

## Review of Solid Waste Management of Quetta City

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### Abstract

The present review presents a sketch of solid waste management practices in Quetta. The growing population of the city has prompted the production of a huge amount of solid waste. However, the city lacks a systematic waste management system. We have reviewed the overall generation of solid waste in the city including amount and composition, the method of collection, transfer, processing and disposal as well as options for the management of Municipal Solid waste (MSW). According to Metropolitan Corporation Quetta (MCQ), daily waste production in the city is 1000 MT out of which approximately 350 MT is collected by MCQ and rest of 650 MT is left behind. The waste is collected in open dumps and open landfills are used for the waste disposal, which cause soil and water contamination by leachates. These unsanitary zones are not just damaging the health but they are also unsightly. Approximately 50% of the waste generated includes organic matter and recyclable material. The waste is a resource if properly managed, nevertheless QMC is not carrying out recycling activity, and instead it is collected by the wandering traders in an unorganized manner. The review of legal framework shows that there is a need of detailed rules and regulations for systematic handling of MSW. For environmental maintenance there is a need for the advancement of public awareness, formulation and implementation of environmental policies and regulations, financial provisions, and initiation of sanitary landfills. Lack of resources, infrastructure, planning, leadership and public awareness are the main challenges for Solid Waste Management of Quetta.

**Keywords:** Composting; Landfill; Recycling; Solid Waste Management; Treatment

### Abbreviations

SW: Solid Waste; WMS: Waste Management Strategy; SWMS: Solid Waste Management System; MCQ: Metropolitan Corporation Quetta; MT: Metric Ton; LFGs: Landfill Gases; PHED: Public Health Engineering Department; TMA: Town/Tehsil Municipal Administration; NGOs: Non-Government Organizations; RDL: Refused Derived Fuels; OWRCMR: Organization for Waste Recovery and Composting of the Municipalities of Rasht; CMA: Close Cycle Management Act

## Introduction

Solid waste management is very serious problem all over the world. From past few years, most of developing countries are trying to improve their waste management strategies. Developing countries deal with many difficulties in solid waste management system, including low technical resources and low financial resources which cover only collection and transfer cost [1]. The term "Municipal Solid Waste" means waste from households, commercial areas, offices, and hospitals. Collection and management of these type of waste is responsibility of Municipals. Waste that generates from industries are not considered as municipal waste [2].

Presently Solid Waste in Pakistan has not been carried out in sufficient and proper way of collection, transportation and disposal or dumping, whatever the size of the city; therefore, the environmental and hygiene conditions have become more serious year by year, and people are suffering by living in such conditions [3].

Quetta just like other developing cities, faces serious environmental problems. Increasing population (annual growth rate of 2.61% per year) and impressive economy growth has put a huge pressure on natural resources and has increased the pollution.

Baluchistan did not talk about the issues of sustainable development and environmental protection in the decision-making process. Uncontrolled use of forest land, water, urbanization and expansion of agricultural land but not trying to increase the crop production, improper use of pesticides, ecological and health hazards, industrial wastes are due to being unconcerned to poverty, environment-nexus and the defects in our policies.

Solid waste collection by government owned and operated services in Quetta averages 50 percent of the waste quantities produced; however, for a city to be clean, at least 75% of these quantities should be collected. To achieve this level, a huge investment is required. Service demand will grow as urban population grows and as per capita, waste production grows.

Presently, according to Metropolitan Corporation Quetta, daily waste production is 1000 MT out of which 350 MT is collected by QMC and rest 600 MT to 850 MT is left behind. The increased amount of waste will also have produced demands on disposal

services thereby worsening and already poor situation since current disposal methods for solid wastes are totally insufficient.

A lot of the uncollected waste causes serious risk to public health through clogging of drain, formation of stagnant ponds and providing breeding grounds for mosquitoes and flies with the risk of cholera and malaria. In addition, because of the lack of sufficient disposal sites, a lot of collected wastes find its way to dumping grounds, open pits, ponds and agricultural lands.

This concern has led to a growing recognition that economic development and the health and well-being of Quetta population are closely linked with improved environmental management and protection [anonymous 1, 2010].

## Solid Waste Treatment Options

Waste management and Techniques takes place in many ways like, landfill, incineration, pyrolysis and gasification, composting and anaerobic digestion. Different types of waste management methods that should be applied, depend on the composition of waste. For all organic waste composting is an appropriate method. Another types of waste such as glass and metals are better handled by recycling [4].

### Landfilling

Landfill is an area of land where waste is deposited. The objective of the technology is to keep away any contact between the waste and the environment. Landfill is the cheapest and most common practice for disposal of waste [5]. It is the most common waste disposal method in many countries. Various forms of landfill are following:

#### Ordinary landfill/ Open Dump landfill

This is the non-engineered method of landfill mostly used in all developing countries. Open dumping requires the refuse simply dumped randomly into low lying areas of open land. An open dumpsite is land at which solid wastes are dumped in a manner that can cause environmental contamination. Disposal of MSW involves inadequate practices captivate birds, rodents and flies to the dumping side and generate unhygienic conditions [6]. In India about 90% of waste is disposed of in such an unacceptable manner [7]. Thus, causing many health and environmental hazards [8].

### Sanitary Landfill

It is an engineered method for disposal of solid waste, using thin layer, compressed into the smallest feasible volume and cover with inert ash at the end of each working day. Effects of sanitary landfill on environment are production of leachate and landfill gases (LFGs). Leachate production is the major issue unless a collection system is designed. Leachates contain high amount of nutrients (nitrogen, phosphorus, potassium) and heavy metals and cyanide like toxins and dissolved organics [9]. Leachates may invade into ground water resources and pollute it, that may cause harm to the public health's [10].

### Secured landfill

This type of landfill is mainly for hazardous waste disposal including hospital waste, and radioactive waste. It should be designed properly; the resultant effect could be like the sanitary landfill.

### Incineration

It is the process in which waste burned in high temperature in a high efficiency furnace to produce steam and ash [11]. The major benefit of incineration is waste reduction and production of energy in form of electricity [12]. But it is too expensive for Pakistan like developing country [13].

### Process of incineration

**Combustion:** waste is constantly fed into the furnace by overhead crane. The waste is burned in a particular designed furnace in a high temperature >850 for more than 2 seconds with adequate supply of air to ensure complete combustion of the waste and to stop the formation of dioxins and carbon monoxides.

**Boiler/ steam turbine:** the heat from combustion is used to cause steam in the boiler. The steam then operates the turbine which is coupled to the electricity generator. The surplus heat generated can also be used for other purposes, e.g. heat for swimming pools.

**Exhaust gas cleaning:** the exhaust gas from the boiler is generally cleaned by the following advance pollution control systems to ensure acquiescence with the strict environmental standards.

**Dry or wet scrubber:** to sprinkle lime powder or splendid atomized slurry into the hot exhaust gas to neutralize and detach the polluted acidic gas (Sulphur oxides, hydrogen chloride).

**Activated carbon injection:** to accumulate and detach any heavy metal and organic pollutants (e.g. dioxins) in the exhaust gas.

**Bag house filter:** to filtrate and detach dust and fine particulate.

**Selective non catalytic reduction:** to detach nitrogen oxide by reacting them with ammonia and urea [14].

### Pyrolysis and Gasification

These are the techniques for managing waste under controlled situation to produce low to medium heating fuel gases, tars, and ash; under a high temperature with limited oxygen [15]. This process takes place in a sealed vessel under a high pressure. The process of Pyrolysis converts the solid waste into solid, liquid, and gas products. Pyrolysis is used to convert wood to charcoal in Nigeria, where people used for domestic cooking. Whereas gasification is used for conversion of organic materials into syngas (CO, H<sub>2</sub>). The main effect of pyrolysis is loss of biodiversity, desertification, and emission of greenhouse gases. But in developing countries due to expense of equipment, pyrolysis and gasification is not a common method. Pyrolysis and gasification are not a sustainable method due to emission of greenhouse gases during thermal process.

### Composting and Anaerobic Digestion

Composting is a controlled procedure, using microbial organisms to decompose the organic solid waste [16]. In developing countries composting is the sustainable way of SWM due to low operational cost. Incineration of organic waste is a waste of time and landfill will be the loss of resources [17]. Composting has been used productively to repair soil and sediment with hydrocarbons [18]. 73% PAH degraded by composting [19].

### Solid Waste in Quetta

The amount of problem related to the solid waste management is very wide and involves all aspects regarding the solid waste and its management, either directly or indirectly.

The municipal institution in Quetta city does not have enough resources technical capacity to adjust the needs of increasing urban population. The poor communities living in the rural areas are often involved in several initiatives on self-help basis e.g., solid waste management and recycling. Almost all the paper, plastics, metals and glass are recollected and recycled or re-used.

Thus, the poor communities in rural areas play an important role in the recycling of the waste. The only waste which remains on the streets and collection points is the organic waste. These organic wastes could be used for making fertilizer but neither the municipalities nor the private sector has moved towards full use of this business.

**Physical Formation of Waste**

Solid waste in Quetta is generally formed by plastic and rubber, metal, paper and cardboard, textile waste, glass, food waste, animal waste, leaves, grass straws and fodder, bones, wood and stones. There is a huge noticeable amount of plastic in the solid waste produced in Quetta which is a cause of great concern. Plastic waste is produced during all the stages of production and every plastic product is a waste after it is used. Both the quality and quantity of plastic waste causes environmental problems.

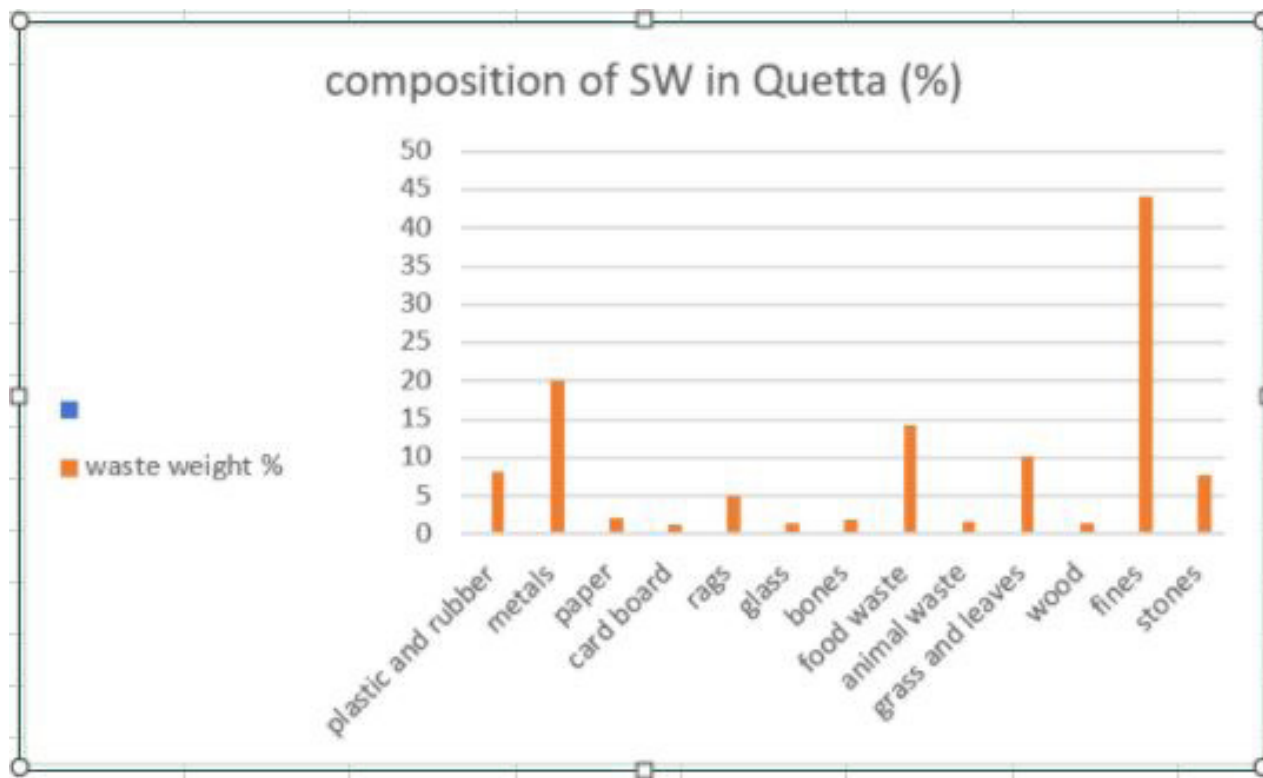
This is because they are found in large amount and have less weight. Some of the environmental problems of plastic wastes are litter, emission of hydrogen chloride and dioxins from incinerators and contamination from chemical additives. Plastic waste is a direct threat to the wildlife as well.

The formation of waste has revealed that there is a noticeable possibility in solid waste management to make it a profitable business. It may be realized that through the sale of the recycled products. Composting, energy production and use of waste as earth filler, almost all the waste can be put into one of the above-mentioned uses. Only the unsafe waste from hospitals and industries needs a proper and careful arrangement for its management.

**Waste Generation Estimates**

The Ministry on Environment and Urban Affairs Division, Government of Pakistan undertook study during 1996 on "Data collection of preparation of National study on Privatization of Solid Waste Management" in eight cities of Pakistan. The study revealed that the rate of waste production on average from all type of municipal controlled areas varies from

0.283kg/capita/day to 0.613/capita/day or from 1.896kh/house/day to 4.29kh/house/day in all selected cities. It shows a particular trend of waste production whereas increase has been recorded related to city's population besides its social and economic development.



### Waste Collection and Street Sweeping

QMC has posted sanitary workers and sweepers. The workers collect the solid waste from small heaps and dustbins with the help of wheelbarrows, brooms etc. and store it at informal and formal depots and carry out sweeping of streets and roads. It has been noted that the service street or road sweeping is not regular and mostly limited to administrative, commercial and small industrial areas.

The number of formal collection bins such as Masonry Enclosures, Containers and Trolleys are to less adjust the waste produced in the city. Also, these points are not located according to population and area requirement. This is the reason that many open heaps can be seen in the city.

### Waste Management in Quetta

Before the publication of local Government in 2001, the Provincial



Waste collection from dumps  
Photo Credit: Mr. Marjan



Street Sweeping  
Photo Credit: Mr. Marjan

Public Health Engineering Department (PHED) was responsible for the development and maintenance of water and sanitation services including solid waste management. Under the recently prevailing system of local government, it is the responsibility of town/tehsil Municipal Administration. However, it is the responsibility of the District council for the sighting of disposal facilities. Paid sanitary workers are hired by TMA to sweep the streets and collect the trash from a specific place from where it is taken to the dumping site by the Municipal carrier. In addition, no private entrepreneur has entered the field. Some INGO's and NGOs's have spread awareness and sensitization sessions on SWM. However, working of these organizations are limited in size and scope.

### Waste Treatment and Disposal

The waste is disposed outside the municipal limits into low lying

areas like pits and ponds etc. Without any management except recyclable separation by scavengers. These lands are hired for long term basis for disposal. Treatment and disposal technologies such as sanitary land filling, composition and incineration are very low in Quetta. Crude open dumping is the most common practice throughout Quetta and the dumps are commonly set on fire to reduce the amount of the waste which adds to the air pollution caused by these dumps that are set on fire.

There is a need that Government of Baluchistan should put forward a clear policy for waste recovery, as well as composting. Compost is an attractive waste which can be further used for agriculture purpose.

There is a need for establishment of at least one window composting plant in Quetta to promote composting.



Open Dumping

Photo Credit: Mr. Marjan

## Potential for Waste Recycling in Quetta

Under the present system, QMC is not carrying out any type of recycling activity. The main recyclable items like paper, glass and metals are kept by the people themselves which are later sold to street hawkers for recycling.

Whereas the recyclable items mixed with discarded wastes are picked up by the scavengers who make 2 to 3 trips to different dumps and earn 150/300 per day.

## The Informal/Formal Sector

Private sector that is involved in waste management activities are divided into Formal and Informal categories. The Formal Sector consists of Govt organizations and Non-Government organizations.

The Informal Sector is big in size and consists of thousands of Itinerant Traders (called kabari walas) who are spread all over the city who are busy in collection of waste material of different kinds. Private firms can start projects based on organic and inorganic waste management. Organic waste produces organic fertilizer. Inorganic waste is first divided into paper, tin, plastic etc. It is then sold to industries which is then recycled to make products such as plastic woods and tetra sheets. Unplanned urbanization, poor sanitation and drainage system, insufficient human and capital resources for waste collection, unavailability of official dumping sites, absence of weight bridges for proper measurement of waste coming at site, and almost zero presence of recycling processes have wrongly impacted waste management in Quetta.

In Quetta, there is a huge possibility to convert waste into resource for the economy. In this regard, some NGOs and private firm can step into the industry. These organizations can collect waste and reprocess it to produce fertilizer, plastic bottles and tetra packs. A private firm can establish a recycling facility in Quetta where it can engage to produce Refuse Derived Fuel (RDL) based on the concept of waste-to-energy. NGOs can also encourage people to sell their waste to them and prepare soil conditioning fertilizer. The extracted liquid from waste could be sold in market as liquid plant nutrient.

Even though there has been commitment on part of government to bring opportunities of changing waste to energy and other useful purposes, less amount of adequate infrastructure is stopping the industry to grow. The government of Baluchistan is

aware of the role of waste management industry; however, there is a need for more active and reasonable approach, likely based on public private partnership to help this industry provide a cleaner environment while adding value to the economy.

It is highly suggested that Government of Baluchistan must develop a public and private partnership policy along with a study on privatization on solid waste management to institutionalize the process and address environmental issues with added advantages of revenue generation capacity for local governments [anonymous 2, 2010].

## Legal Framework for Mswm in Quetta

Every state should have a policy on sustainable solid waste management (SSWM) that covers such aspects including maintenance of public health, cleanliness, conservation of environmental quality. The policy should inscribe sustainability in order of availability of landfill space for future generations. Legal rules and regulations for solid waste in Pakistan are insufficient and outdated. There is an immediate need of SWM law that should be legislate. Law should be legislated including activities concerned with the municipal solid waste management. There should be a policy that addresses the responsibility of public, government and private stakeholders. It has been noticed that legal documents are formulated as a mean of assigning responsibilities. It is mandatory to broaden the scope of legal law and policy paper. Legal framework should ensure that the target defined in the policy paper should meet in specific timeframe. There should be a policy framework that facilitate the planning and operations of the techniques and systems of MSWM.

## Mswm in Rasht City, Iran

The city of Rasht has a population of about 520,000 which is located in the northern part of Iran [20]. All aspects of solid waste management are handled by municipality of Rasht. It has 3 sub municipalities. An organization that is responsible for handling of solid waste management in Rasht is name as "Organization for waste recovery and composting of the municipalities of Rasht" (OWRCMR). Recently Rasht city has constructed a compost plant for capacity of about 250 tons/d, and they also started the source separation of waste project.

The total amount of solid waste generated in Rasht city is about 420 tons/d [21]. When the waste gets separated at its first place, it will not only bring economic benefit, but it will make the recycling process easier [22]. In 2005 some areas of Rasht city had started

source separation program. Separation of hazardous waste from household is not considered in this program. There are many types of containers in different areas of city. In commercial areas they mainly use large sized and medium sized containers.

Municipalities of Rasht city is fully responsible for waste collection either directly through their own fundaments or by private sector contracts. For collection of residential waste, they use both manual and mechanical methods. Although mechanical system of waste collection is implemented in some areas of Rasht. In some other parts of Rasht, direct lifting and carrying of waste is commonly used. All the waste collected on the daily basis and transported to the disposal sites even on holidays.

There is different small transfer station in every city of Iran. Transfer stations can decrease the operational costs. In Rasht city the type of transfer station is direct load. Two main disposal methods are composting and open dumping in Rasht city. Collected wastes by small vehicles are discharged into open dumping sites and then they transfer the collected waste to the compost plant. About 60% of MSW is transferred to composting plants. Organic waste is converted into a fine compost and other recyclable components are manually separated through this compost plant. This plant is operational about 300 days per year.

The remaining waste (about 170tons/d) is transferred to the dumping sites. The dumping site of Rasht is in the southern part in Saravana area, 20km far from center of the city [23]

### Waste Management in Germany

Collection of recyclable waste is well established in Germany. In Germany there is a Closed Cycle Management Act which is aimed to turn the waste into a resource management and make it useful source of raw materials and energy. Closed Cycle Act has been adjusted in Germany over 20 years ago. It is based on disposal responsibilities to manufacturers and distributors of products. This has made individuals to consider the separation of wastes and increased in recycling capacity of waste. Waste management policy of Germany is based on five steps depends on the environmental impacts called "Waste Hierarchy". The waste hierarchy's main target is to prevent the waste at generating point. When the waste is made, they try to prepare it for recycling, energy recovery and disposal activities, for the protection of environment.

Close Cycle Waste Management Act has been introduced an obligatory "uniform cycling bin". for collection system with this

framework community should not only discard packaging as well as other misuse of similar materials. E.g. Plastic or metals in other recycling containers. this is helpful to collect the recyclable from households in better quality and in bigger amount.

Before landfilling of waste, waste should be pre-treated. the process of pre-treatment occurs in incineration plants or mechanical-biological plants. Pre-treatment of waste is important because it cannot degrade inside a landfill. Waste management of Germany is completely financed by expenses, there is no subsidies the follow "polluter-pays" standard, means producer need to pay for waste treatment or disposal.

Different groups of stakeholders are working in waste management which involves municipals and private waste management companies. Municipal waste management organizations are liable for bio-waste and domestic waste. Private waste management organizations are liable for the recycling of wastes including household wastes, commercial waste, and trade waste [24].

### Recommendations for Improving Swm of Quetta City

- α) Source reduction should prioritize to reduce the volume of Municipal Solid Waste (MSW).
- β) Social media is a platform where Municipal Corporation Quetta (MCQ) and different NGOs can educate and encourage the people about segregation and separation of wastes at household level.
- χ) Manufacturing organizations should name the items as recyclable or non-recyclable to make it easy for the separation in a better way/ for better understanding of the people.
- δ) Stakeholders need to adhere to the regulations to ensure a better MSWM system will be handled, in such manners public-private partnership seems to be the solution to be the solution to tackle the problems of MSWM as MCQ are unable to accomplish targets of MSWM.
- ε) There should be container on the roadside.
- φ) Disposal sides should be based on closeness to the collection area.
- γ) MCQ should hire more staff members and increase in sweepers for collection purposes. And they should organize training sessions time to time for staff members.
- η) Monitoring of landfill side is mandatory for MCQ.
- ι) For solid waste generators there should be "polluter pay" rules.



Implementation of these recommendations is not easy task for Quetta municipality. We need to aware people about the consequences of MSW through different plat form in different methods like for tribble areas there should be awareness sessions in their own languages. Public awareness and lifestyle towards waste can affect all aspects of SWM.

### Gaps in The System of Msw

Lack of capacity.

Lack of IT based solutions

Non availability of scientific disposal system

Absence of complaint management system

Poor data management

Lack of skilled staff members

### Conclusion

SWM is becoming a serious problem all over the world. Where Pakistan and its province Baluchistan which is in the vicinity of mountains, wrapped in generation and poor management of Solid Waste. Quetta is the capital of Baluchistan where MCQ is responsible for overall handling of Solid Waste generated in Quetta City. Due to lack of policies and regulations MCQ fails to control the generation and collection of MSW in the first place. The people of Baluchistan are mostly uneducated due to which they didn't know what are the consequences of Solid Waste on environment and as well as on public health. The other factor of increasing in amount of Solid Waste is changing life style of people day by day.

Other developing countries are working on betterment of MSWM and they have implemented different strategies for the reduction of waste. The most common practices for developing counties are composting of organic waste. Where in Quetta city there is no any specific area for composting of organic waste. Waste in Quetta city generated in large amount and MCQ do not have the capacity and resources to collect all the amount of generated waste. Furthermore there is no any sanitary landfill system for disposal of collected waste. The most common practice for the disposal of waste is open dumping system with no any scientific methods and regulation.

From different studies and personal observations, it is found that non availability of disposal system, lack of resources, absence of skilled staff members, and poor complained system for

communities are the main challenges of solid waste management in Quetta. Solutions to these all gaps are that government of Baluchistan should take action for making policies and its implementation. And on community level there should be awareness sessions regarding separation of waste from household levels. And encourage the people to take part in different activities of recycling and composting.

## References

1. Moghadam MA, Mokhtarani N, Mokhtarani B (2009) Municipal solid waste management in Rasht City, Iran. *Waste Manage* 29: 485-9.
2. Chandrappa R, Das DB (2012) *Solid waste management: Principles and practice*. Springer Science & Business Media.
3. Ahmed SA, Ali SM (2006) People as partners: Facilitating people's participation in public-private partnerships for solid waste management. *Habitat Int* 30: 781-96.
4. Taiwo AM (2011) Composting as a sustainable waste management technique in developing countries. *J Env Sci and Tech* 4: 93-102.
5. Singh RP, Singh P, Araujo AS, Ibrahim MH, Sulaiman O (2011) Management of urban solid waste: Vermicomposting a sustainable option. *Resources, conservation and recycling* 55: 719-29.
6. Srivastava V, Ismail SA, Singh P, Singh RP (2015) Urban solid waste management in the developing world with emphasis on India: challenges and opportunities. *Reviews in Env Sci and Bio/Tech* 14: 317-37.
7. Sharholy M, Ahmad K, Mahmood G, Trivedi RC (2008) Municipal solid waste management in Indian cities—A review. *Waste manage* 28: 459-67.
8. Ambulkar AR, Shekdar AV (2004) Prospects of biomethanation technology in the Indian context: a pragmatic approach. *Resources, Conservation and Recycling*, 40: 111-28.
9. El-Fadel M, Findikakis AN, Leckie JO (1997) Environmental impacts of solid waste landfilling. *J Env Manage* 50: 1-25.
10. Adekunle IM, Adetunji MT, Gbadebo AM, Banjoko OB (2007) Assessment of groundwater quality in a typical rural settlement in Southwest Nigeria. *Int J Env Res and Public health* 4: 307-18.
11. EPA U (1995) *Integrated risk information system*.
12. Yu JH, Hamari Z, Han KH, Seo JA, Reyes-Domínguez Y, et al. (2004) Double-joint PCR: a PCR-based molecular tool for gene manipulations in filamentous fungi. *Fungal genetics and Biol* 41: 973-81.
13. Rand GM, Clark JR (2000) Hazard/risk assessment of pyridaben: I. Aquatic toxicity and environmental chemistry. *Ecotoxicol* 9: 157-68.
14. Nidoni PG (2017) Incineration Process for Solid Waste Management and Effective Utilization of by Products. *Int Res J Eng and Technol* 4: 378-82.
15. Rohrs B, Douglas S, Heimlich J, Miller J, Burgess G, et al. (2005) US Patent Application No. 10/825,397.
16. Yu JH, Hamari Z, Han KH, Seo JA, Reyes-Domínguez Y, et al. (2004) Double-joint PCR: a PCR-based molecular tool for gene manipulations in filamentous fungi. *Fungal genetics and Biol* 41: 973-81.
17. Airan DS, McMurray DT, Airan LD, Bell JH (1980) Hospital Solid Waste Management: A Case Study. *J Environ Eng Division* 106: 741-55.
18. Williams RT, Keehan KR (1993) Hazardous and industrial waste composting. *Sci and Eng of composting* 363-82.
19. Beaudin N, Caron RF, Legros R, Ramsay J, Lawlor L, et al. (1996) Cocomposting of weathered hydrocarbon-contaminated soil. *Compost Sci & Utilization*, 4: 37-45.
20. Moghadam MA, Mokhtarani N, Mokhtarani B (2009) Municipal solid waste management in Rasht City, Iran. *Waste Manage* 29: 485-9.
21. Abdoli MA (2000) Disposal and recycling management of solid waste in Iran. Iran Municipalities Organization, In Persian.
22. Aydin GA, Kocasoy G (2004) Significance of Source Separation and Composting of Wastes of Istanbul: From Theory to Practice, CD-ROM of ISWA 2004 World Congress, October 17–21 Rome, Italy.
23. Moghadam MA, Mokhtarani N, Mokhtarani B (2009) Municipal solid waste management in Rasht City, Iran. *Waste Manage* 29: 485-9.
24. Nelles M, Gruenes J, Morscheck G (2016) Waste management in Germany—development to a sustainable circular economy. *Proceedings Environ Sci* 35: 14.