and final disposal differ significantly among countries, based on the waste compositions, key environmental and economic features. Among management practices, the least efficient are generally found in developing countries, creating serious threats to local environmental quality and public health. This is of serious concern since it is projected that Municipal solid waste will increase at an annual rate of 2.7 percent through the year 2010 in developing countries (Pilapitiya, 1997). Asian cities, however exhibit a lower specific waste generation rate than cities in industrialized countries due to the intensive recycling activities of the formal and informal. The capacities of Asian municipalities to collect, process, dispose of, or reuse solid waste in a cost efficient way is far limited. It was estimated that 20-50% of the solid waste generated in the South Asia remains uncollected (UNEP, 2001a). At present in many large cities in developing countries, such as Sri Lanka and India, less than 70 percent of municipal solid wastes are collected and only 50 percent of the household areas are served. Due to low technical standards of both collection and final disposal of the waste ends up to a large extent either in open dumpsites, non-engineered landfills, burned in the open or dumped haphazardly. Such practices are putting increasing pressure on land, air and water quality and posing threats basically to human health and degrade the total landscape (Pilapitiya, 1997).

1.3 State of Municipal Solid Waste in Sri Lanka

The urban population of Sri Lanka accounts for 23% of its 19.6 million inhabitants. The country is mainly an agrarian country with an economic growth rate of 3.9% per annum during 1981–1991 and 4.9% during 1991-2001 (World Bank, 2003). Management of solid waste has become a critical environmental concern particularly in the urbanized areas. With the changing consumption patterns fostered by improved living standards, the quantity of solid waste has been increasing over the years. Rapid economic changes resulting from the introduction of more liberal and growth oriented industrial policies during the last two decades have not been balanced by necessary investments in urban infrastructure facilities, especially the urban solid waste management sector. The heterogeneity of the waste also causes a serious threat to the workers and the general environment. Figure 1.5 shows the MSW generated in the Colombo Municipal Council

(CMC) area, the capital city, which indicates a steady increase in waste generation between 1998 and 2000.

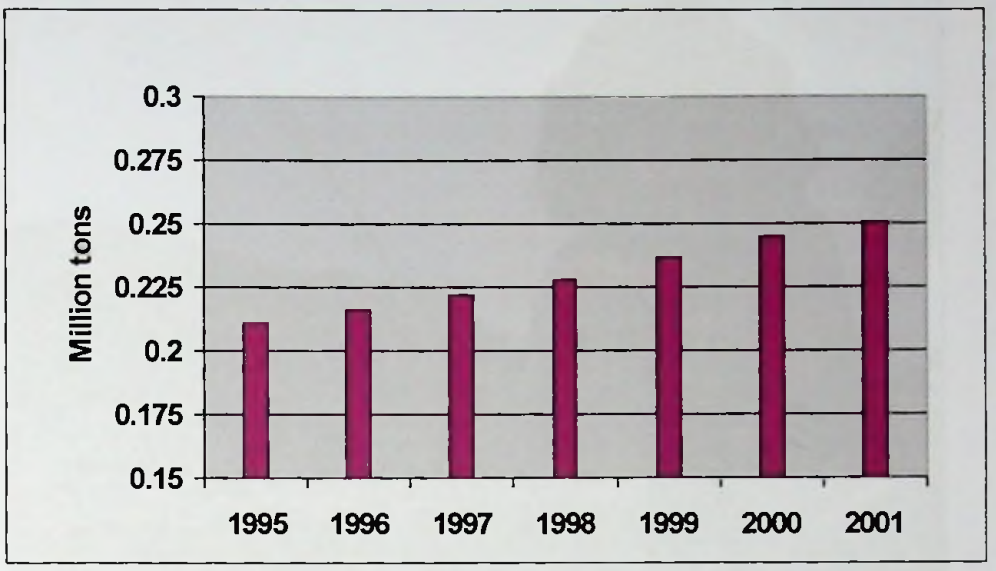

Figure 1.5 Solid Waste generated in the Colombo Municipal Council area

Source: MSWM in Asia, AIT, 2006

Analysis of date has revealed that the per capita solid waste generation per day on the average was 0.85 kg in Colombo Municipal Council area, 0.75 kg in other Municipal Councils areas, 0.60 kg in urban council areas and 0.40 kg in Praseshiya Sabahas areas. The primary sources of the municipal solid waste are households, markets and commercial establishments while the secondary sources are industries and hospitals. Like other developing nations this sharp rise in the municipal solid waste generation is mainly due to the improved living standards, population growth and urbanization. Daily waste collection by local authorities in country area is estimated at 2683 tons. However the total municipal solid waste generation is assumed to be around 6,400 tons per day (UNEP, 2001a). This means that nearly a half of the waste generated is not properly collected in the island by most of the local authorities and poses a threat to human hygiene, safety, and the environment (Figure 1.6).

Figure 1.6: Children are at greatest risk from the garbage being deposited daily in Sedawatte, Colombo *Source: The Sunday Times, Sunday March 22, 2009*

1.4 Role of Central Government in Solid Waste Management

The Government of Sri Lanka has taken initiatives to preserve its pristine environment in the island, and has adopted the following measures:

1. The National Environment Act (NEA) was enacted in 1980 to establish the Central Environmental Authority (CEA) whose powers, functions and duties relate to the protection, management and enhancement of the environment by regulations to not only maintain control of environmental quality but also to abate pollution and other related matters.

2. The National Strategy for Solid Waste Management was launched by the Ministry of Environment and Natural Resources in May 2000 to manage solid waste from generation to disposal, and identify strategies of waste avoidance, reduction, re-use, recycling and final disposal.

In addition the government has to take initiative to provide infrastructure facilities to establish proper waste collection and transport of solid waste to reduce haphazard disposal practices and to ensure disposal of waste in an environmentally sound manner.

1.5 Role of Local Authorities in Municipal Solid Waste Management

The general duties of local authorities are more important for the well being of the public in their respective administrative areas. Urban Development, Environment management and Provision of Infrastructures, are some of the main responsibilities assigned to local authorities (UNESCAP, 2003). Even at the time of independence in 1948 the systems of local authorities were in operation as municipal councils, town councils and village committees and in 1987 under the provision of Pradeshiya Sabha Act No.15 of 1987 the Pradeshiya Sabha the smallest administrative units were established. Maintenance of roads, sanitation, public health, water supply, solid waste and sewerage management systems etc. are the main functions of local authorities since their very inception.

1.5.1 Provisions of the Local Government Law

The legal framework required for solid waste management is adequately provided under Local Government Acts and the local authorities are responsible for the collection and disposal of solid waste in the country. The sections 129, 130, and 131 of the municipal Council Ordinance; the sections 118, 119 and 120 of the Urban Council Ordinance and the section 93 and 94 of the Pradeshiya Sabha Act have clearly and adequately provided for the management and disposal of solid waste in the respective areas. All street refuse, house refuse, night soil or other similar matter collected by the local authorities under the provisions of this part shall be the property of the council, and the council shall have the full power to sell or dispose of all such matter and local authorities shall provide places convenient for the proper disposal of solid waste collected in their respective area from time to time as necessary. However local authorities in Sri Lanka are faced with increased demands for improved services, while facing infrastructure challenges, fiscal constraints and scarce resources (Anon, 2000).

1.5.2 Constraints in Local Authorities in solid waste management

Following constraints are typical in local authorities at both national and local levels in solid waste management sector, (UNESCAP, 2003)

(a) Technical Constraints

Many officers in charge of solid waste management, particularly at the local level, have little or no technical background and training in environmental planning, engineering, and management. Sometimes there is no overall master plan for solid waste management. As a result, a solid waste management technology is often selected without due consideration to its appropriateness in waste management. Therefore even some assistance is provided to a component of a solid waste management system for which the use of resources may not be most cost-effective in improving a general disposal site and would have little impact on the overall solid waste management effectiveness.

(b) Financial Constraints

In general, solid waste management is given a very low priority in developing countries, except in capital and large cities. Limited funds are provided to the solid waste management sector by the central government. The problem is acute at the local government level where the local taxation system is inadequately developed and therefore, the financial basis for public services, especially the solid waste management, is very weak. Thereby, the levels of services required for protection of public health and the environment are not attained. In addition to the limited funds, many local governments in developing countries have experienced with lack of good financial management and planning, as such in many local authorities in developing countries, over 90% of the annual budget provided for solid waste management was often used up within the first six months.

(c) Institutional Constraints

Although several agencies at the national level involved in solid waste management and related planning works, the roles or functions of these agencies in waste management and planning, defined in relation to the issue of waste management is not clear. The lack of coordination among agencies often results duplication of efforts, wasting of resources, and un-sustainability of overall solid waste management and planning programmes. In large metropolitan areas where there is more than one local government, coordination among the local governments is critical to achieve the most cost-effective alternatives for solid waste management in the area. For instance, the siting of a common solid waste transfer station or disposal facility for use by more than one local government is cost-effective due to its economy of scale. However, as these facilities are usually considered unwanted installations and create not-in-my-backyard (NIMBY) syndromes among the residents, and therefore, no local government is willing to locate them within its boundary.

(d) Economic Constraints

Economic and industrial development plays key roles in solid waste management. Most developed countries or local government with an enhanced economy are able to allocate more funds for solid waste management, providing a more sustainable financial basis, while the local authorities which have weak economic bases and, hence, insufficient funds for sustainable development of solid waste management systems.

(e) Social Constraints

The social status of waste management workers is generally low in both developed and developing countries. This owes much to a negative perception of people regarding the work which involves the handling of waste or unwanted material. Such people's perception leads to the disrespect for the work and in turn produces low working ethics of laborers and poor quality of their work. At dump

sites, transfer stations, and street refuse bins, waste picking or scavenging activities are common scenes in developing countries. The existence of waste pickers/scavengers creates often an obstacle to the operation of solid waste collection and disposal services. However, if organized properly, their activities can be effectively incorporated into a waste recycling system. Such an opportunistic approach is required for sustainable development of solid waste management programmes in developing countries.

1.6 Issues of Municipal Solid Wastes

The price one has to pay for neglecting the issue of municipal solid wastes is unpredictable. Tons of solid wastes remain unattended under the existing system in most of the developing nations and those collected are disposed in open dumps providing free access to scavengers and animals without considering the aesthetic values of the particular environment, health and safety factors in the areas (Figure 1.7).

Figure 1.7 Scavenging animals at the dumpsite in wildlife protected area in Habarana

Further the disposal of solid waste has resulted in environmental problems like the use of wetlands as disposal sites, ground water contamination, air pollution, decreased values of properties, affect on the ecosystem and damages to total landscapes. Figure 1.8 shows the haphazard solid waste disposal in the catchment of the Darga Town Lake.

Figure 1.8 Degradation of water bodies due to disposal of solid waste

The major environmental issues and concerns in municipal solid waste are:

1. Ever increasing demand for land required for municipal solid waste disposal
2. Unsanitary disposal of wastes in open dumps leading to surface and ground water contamination
3. Seepage of leachate from existing non-engineered landfills leads to ground and surface water pollutions
4. Release of landfill gases from open dumps and non-engineered landfills contributing to global warming
5. Open dumping of biomedical wastes that could trigger epidemics and other hazardous wastes (oils, used batteries, discarded paints, spent chemicals) and carcinogens like asbestos causing significant adverse impacts on the environment and human health

6. Air pollution by dioxins, particulates and hydrocarbon emissions from local incineration plants or by open burning due to incomplete combustion of commingled waste and its plastic derivatives
7. Occupational hazards to solid waste workers, scavengers and waste pickers;
8. Aesthetic nuisance due to odor, noise, dust and appearance especially by littering of the disposables and infestation by scavenging animals and pests on uncollected garbage or at the dumpsites.

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Chapter Two

Methods of Solid Waste Management

2.0 Definition of Solid Waste

Solid waste is described as non liquid waste materials arising from domestic, trade, commercial, industrial and agricultural sectors as well as wastes arising from public sectors. Solid waste comprises various different materials such as food waste, discarded clothing, garden waste, construction waste, factory off cuts and process waste and packaging in the form of paper, metals, plastics, or glass etc (Anon, 2000).

2.1 Solid Waste Management

Solid waste management includes management activities associated with generation of waste, storage, collection, transfer and transport, processing and final disposal of solid waste in an environmentally sound manner. It encompasses planning, organization, administration, financial, legal and engineering aspects involving interdisciplinary relationships (Anon, 2000).

2.1.1 National Solid Waste Management Strategy in Sri Lanka

The National Strategy for solid waste management was introduced by the Ministry of Forestry and Environment in year 2000 and it is based on the broad policy of waste management from generation to final disposal and aftercare. The national strategy of solid waste management involves public awareness, waste avoidance, reduction, reuse, recycling and final disposal in an environmentally sound manner.

2.1.1.1 Public Awareness:

Public awareness is the first step of any solid waste management process. Waste management does not begin, at the time of waste collection begins, as commonly perceived. It begins with the consumer at the time of purchase of any goods, since any purchase results in waste. Public awareness on possible ways to reduce waste as a consumer, such as less packaging, is the starting point of an integrated solid waste

management system. The well known 3 R's of waste management Reduce, Reuse, and Recycle is the part of waste management process that provides the best opportunity for public participation followed by a final disposal method for the residue. Many countries in the world follow this strategy for Municipal solid waste management.

2.1.1.2 Sorting of Waste at Source

Source level waste materials separation has been practiced in the Asian region long before it was introduced in the western countries. Separation of bottles and newspapers at the household level for sale to venders has been a feature of south Asian life for decades. Sorting of waste at source level is an important activity which should be encouraged through education and awareness programs. Sorting of waste at the source level make recycling, reuse, and use for other disposal processes economically viable to a considerable extent.

2.1.1.3 Waste Reduction

Generation of waste in the process of production and consumption is inevitable. However the national policy should be aimed at reduction of waste by encouraging producers and consumers through education and awareness as the present rate of waste generation can be reduced to a considerable extent by good house keeping practices. Excessive packaging causes rapid increase of the generator of solid waste. Generation of such waste can be reduced to a considerable extent, by reducing the demand for such packaging by consumers by considering their own disposal problems at source and the problems associated with the final disposal. Waste reduction may be approached in several ways. Increased environmental awareness among consumers can lead to waste minimization and reuse. Though the waste minimization in the Asian region is little less, there is an extensive reuse and recycling of material in the region, mainly due to economic necessity rather than through environmental awareness.

2.1.1.4 Reuse of Waste

Reuse of waste helps waste reduction. A product becomes a waste when it is not used any longer. Therefore, consumers should encourage re use of the products for some other purposes when such products have completed their original intended use.

2.1.1.5 Recycling of Waste

Recycling of waste also helps to reduce and reuse the amount of waste to a considerable extent, making final disposal manageable. Sustainable waste collection systems should be established in order to make recycling economically viable.

2.1.1.6 Composting

Analysis of data in Sri Lanka reveals that most of the solid wastes contain biodegradable waste is suitable for composting. The local authorities should promote this activity. This activity would reduce by a considerable amount the bulk of final disposal.

2.1.1.7 Final disposal

The remaining solid waste, mostly inert and unusable has to be disposed of somewhere in a final disposal site. Final disposal is an integral part of any municipal solid waste management plan. Final disposal in most of the developing countries is usually a matter of transporting the collected waste to the nearest available open space and discharging it. Open Dumping, Controlled dumping, Engineered and, Sanitary Landfill, Controlled Contaminant Release Landfill, Landfill Bioreactor, Open burning, Incineration, Energy Recovery bio gas utilization are some of the disposal methods practiced in the World.

2.2 Integrated solid waste management

A sustainable solid waste management system should include an integration of the preceding activities in an economically feasible manner. Integration of waste avoidance, sorting at source level including waste reduction, reuse and recycling, composting and finally disposal through an environmentally sound manner could be developed either individually or by combination of several local authorities together depending on the amount and type of waste generated. The process is completed with the introduction of environmentally sustainable closure and aftercare of the disposal sites. (Anon, 2000)

2.3 Solid Waste Disposal types and related environmental problems

Open dumping including open burning, is the predominant waste disposal method carried out in many developing countries. Composting is not often carried out to its full capacity that can reduce almost by half the municipal solid waste of the final disposal site. Other types of disposal like animal feeding, ploughing into soil, open burning and dumping in water bodies or wetlands contribute to environmental hazards. Burning of solid waste is practiced by most of the local authorities both in waste collection points and the disposal sites to reduce its volume and minimize the attraction of animals and vermin. This will leads to degradation of valuable land resources and the creation of long-term environmental and human health problems. It is also Carbon unfriendly (ISWA & UNEP 2002). Table 2.1 illustrates the methods in some selected countries of the Asia and the Pacific Region.

Table 2.1 Final disposal methods of solid waste in selected countries of the region

Country	Open dumping/ Burning	Composting	Land filling	Incineration	Others
Japan	0	10	15	75	0
Singapore	0	0	30	70	0
Australia	0	10	80	5	5
Republic of Korea	20	5	60	5	10
Malaysia	50	10	30	5	5
Indonesia	60	15	10	2	13
Philippines	75	10	10	0	5
Vietnam	70	10	0	0	20
Pakistan	80	5	5	0	10
Bangladesh	95	0	0	0	5
Nepal	70	5	10	0	15
Mongolia	85	5	0	0	10

Source: UN, 2000

2.3.1 Land filling

A landfill, be it an open dump, a semi controlled landfill or a sanitary landfill, is an integral part of any municipal sold waste management plan. This fact has to be borne in mind by any solid waste management planner or policy maker, regardless of possible claims that may be made to the contrary. While the introduction of 3 R's (Reduce, reuse and recycle) and various other solid waste treatment technologies into an integrated solid waste management plan would reduce the volume of waste that requires disposal at a landfill it by no means eliminates the need for ultimate disposal (Noble, 1995). All forms of materials recovery and waste treatment technologies result in a residue that needs a final disposal option, which will continue to be a landfill for the foreseeable future. For example, non reusable or recyclable products which may in turn be subject to some form of treatment by composting, anaerobic digestion or incineration would result in residues non-degradable from the biological processes and ash from incineration, which require ultimate disposal. Solid waste managers and planners have control over it (Noble, 1995).

2.3.1.1 Dump site verses landfill

Dumpsite and landfill are two means of waste disposal used in different countries. The main difference between them is that, a dumpsite is an area where the waste is unloaded

in a pile without proper site preparation while a landfill (normally refers to a sanitary landfill) is designed to minimize the potential for groundwater contamination. A dumpsite is normally an open or excavated area where the waste is disposed of and left uncovered without any surface liner or protective measures. Such sites allow free access to waste pickers and often produce unpleasant odours and aesthetic nuisance. At present solid waste disposal sites are often located in low-lying areas creating a tendency to surface and ground water pollution. Landfills, on the other hand consist of an area of excavated land covered with protective, impervious liner to shield the surface from direct contact with disposed waste. Sanitary landfills have covers and leachate collection/ treatment systems where as open dumps confined by a rough edge bund but with no attempt made to prevent leachate contamination of ground water (see figure 2.1 and 2.2). (Basnayake, 2006).

Figure 2.1 Bluemendhul open dump in Colombo

Figure 2.2 Gohagoda open dump in Kandy

2.3.1.2 Sanitary landfill

A sanitary landfill is designed for the final disposal of waste in an environmentally sound manner. There is a clear distinction between dumping which is a common disposal practice in many developing countries like Sri Lanka, India and a sanitary landfill site. A sanitary landfill site is designed to minimize the adverse effects associated with solid waste disposal. The design aims to include avoidance of containment of leachate and gas, daily cover for the working surface and avoid ground water pollution. A sanitary landfill site is also aesthetically more acceptable and may be designed with involvement of a landscape designer in the planning team. (Anon, 2003)

leachate which can contaminate nearby surface and ground water (Figure 2.6). Abandoned open lands in urban areas have become typical places for the disposal of solid waste.

Figure 2.5 Dumpsites - a burning problem

Figure 2.6. Dumpsites - potential source of water pollution

Figure 2.7 Dumpsites – animals roaming

Figure 2.8 Dumpsites – scavenging

These wastes may be scattered all over the streets and such abandoned land degrades the urban landscape. Once begun for disposal, these places can build up huge mountains of solid waste in no time. This practice is seen all over the world, especially in developing countries. Illegal disposal is also seen along road sides. Communities and commercial people carry their waste and dispose of them in ditches and roadsides. Failure to collect these wastes by municipalities results in their degradation causing water pollution, air pollution and bad odour. Combustion and explosion of dump sites due to fire may also be able to be seen in many urban areas. The fire can be dangerous if not properly controlled (Figure 2.5).

2. 4 Land Use Planning for Municipal solid waste management

Land use planning should be integrated with solid waste management. Land use planning should be carried out in three strategic levels namely Macro level, Meso-level and Micro levels.

1. **Macro level** – Strategically located sites are to be reserved for regional urban solid waste sanitary landfills, hazardous waste sanitary landfills, and some combined sanitary landfills planning for long term.
2. **Meso–level** – Sites to be allocated for urban solid waste transfer stations, preferably shared by 2 or more adjacent local authorities. These should be permanent and long term sites but some sites may be planned for temporary transfer stations.
3. **Micro level** – Neighborhood recycling sites, composting sites, street corner/end storage and collection sites, small scale composting, recycling sites, home garden level composting, and other processing space, individual plot storage for collation space.

Understanding the nature of the problem is very important in land use plan preparation for solid waste management. The land use plans should be included in physical planning at national, provincial level considering the institutional set up and integrated with local and urban planning and zoning plans and the use of sites in coordination, shared between local authorities with agreements (Kurian Joseph, 2006).

2.4.1. Selection criteria for waste disposal sites

Thought out the world, waste disposal site selection is one of the most difficult and controversial tasks for communities and local authorities. In most developing countries, disposal sites close to generation areas have been used without considering the environmental consequences. Low-lying areas, wetlands, river banks, seaside sites, have been degraded in this way. Decision makers and planners should have a defensible reasoning that demonstrates why a particular site is selected. Ideally there should be a

number of alternatives sites, assessed through structured methodology before selection, but this is rarely possible in already developed urban areas and likely to be more costly. The following criteria should be considered when evaluating potential sites;

1. **Haulage distance**

   It can significantly affect the overall design and operation of a waste management system. Minimum distance is desirable but environmental and political concerns are increasingly governing the selection of sites and often necessitate long distance haulage. Intermediate transfer stations are an accepted solution and more economical using very large trucks for the final transfer

2. **Location Restrictions**

   Avoid airports, flood plains, riverside slopes and wetlands. Local authorities may impose additional localized restrictions. Population distribution and zoning aspects have to be considered. The current land use, zoning, and proposed urban or rural development plans must be considered. In the case of urban planning in particular, sites should be earmarked in the physical plans themselves in a systematic manner as far as possible. It is best to select low density zones as the buffer zone requirements will increase with higher density. Locations of schools, hospitals and religious places should be taken into account. Archeological sites and historical sites should be avoided

3. **Available land area**

   The land should be adequate for a land fill for at least for 5 years. The extent should be calculated on the basis of amount to be disposed of each day and per annum, considering also peak generation periods, compaction density, daily cover and depth, and types of landfills. There should be sufficient space for a buffer zone between the landfill and housing, etc. there must be enough land for a weigh

bridge, adequate parking for trucks and other vehicles, administrative and processing buildings or recycling and adequate internal road network. Also may have some additional room for phasing out works within the site.

4. **Site access**

The site access road and roads leading to the site should be major roads and their constriction should be suitable for expected frequencies and loads of compactors tracks. There should be more than one access road to the landfill.

5. **Soil condition and topography**

Sites having relatively impermeable depressions such as spent brick clay pits are especially suitable provided they have no other restriction. A Daily soil cover and a final soil cover layer or cap are needed. It is advantageous to have this at site itself provided its geological and hydrological characteristics are suitable.

6. **Climatic conditions**

Local weather conditions could greatly affect the land fill operation and management. The intensity of rain and wet seasons will be major factors. Lower intensities and less seasonality are more suitable.

7. **Surface water hydrology**

The pattern of natural drainage and runoff characteristic of a site its potential flooding likelihood and the limits of a 100 year flood should be ascertained.

8. Geological and hydrological conditions

Hydrologic data are needed to assess the pollution potential of a prospective site – the movement of leachate and gases from the landfill should not contaminate local ground water or underlying bedrock aquifers. Geological survey maps and local geological information are needed. Geological drilling logs of nearby wells can also provide useful information.

9. Local environmental conditions

Local environmental conditions should be considered, and particularly the relationship of ground and air temperature in relation to the biodegrading of organic waste.

10. Potential ultimate uses

A capped and decommissioned dumpsite/landfill provides a stable area of land which may be used for certain other purposes, such as Parking areas, Sports fields and playgrounds. Ideally, the end use should be considered when designing and operating the landfill and in future land use planning. Such land can made highly valued contributions the meeting the balanced needs of local communities

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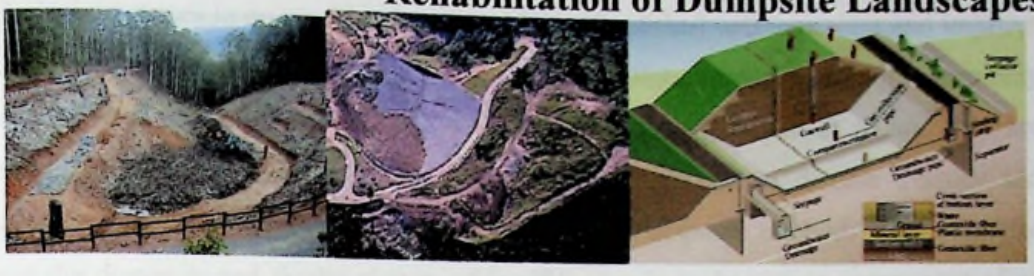
Chapter Three

Rehabilitation of Dumpsite Landscapes



3.0 Rehabilitation of Waste Disposal Sites

In many developing countries, solid waste disposal method still remains as open dumping due to ignorance of the health risks associated with dumpsites, lack of financial and technical resources to do anything better and lack of political will to protect and improve public health and environment quality. (Lee *et al*, 1989a). Open dumping, commonly practiced in many Asian countries does not protect the environment at all and they are susceptible to open burning, sudden explosion and exposed to disease vectors and scavengers. Thereby, introducing a safer and reliable disposal method, restoration for reuse the dumpsite and finally closure of landfill sites is an important component of an integrated waste management system. Waste disposal sites which are planned, designed and constructed for the purpose with appropriate environmental engineering practices, and operations, result in minimum environmental impacts, and are called sanitary landfills (Esakku, S, K. Palanivelu & Kurian Joseph, 2003). Sanitary landfills on closure will have a fine finish and the sites which are aesthetically acceptable, and able to be used for predefined land use practices such as open space, forest vegetation or other reliable land uses planned and designed.

Almost all dumpsites and non engineered landfills need re-correction of the environmental damage before reuse of it or termination of the disposal activity. The re-correction of dumpsite may involve the excavation, screening and separation of materials from landfills into various components. This is called dumpsite rehabilitation, which is defined as excavation of a portion or all of the dumpsite with the ultimate goal of reducing its volume through separation of materials into recyclable, reusable, and combustible components, reducing closure and post closure costs and environmental impacts. (Esakku, S, K. Palanivelu and Kurian Joseph, 2003).

Many old landfills and dumpsites existing throughout the developing countries pose a threat for human health. Dumpsite closure can help to moderate the environmental impact of such improper disposal practices. The growing concerns about public health, environmental quality and the risks associated with the existing and newly designed

landfills are making it nearly impossible to site new landfills in many parts of the world (Lee *et al*, 1989a).

This calls for a new approach of integrating the concepts of dumpsite rehabilitation involving the practice of waste minimization and recycling to conserve the remaining space in currently used landfills, and landfill mining operations to free new land filling space at currently used and closed landfills, and open dumpsites, for sustainable management of waste disposal sites.

3.1 Suitability and Scope of Dumpsite Rehabilitation

The nature and state of dumpsites in developing countries especially in the Asian region is typically of indiscriminately dumped, seemingly unplanned heaps of uncovered wastes, most of the times open burning, pools of standing polluted water, rat and fly infestations, domesticated animals roaming freely, and, families of scavengers picking through the wastes. Dumpsite rehabilitation is required due to one or a combination of reasons such as market value of excavated materials, directed closure of the facility and minimization of post closure impacts, and monitoring costs. To have a properly closed landfill, two basic goals must be kept in mind.

(1) Minimizing the need for continual maintenance of the landfill site,
(2) Placing the landfill in a condition that will minimize future environmental impacts.

Rehabilitation of dump sites and upgrade to sanitary landfills or conversion to a designated land use will have to be done in a phased manner depending on the risk and financial aspects of each dump. It is clear that changing from an abandoned dumpsite or existing open-dumping to high standards of sanitary land filling, or other use cannot be achieved overnight. Such improvement needs the involvement of varies disciplines such as environmental engineers, biologists, geologists, agronomists, and land use planners, landscape architects and other scientific personnel and the introduction of small

incremental improvements in the standards of disposal, in line with the financial resources available. The scope of a Dumpsite/Landfill Rehabilitation project will be determined by whether its goal is one or a combination of the following:

- Reduced landfill footprint and cover
- Recovered landfill space for continued operation
- Landfill up-gradation or installation of landfill liner and relocation of the entire landfill.

The first step in planning a landfill mining and rehabilitation project should be a site survey to gather site-specific information such as its operating history, types of wastes present, dimensions, topography and physical characteristics (Salerni, 1995).

3.2 Approach of Landscape principles in dumpsite rehabilitation

The closure as well as upgrading of existing dump sites is one of the most important steps towards sustainable solid waste management. The lack of technical knowledge and human resources limits the extent to which landfills can be rehabilitated, operated and maintained at minimum standards of sanitary practice and indefinite post closure control of gas, and leachate and stability risk require technical skills for post closure activities. Therefore, design of an appropriate landfill and post closure technology demands for a comprehensive approach.

Planning and designing requires the preparation of a list of every activity to be conducted during site investigation. The primary activity of the site investigation is to characterize the wastes in the areas to be excavated or contained in the dump. This is accomplished with digging test pits and analyzing to determine material volumes, soil to waste ratio, waste composition and its state of decomposition, investigation on slope stability, access roads, leachate management, fire control, soil cover, waste reception, fencing, scavenger control, use of mechanical equipments, limiting the working face and waste disposal operations (Salerni, 1995). A conceptual landscape plan has to be prepared before the commencement of the rehabilitation works.

1. Slope stability

Over-steepened waste slopes should be identified and quantified for waste to be moved. Unless there are compelling local geotechnical reasons, in parts of the site not in use, no waste side slope should be steeper than 1 in 3 (33% gradient) and top slopes should not be more than 1 in 20 (Rushbrook; 2001). The slope stabilization activities should look to redistribute waste within the confines of the existing dumpsite and not extend the external boundaries of the fill. The movement of waste will depend on the final land setting and appearance.

2. Access road

Access to a disposal site from the highway is essential. The running surface should be firm and not easily disrupted by traversing trucks. A minimum standard for the road surface is compacted earth or similar material with a top dressing of road stone. A durable, asphalt surface would be preferred, if resources are available.

3. Leachate accumulation and treatment

If accumulated leachate is identified on the open dumpsite then a plan should be made to drain or pump the leachate into a prepared lagoon not liable to flooding or re-circulated back into the waste. The source of the leachate should be determined and the remedial works defined to prevent leachate accumulations reoccurring in the future.

4. Dumpsite fire control

A plan should be prepared to control existing fires as the rehabilitation work progresses across the site. The method to be used for extinguishing fires should be presented in the plan. The use of water to extinguish fires should be avoided. Isolation and rapid natural burnout or smothering with soil is preferred that is by oxygen depletion.

5. Soil cover

Compared to the benefits of a better-controlled operation and improved compaction of waste, soil cover is expensive and may not be that beneficial, especially if the dumpsite is located in a remote area. In a situation where dumpsite volume is limited, the use of soil cover implies less site volume will be available for waste disposal. In case a decision is made to use cover material then the daily quantity of cover material (at least 5 cm depth of daily cover, 25 cm intermediate cover and 50 cm final cover) required should be estimated. Clay soils can be used as cover material.

6. Waste reception area

A reception area should be clearly defined to allow incoming vehicles to be stopped and checked by operating staff. The reception area should have an entrance gate or barrier to regulate the flow of vehicles to and from the disposal site and a gatehouse to store waste records and documents and provide landfill staff with protection from un-favorable weather conditions. The reception area should have sufficient space for at least two trucks to be parked and not interfere with the vehicle movements in and out of the site.

7. Fencing

The provision of perimeter fencing is desirable but may not be practicable to install around all rehabilitated open dumpsites. The purpose of simple fencing is to delineate the boundary of a site and to discourage un-authorized vehicular access and straying animals. Simple fencing will not deter scavengers from entering a site. The minimum form of fencing to control vehicular access and larger animals should be a stake-and-wire strand fence or an excavated perimeter ditch and bund, planted with fast growing hedge-forming shrubs.

8. Scavenging Control

Inevitably, scavenging is disruptive to controlled and safe land disposal operations. Ideally, it should not be allowed to take place, but when difficult economic circumstances prevail it is not easy to eradicate it from a disposal site.

9. Mechanical equipment

The preparations for dumpsite rehabilitation should include a list of equipment to be provided to the improved site.

10. Area of exposed waste

All exposed and uncontrolled piles of waste should be compacted into layers. They may also be moved to other parts of the site if this facilitates the creation of the eventual final landform of the site. All uncovered areas of waste not expected to receive new deposits of waste, or at least not in the next few months, should be covered with an intermediate or final layer of soil material. The remaining area of exposed waste will form the initial working area for the emplacement of incoming waste. All these preparatory aspects of the planning and design of open dumpsite remedial works should be presented to the relevant technical and municipal authorities in a 'Rehabilitation plan'.

3.3. Rehabilitation of dumpsite landscapes in Tropical countries

Little research has been carried out and published about factors like the distinct influence of tropical climatic conditions such as monsoonal variations of rainfall, temperature, wind, and light conditions. Suitable options on reducing gaseous and liquid emissions and microbial activities with the temperature and waste compositions under local conditions should be considered in planning and designing a dump site rehabilitation programme. Practical approaches to improve landfill design and operation in tropical countries could be achieved by proper understanding of these variables influencing leachate and landfill gas generation, the optimum process or process combination to reduce or control these emissions, suitable and feasible technologies to abate the inevitable emissions, and

feasible ways to upgrade dumpsites to low emission landfills. All these aspects have to be seen under the viewpoint of environmental and economic feasibility and appropriate technology to achieve best sustainable solutions.

The tropical Asian climate with intensive precipitation and humidity aggravates the problem of waste disposal. The leachate flow from dumpsites increases as a result of inappropriate or even missing top covers and intensive downpours thus creating an everlasting threat to the aquatic environment. Additionally methane and carbon dioxide generated by anaerobic degradation processes in landfills contribute to global warming. Landfills rank third in anthropogenic sources, after rice paddies and ruminants in contributing to global warming. Proper management of landfill gas is therefore one of the most important components in landfill operations and the rehabilitation of them. The ultimate fate of disposed of waste and related emissions in tropical countries is controlled neither at the (non-engineered) landfill sites nor dumpsites much longer than the operation period lasts

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Chapter Four

Experiences in Rehabilitation of Dumpsites Landscape

4.0 Experiences of Rehabilitation of Dumpsite landscapes in the World

There are many successful stories of dumpsite rehabilitation in the developed and developing world. The USA had over 3500 landfill sites to be closed and rehabilitated into various other reliable land uses. These are either passive open spaces or active redevelopment for commercial and institutional uses. A few examples are as:

- A nature centre in Florida ,
- A ski and sledding slope in New Hampshire and Virginia
- A sculpture garden in New York
- A botanical garden and an amphitheater in California
- Active sports fields in Massachusetts and North Carolina
- Driving ranges and golf courses nationwide

  [Source: http://nyfedreration.org/PD/7 successfullandfillresuse.pdf]

In the city of Pune, India, generated approximately 1000 tons municipal solid waste per day and disposed of it an open land and abandoned quarries. Dumping was in progress for 4 years to its full capacity until a serious ground water contamination was observed in wells on the down stream slopes up to 2 km away from site. The Pune Municipal Council adopted a strategy of rehabilitating the dumpsite by capping and the construction of a sanitary landfill over the capped site. The closure covered an area of about 34,600 m2. The height of dump was 18 m at the edge after proper leveling. Once the waste was graded and compacted, a 0.75 mm thick Very Flexible Polyethylene liner was installed above it to avoid ingress of rain water. This was protected with a geo-textile overlaid by 300 mm thick soil layer. The soil layer was finally covered with sweet earth for planting of grass, which would prevent erosion of the cover soil. The capped landfill had a top plain surface area of about 18,500 m2. The cost of the dumpsite closure was about US $ 0.2 million. They started composting and constructed a smaller sanitary landfill over the capped dump. Figure 4.shows different stages of the dumpsite rehabilitation process (Purandare, 2003).

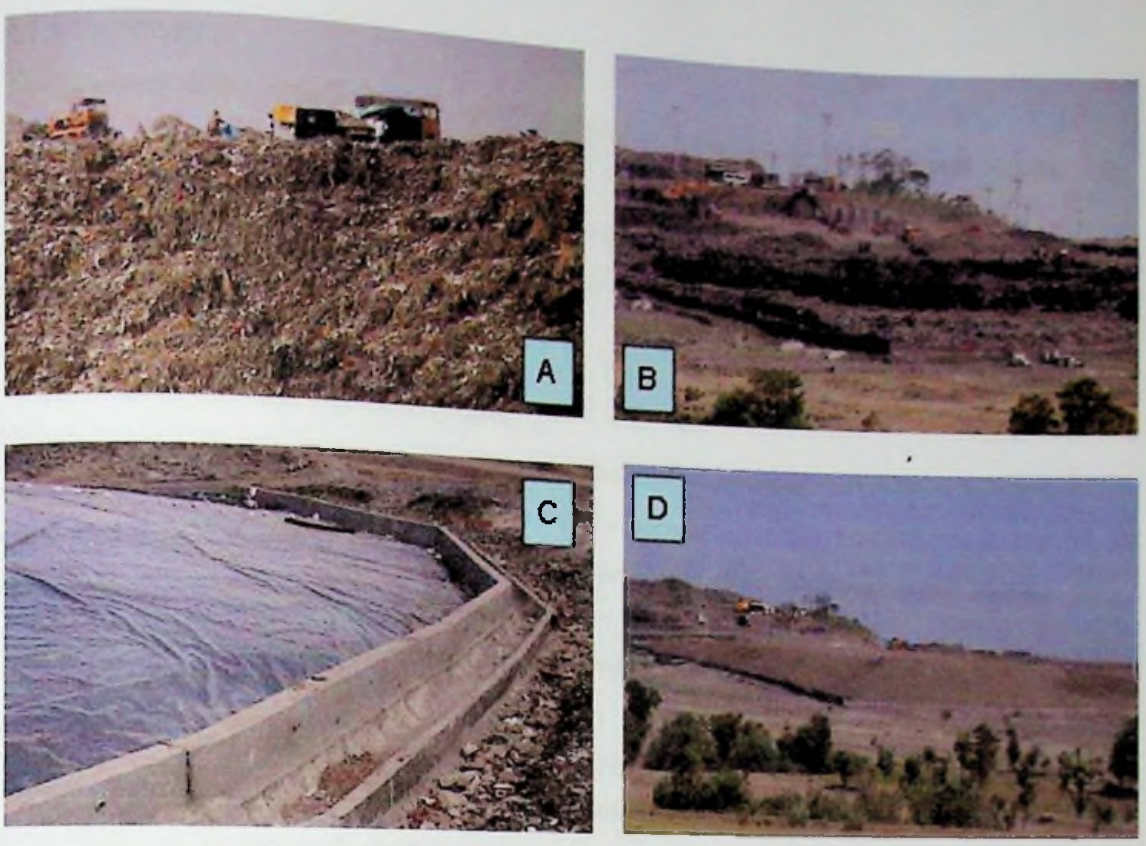


Figure 4.0 Different stages of Pune dumpsite rehabilitation process A – Dumpsite; B – Work in progress; C – Cover and storm drain;D – After reclamation.
Source: Purandare, 2003

Many other counties in the world including the Asia had such successful stories in this nature and therefore, there are ample opportunities for the rehabilitation of dumpsite landscapes into reliable other land uses to minimize the bad impact to the nature, economy and the society. A successful story of Rehabilitation of Nanjido dumpsite (renamed as World Cup Park) in Seoul, South Korea and in rehabilitation of Navinna dump site to a Public Sport Complex (still in progress) and a potential site to be rehabilitated to an Eco-Park at Bloemendhal in Colombo, Sri Lanka will be discussed below.

4.1 Case Study 1:

The opening of the World Cup Park –Rehabilitated dumpsite in Seoul, South Korea

"A clear creek, its banks lined with fragrant orchids, once flowed through Nanjido,
But in the relentless race for prosperity, this pristine landscape was transformed, into two mountains-mountains of waste."

'Today, Nanjido has been transformed again.
Visitors to the is changed environment are now greeted with green trees,
Clear water, chirping birds and fish splashing in the stream.'
World Cup Park, established by the Seoul Metropolitan Government, is Nanjido's new identity.
The new Nanjido represents Seoul's apology to nature.
It also represents a gift to ourselves-and to our children."

"The area has been re-landscaped into a complex of parks.
Pyeonghwa Park is a place for people and nature to mingle harmoniously.
Haneul Park, the highest point, is where the grassland reaches to the sky.
From Noeul Park, can be viewed the most spectacular sunsets in Seoul,
While Nanjicheon Park blooms with catkins.
Finally, the Nanji section Hangang Riverside Park,
Is a place to appreciate the scenic beauty of the broad, slow-flowing Han".

-The Revival of Nanjido –the Birth of World Cup Park, Nanjido, Seoul, South Korea, the Isle of Orchids, was for 15 years buried under a giant municipal waste dump. After extensive landscaping, it has been reborn as an ecological park.

That is how the **World Cup Park Administration Centre** proudly repented of their past misdeeds by rejuvenating an abused landscape to the new generation

Experiences of been walked through the dump site.... ***This is common in any dumpsite in the region***

"He walked with eyes half open.
He couldn't close his eyes completely,
nor could he open them wider.
There was bright sunlight
but all he could see was garbage.
Pieces of stained Styrofoam were
scattered across the landscape
Plastic bags covered with dirt lay on the ground.
Warped drums, rusted paint cans,
tins, black tires, and a sofa- which once
boasted a colorful pattern-lay abandoned,
covered with dirt and dust.
The bald head of a mannequin stared
at him with a surprised look.
The light existed only to show the garbage.
It was useless to run.
It was too wide, too deep.
It was useless to close his eyes.
The stench of decaying garbage was inescapable"

– From Jeong Yeonhee's Novel, [Nanjido]

4.1.1 The History of the Nanjido dumpsite

Before 1978, when the landfill was started, Nanjido was a low-lying flat piece of land where peanuts and millet were cultivated. During the rainy reason, the island often flooded. It was loved by many as a picnic site for students, a meeting place for lovers, and a setting for romantic movies. With an abundance of reeds and plenty of food for birds in the water, flocks of swans and spotbill ducks spent their winters here. It is a cruel irony that such a beautiful island, where flowers grew and birds landed, became a stinking mountain of waste.

4.1.2 The dark side of Nanjido, Seoul

Nabjido became the unwilling recipient of the byproducts of desire and vainglory produced by the citizenry of Seoul. Result of rapid urbanization and industrialization-filled Nanjido with the leftovers of development and material prosperity and after 15

years, Nanjido where flowers and birds once thrived was transformed into two monstrous mountains of waste, each over 90 meters high. Figure 4.1 shows how the dump site appeared before rehabilitation.

Figure 4.1: Nanjido Landfill site - Pollution of water

Figure 4.2: Nanjido landfill - Cover the waste with soil

Figure: 4.4 Pioneer plants grown after covering the landfill with soil

Figure: 4.5 Animals visited after greening the landfill

The Rehabilitation of Nanjido

The Seoul Metropolitan Government has waited until the waste decomposed naturally and then built the environment friendly park and in the meantime helped the stabilization process. They formulated a long term plan to restore the devastated land into an environmentally friendly park. As part of the preparation stage, the Landfill Recovery Project attempted to find and eliminate the factors of contamination. Four major works of the landfill recovery project were thoroughly planned and implemented within 1991 – 1996 period.

1. Gas Extraction and Treatment
2. Leachate Treatment
3. Slope Stabilization to manage the environment around the landfill
4. Top Soil leveling and Soil Recovering

1. Gas Extraction and Treatment

As waste decays, poisonous gases such as methane and carbon dioxide are generated. These gases pollute the air and also easily catch fire or explode. The extracted gas may be used as energy source for heating and cooling nearby apartment's complexes. The World Cup Stadium is today being supplied with heat from this system. Figure 4.6 shows how the gas is extracted and treated.

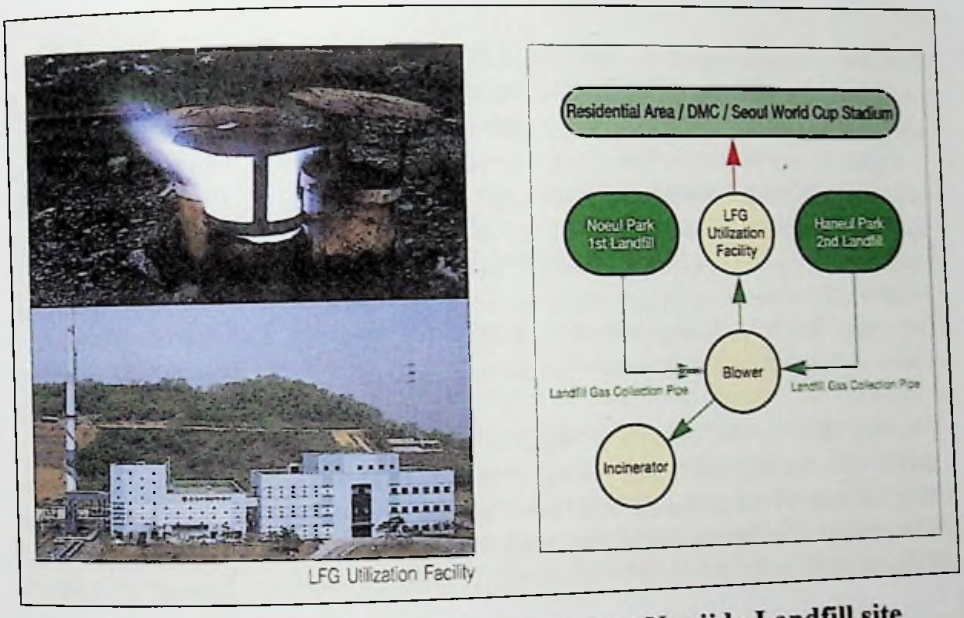


Figure: 4.6 Gas Extraction and Treatments at Nanjido Landfill site

2. Leachate Treatment

To prevent the leachate from leaking out and contaminating the ground water and soil 31 collection wells were installed with 200 m in total of 6,017m length of leachate vertical barrier. The amount of 1,860 tons of treated leachate daily runs into a nearby river as clean water after having primary and secondary treatments. In order to monitor the condition of ground water, water quality is checked every month through two monitoring wells.

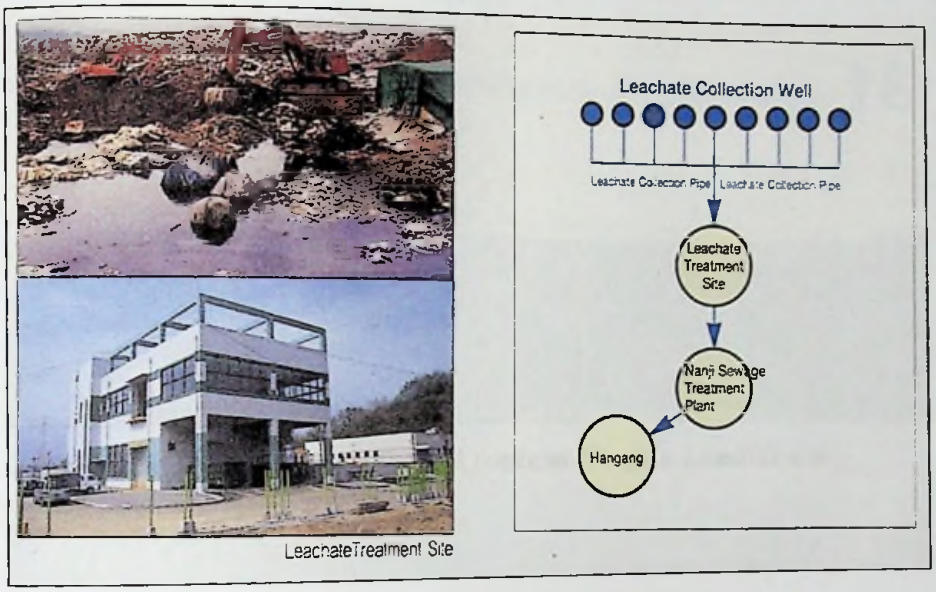


Figure: 4.7 Leachate Treatments at Nanjido Landfill site

3. Slope Stabilization to manage the environment around the landfill

To prevent landslide of the landfill slope, the angle of the incline was readjusted and geo cells were installed. Cherry trees, silk trees, peach trees, winter jasmines, and apple trees were transplanted with the soil when the slope was cover with soil.

4. Top Soil leveling and Soil Recovering

Top soil was added to cover the top of the waste mountain, block the penetration of rain water into the landfill, control landfill gas emissions, and form an environment appropriate for plant growth.

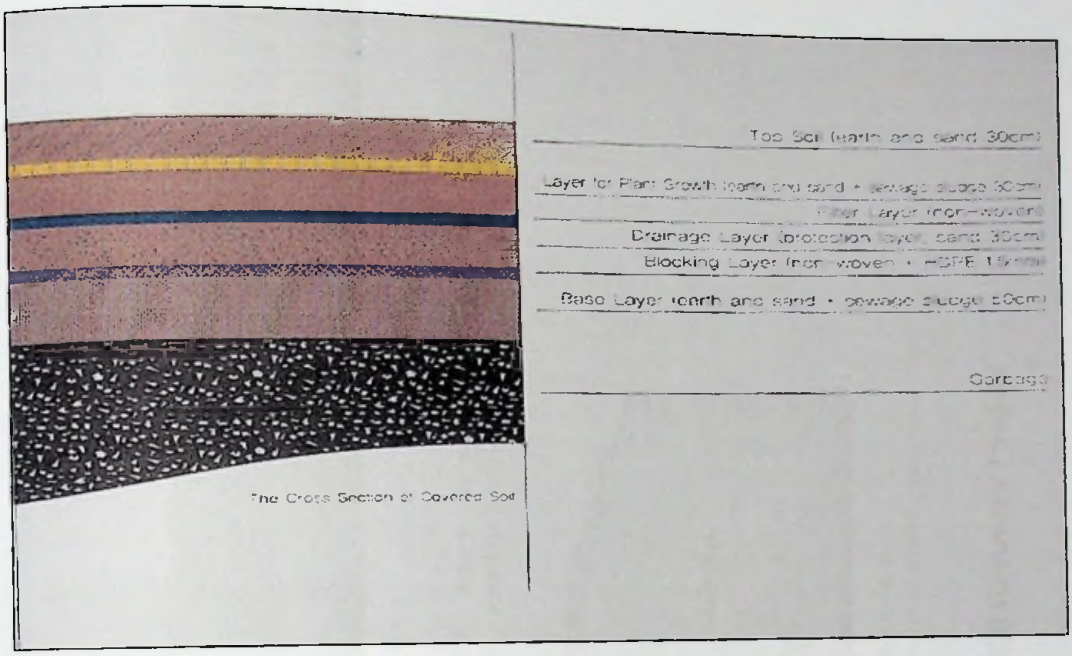


Figure: 4.8 Cross section of the soil cover at Nanjido Landfill site

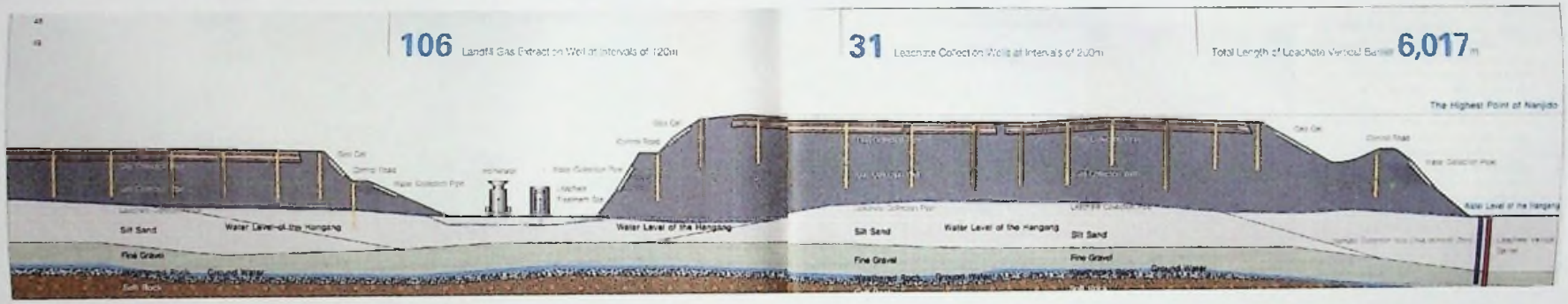


Figure: 4.9 Cross sections of the Nanjido Landfill site

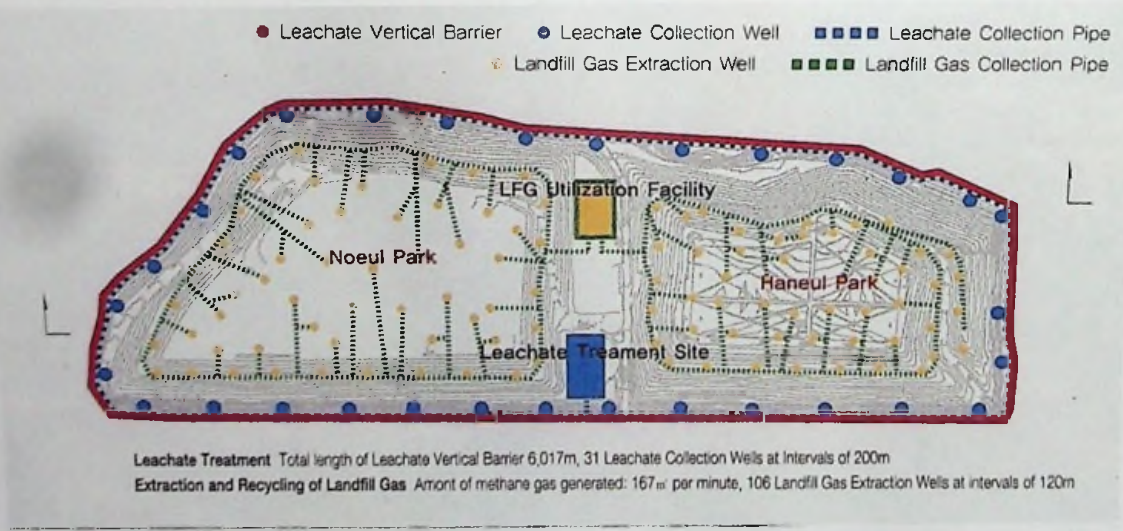
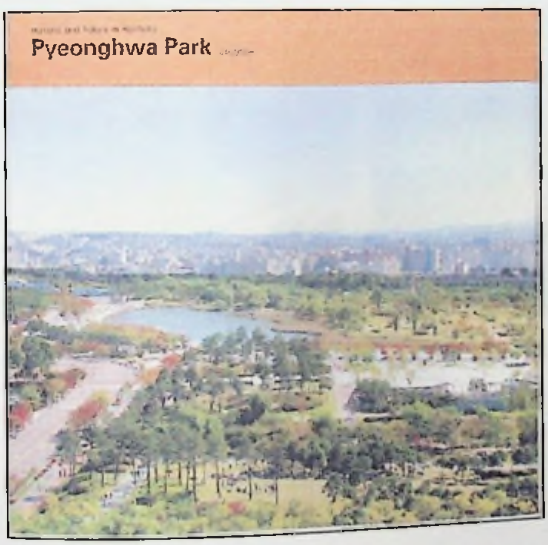


Figure: 4.10 A Sectional View of the landfill Recovery Project at Nanjido Landfill site

Figure: 4.11. Conceptual Design of the World Cup Park



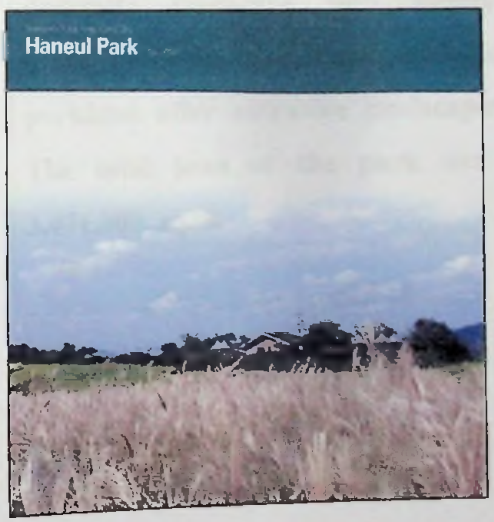


Figure: 4.12 Rehabilitated landfill sites

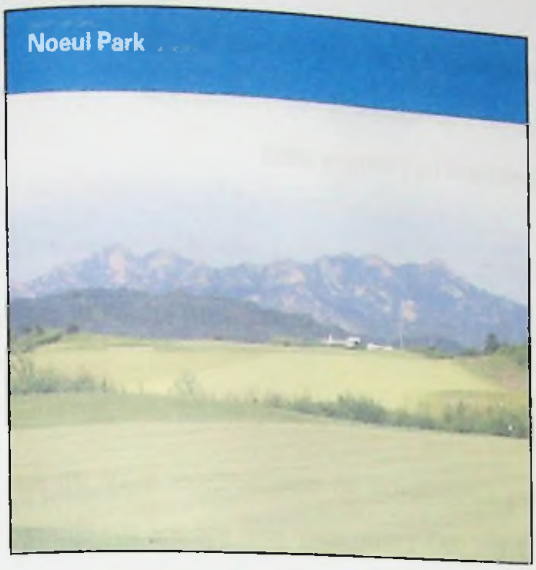


Figure: 4.13 Rehabilitated landfill sites

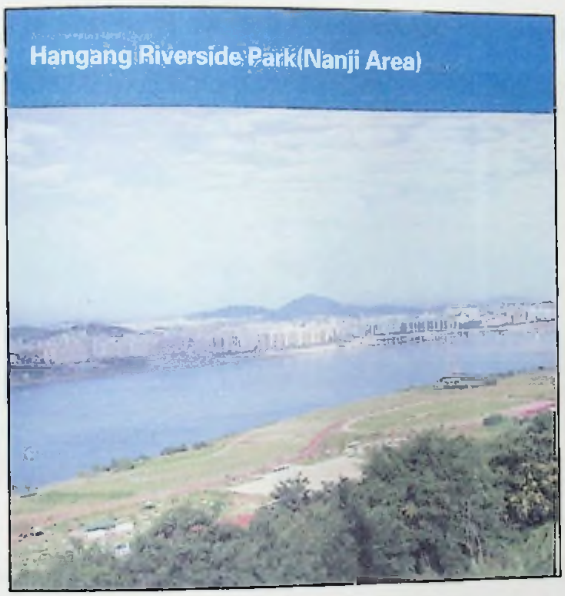


Figure: 4.14 Rehabilitated landfill sites

The World Cup Park in Seoul, South Korea is a very good example of good practice in the rehabilitation of dumpsite landscape into different kinds of open spaces and ecological parkland after extensive landscaping. The total area of the park site is 3,471,000. sq.m.

4.2 Sri Lankan experiences and possibilities of rehabilitation of waste disposal sites

4.2.1 Navinna Dump site (Case Study 2)

The abandoned paddy field in Navinna has been filled with garbage collected in Maharagama Urban Council and suburban. It was a huge public nuisance in the area and had come to its saturation level and the Urban Development Authority (UDA), together with Maharagama Urban Council (MUC) decided to terminate the disposal activity and rehabilitate the dump site and covert it to use as a sports complex. Figure 4.15 shows the condition of the dumpsite.

Figure 4.15 Dump site before rehabilitation..Scavenging animals, pollution of water

It was found that the Navinna garbage dump needed both capping and restoration (both physical and ecological) in order to use it for any beneficial use. Hence the development proposal aimed at designing capping and restoration in conjunction with all the other related engineering and ecological aspects.

The following areas were addressed in preparation of plans and designs under the capping and restoration stages,

1. Site assessment
2. Design of landfill caps and Construction of landfill caps
3. Implementation of landfill restoration schemes e.g. re-vegetation
4. Aftercare: maintenance and management of the restoration scheme

4.2.1.1. Methodology on capping and restoration and the environmental performance of landfills.

The capping and restoration systems for landfills in Sri Lanka have been designed without the rigorous assessments required to satisfy any particular regulation. In fact, there is no regulation or guidelines stipulated in Sri Lankan for such restoration works. Therefore, the standards and guidelines used in other countries were followed in developing conceptual designs. The following key problems were identified in the capping restoration and after use programmes.

1. Infiltration through the cap and treatment of the leachate
2. Migration of gas through the cap
3. The stability of the cap (which influence the both the above)

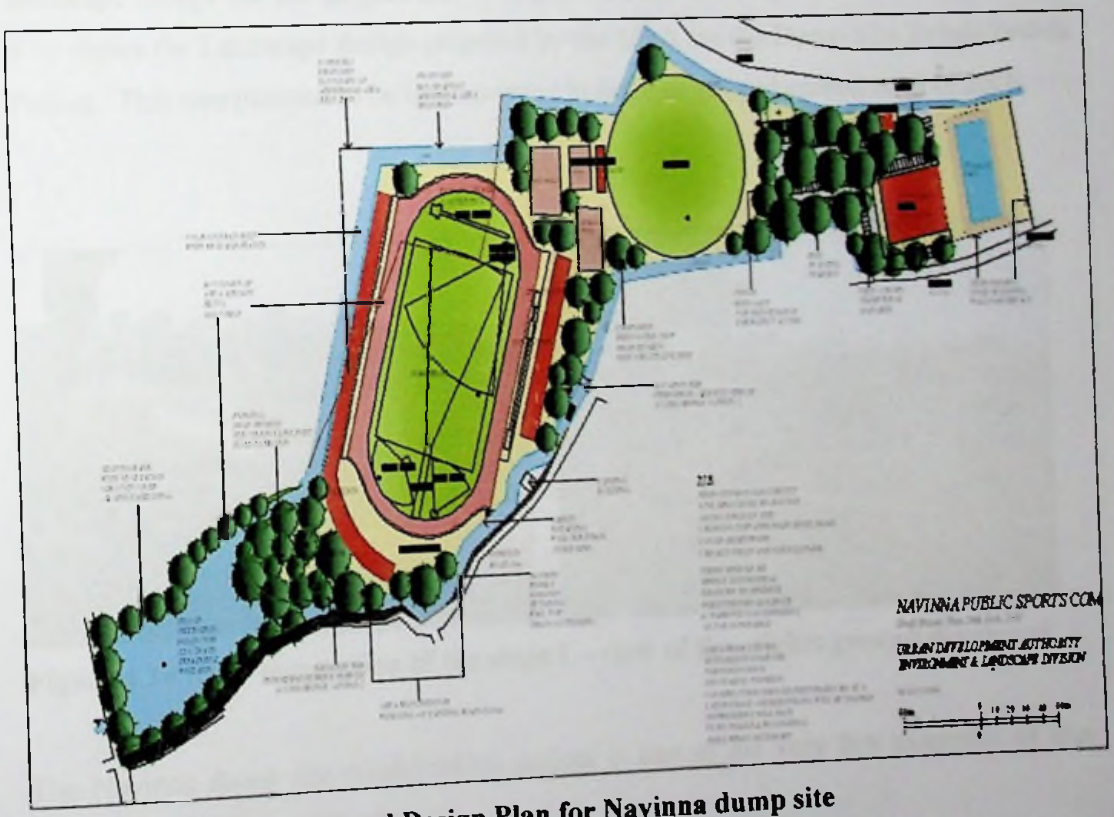


Figure 4.16 The Conceptual Design Plan for Navinna dump site

Figure 4.17 Rehabilitation of the dump site in progress, construction of retaining walls

Some engineering works such as the provision of gas and leachate treatment facilities were not implemented due to the financial constraints. The UDA has developed the landscape design for the project and is responsible for the project coordination. Figure 4.16 shows the Landscape design prepared by the UDA for the Dump Site Rehabilitation Project. This was planned to be implemented in three stages and commenced in 2008.

Figure 4.18 After completion of the stage I – view of the cricket ground developed

The Navinna dump site rehabilitation project is one of the very few examples of this nature carried out in Sri Lanka.

4.3. Case Study 3: Bloemendhal Solid waste Dump site – A dump site to be rehabilitated

4.3.1 Present statues and issue of the Bluemendhal dump site

The extent of the dump site is approximately 16 acres (6.5 ha) with an average height of 30 m. It is believed that the dump contained about 1.5 -2.0 Million tons of garbage. An average 600-750 tons solid waste collected in the Colombo Municipal Council area is brought in every day under normal conditions by the Colombo Municipal council. Bluemendhal site is surrounded by unauthorized encroachments and a residential area predominantly with low income dwelling units. Some of theses underprivileged sector people live by scavenging in the dump yard (CEA, 2009). All types of solid wastes including clinical wastes from hospitals, and some construction debris are also dumped here. There is no proper segregation of waste at Bluemendhal site prior dumping. Waste from the construction industry and other different industrial sectors too contribute to the dump and they are dumped in an ad hoc manner (CEA, 2009).

4.3.2 Existing landscape of the site

Huge heaps of solid waste attracting crows and egrets are visible at the Bluemendhal site resulting in poor aesthetic appearance. During rainy seasons, the lower parts of the site are flooded with leachate which is yet another menace ti the nearby residents and as a result they appear to be suffering from health and hygiene problems. The pungent odour that has engulfed the surrounding areas becomes strong with its leachate draining to the nearby low-lying area. Further, The Bluemendhal site has enormously contributed to breeding of mosquitoes and flies in and around the site and constitute a threat to the heath and hygiene of people living in the vicinity of site. During dry seasons, fire leading to smoke emission is a prominent scene at different locations and this is mainly due to methane gas generated from solid waste and trapped within the heap. From time to time

there have been many calamities reported. These scenarios sometime lead to even collapses of waste heaps devastating dwelling units built close to the dump.

Figure 4.19 Bluemendhal Dump Site

Figure 4.20 The bang and crash of shipping containers being dumped on top of the garbage is causing damage to the homes of residents

Source: The Sunday Times, March 22, 2009

4.3.3 Objectives of the Rehabilitation of Bluemendhal Site

As the Bluemendhal solid waste dump site is at its full capacity level, and creating enormous nuisances to its neighborhoods and the city environment, the dump site needs is needed to be rehabilitated. A rehabilitated project will,

1. Address the sudden explosion and fire problem of the dump site
2. Improve the aesthetic appearance of the site and area
3. Come up with solutions for the leachate and gas emission problems at site
4. Develop appropriate landuses to serve the surrounding communities

4.3.4 Rehabilitation options for Bluemendhal site

The eco-park concept has been tried in many countries with success for open dump sites. It is imperative to note that this concept not only receives the incoming waste but also gives a solution to old dump heaps as well. As there is no other suitable site for the final disposal of the municipal solid wastes of CMC area the site still has to use for final disposal and the Eco-park option will be an appropriate option of the Bluemendhal site .

4.4 Uses of rehabilitated landscapes in urban areas in Sri Lanka

Most of the solid waste disposal sites in the country, especially in urban areas had been selected with out any proper environmental feasibility studies. There are about 311 Local Authorities and each will have one or sometimes for large municipal councils such as CMC will have 2 or 3 sites, and almost all these sites are either a valuable urban land and in the middle of the residential or commercial centre e.g. Bluemendhal dump site, in the heart of the city or in an environmentally fragile area like Nawinna dump site. Thereby these dump sites thrive with lots of socio economic and environmental problems. Selection of final waste disposal sites could have therefore been carried out in a proper

urban planning process and these sites have to be rehabilitated immediately or in the near future. An extensive building construction projects or any other commercial activities associated with buildings would not be practically possible in those site which have been used for years to dump the garbage such as Bluemendhal site due their geological instability, and will definitely have be converted into open spaces such as parks, playgrounds or any other compatible uses which incorporated with less buildings. This will also be a very good answer for the prevailing problem of the lack of Public open recreational spaces [PORS] especially it the urban areas in the country.

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Chapter Five

Recommendation for New Directions and Strategies

5. Discussion and Conclusions

The basic appearance of most of the urban areas and the state of dumpsites in Asian countries is similar with indiscriminately dumped, seemingly unplanned heaps of uncovered wastes, fires, standing polluted water, rat and fly infestations, domesticated animals roaming freely and, families of scavengers picking through the wastes.

This is because the handling of Municipal Solid wastes and management of the disposal sites in many developing countries is given only low priority. Little or no involvements of technical experts including urban planners, environmental engineers, environmental planners or landscape designers in the early stages of city planning is all too apparent. Disposal sites are often selected by non-experts without any scientific site assessment. In addition as a result of low technical standards of both collection and final disposal waste ends up to a large extent either in dumpsites or non-engineered landfills. Furthermore, the tropical climate with intensive precipitation and humidity aggravate the problem of waste disposal. Leachate flows from dumpsites as a result of inappropriate or even missing top covers and intensive downpours thus creating an everlasting threat to the aquatic environment. Additionally methane and carbon dioxide generated by anaerobic degradation processes in landfills contribute to global warming. Landfills rank third in anthropogenic sources, after rice paddies and ruminants and proper management of landfill gas is essential significantly. The quality of urban environments and their landscape in Sri Lanka and throughout Asia are thus being degraded.

The final disposal methods will mostly be determined by the land availability, the technology and the affordability of the particular method. Developed countries like Japan and Singapore which are lacking in urban lands have being practicing advanced methods such as incineration as final disposal method provided that they treated its residuals. The initial construction cost of these methods is very high and many developing countries cannot afford them. On the other hand, countries like Australia with abundant with land can afford to waste land for sanitary landfill (see Table 2.8). Developing countries like

Bangladesh, mostly practice open dumping and burning of waste due to financial and technological constraints, need to re-address the issue of waste disposal as they experience occasional flooding. The issue of flooding might be aggressive in the future with the climate changes, and the burning of waste is correlated. Experts have therefore, to be involved in the first stages of land use planning for selection of disposal sites and the particular methods of disposal.

However any of these methods will have some kind of adverse effect on the environment and on future land uses. For example the sanitary landfill design requires to control rainwater entering the landfill body and to minimize the accumulation of leachate at the base of the landfill. The polyethylene line of the leachate barrier introduced in the landfill site will affect the hydraulic performance of the site area in future and therefore it is necessary to consider the hydraulic performance of the landfill capping, drainage and restoration system in the near future and its particular land usage in the long run. After the landfill recovery period which depends on the amount of contaminants and the gas extracted from the site, Mother Nature may be allowed to take care of the rest. Deep roots of the trees planted in the site will break down the barriers and help to return it to nature.

As improper disposal of municipal solid wastes in and around urban areas is a serious nuisance to the public and creates various urban environmental and social issues, rehabilitation of these dumpsite landscapes needs to be a paramount option to improve the urban environment and its landscape. These rehabilitated dumpsites may then be used for compatible urban uses such as the development of much needed urban open recreational spaces such as parks and playgrounds, vegetative covers or urban green/forests, golf courses and many more compatible urban uses will enhance the environmental and social conditions of urban areas in the country.

The general appearance of a city is the mirror of its planning and development, and they deserve serious attention particularly in capital cities, which are often gateways to their countries for foreign diplomats, businessmen, and tourists. Poor visual appearance of these cities caused by present haphazard disposal practices will have negative image on

the country discouraging industrial development opportunities including tourism and official visits. The landscape designer should therefore be contributing and being involved in the early stages of urban planning process and in the selection and design of suitable waste disposal sites. Further much more importantly they must serve the local community to best advantage. The closure as well as upgrading of existing sites is also one of the most important steps towards sustainable solid waste management system and also in sustainable urban planning. The lack of technical knowledge, financial and human resources limits the extent to which landfills can be built, operated and maintained at minimum standards of sanitary practices. In the future the sound operation of landfills properly rehabilitated to reliable urban land uses will be a major issue in urban planning. Therefore, the design of an appropriate landfill site and rehabilitation technology demands a comprehensive approach to their selection, management and aftercare in Sri Lanka and throughout the Asian Community.

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