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Solid Waste Management Issues for Northern Sindh (Pakistan) Cities

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Introduction

The cities in North Sindh, Pakistan are located mainly on river plains with major activity as of agriculture. Most of the waste produced has been dumped in the ground. However with the rapid increase in population and industrial activities the problem became bigger and now need much more resources and technical expertise to be handled. Among these cities Taluka Municipal Authority (TMA) of Sukkur, Larkana, Shikarpur & Khairpur were studied as per scope of this paper. Municipalities in the area are trying hard to cope with increased waste problem and some have chosen the privatization as an option. However the complex power and responsibility sharing system in the area is hindering the quick solutions. Unfortunately major players in solid waste in the country are not very interested in getting involved mainly due to issues like, less volume of waste produced, less recyclables, poor neighborhood and municipalities unable to pay for services. However there are some advantages also and most important of them is hot climate, allowing the development of dry landfill system which is more economical and easy to rehabilitate than conventional system.

Waste Generation rate and waste amounts

a) At source:

Based upon study of previous reports and field visits the waste generation rate of domestic waste can be taken as 0.40kg/cap.day for base year 2007 for the area. However with the developments in cities, growth of population and increase in living standards it is suggested to take 0.50kg/cap.day as the rate of waste generation after 15 years.

The information about waste amount generated at source is required to improve the primary waste collection system in each city. Further amount of waste gets to the secondary waste collection points from some other waste streams such as market, industries, husbandry units and hospitals.

b) At landfill site

As the waste reaching landfill or dumping site also includes waste from other streams like from markets and street sweeping the total amount gets increased. As a rule of thumb from various studies done in that area and survey done a 30% of increase to the waste amount at source should be added to get the quantity of waste reaching the dump or landfill site.

Waste Density & Composition

Density:

Upon physical inspection and based upon different studies and experiences, density of the waste can be taken as 350 kg/m³ at secondary collection point and

as 450 kg/m³ when reaching final disposal site. The density will be high because of loss of moisture due to climatic conditions as well as presence of very high density waste such as demolition waste in the municipal waste.

Waste Composition:

The waste composition showed similarity with the waste composition of other cities in the developing world. The main portion of the waste was organic exceeding 50% of the total. Based upon physical survey, previous studies and experiences following waste composition can be taken for waste at bin or secondary collection point.

Category	% wt
Vegetable, food	20.00
Animal waste	15.00
Leaves, grass	15.00
Paper	2.00
Cardboards/Tetra Packs	3.00
Plastics	5.00
Metals	1.00
Glass/ Ceramic	1.00
Bones	5.00
Textiles/Rags	5.00
Silt, fines and stones	27.00
Non-Separable	1.00
Total	100.00

Table i - Waste composition for North Sindh (Pakistan) Cities, 2007 Survey

Primary Waste Collection

In all the four above mentioned cities primary collection was done by local municipalities through use of sweepers. Some TMAs like that of Sukkur and Larkana have privatized some districts in their area. People are asked to handover the household waste to the sweepers at door steps who in turn use a wheel barrow to bring that waste to a secondary waste storage point. In current situation there is only 1 sweeper serving 1000 households. These sweepers are able to provide door-to-door waste collection service only to 30% of total population. Remaining either throw their waste in to the streets or take it by them to the end of the street to a secondary storage point.

There could be two major approaches to improve this situation. First could be introduction of more sweepers to reach the standard figure of 5 sweepers/1000 houses as advised by research studies or encourage people to bring waste to a certain secondary storage point. The first approach will not be successful in the cities under study, as managing human resource in government under such a complex political conditions is not realistic. Currently the hired staff is working below their capacity due to political affiliations that secures their jobs even if they don't work. In case of Sukkur and Larkana where some districts have been privatized the results are promising but it was found that public sector was only transferring its problems to private sector. Private sector also faced similar political problems while hiring and firing the concerned staff.

The second approach of encouraging people to bring the waste to a certain secondary storage point is more promising with a disadvantage of creating numerous secondary storage points for the waste. However it is easier to manage and will need establishment of such points at suitable points and then allocating

them to the concerned staff with efficient monitoring. This option can work only through extensive public information campaigns and staff training.

Secondary waste collection and transport

In some cities the number of secondary waste collection points is too many while in others less than the required. Based upon the location and distances for collection vehicles, there is a need for optimization of the secondary waste collection points. There were three types of secondary waste storage points in the area. At some places there were metal containers, however not with user friendly design; at other places it was a place with three sided walls and remaining were simply heaps of waste along the road.

Most of the waste in the cities under study is transported using tractor trolleys. This option is very useful for waste type, road type and under existing situations. However it has a disadvantage that long hauling distances do not favour use of the trolleys. In addition manual loading was found to be widely practiced taking up to 120 minutes per loading. While at places where mechanical loader was used this loading time was reduced to 20 minutes only.

Following was the secondary waste collection rate found in the cities under study for year 2007:

	City	Produced Waste (2007) Tonnes/day	Collected Waste (2007) Tonnes/day	waste collected % of produced
1	Khairpur	56	34	60%
2	Shikarpur	80	52	65%
3	Larkana	225	118	52%
4	Sukkur	260	80	30%

Table ii - Waste Collection Rates in the Cities under study, 2007 Survey

Secondary waste storage system must be improved to provide better services to the community as well as to keep the system running. In case where a week's waste gets stored or remains at the secondary storage point it becomes very difficult for the authorities to remove it with daily incoming inflow of waste with every day passing. The most feasible secondary storage point for the existing situation is an enclosure with 3 sided walls with a height of not more than 1.5 meters. It should be however noted that such points with quite large capacities tend to act as final dumping place so the capacity should carefully be decided; a typical capacity should not be more than 10m³.

As far as transport is concerned the current practice of using tractor trolleys must be encouraged with gradual shift to dumper trucks if necessary. Compaction trucks are not feasible mainly due to high maintenance costs involved and presence of large portion of debris in the waste being transported. In order to increase the transport efficiencies assistance in loading by mechanical loader should be introduced. It is suggested that every four tractor trolleys should have at least 1 mechanical loader.

While transporting the waste trolleys should be covered with the plastic sheets so that no waste gets dropped on the way to the dump. In case where huge hauling distance is involved as in Sukkur case an erection of transfer station can help to make system more efficient. However it was found that 4 trips/day was the maximum number of trips driver of the vehicle was willing to make irrelevant of the type of the vehicle. Such local working behaviour should always be kept in consideration while proposing any system improvement.

Final Disposal Issue

Currently collected waste is being dumped randomly and wildly in all cities under study. Most of it is dumped in natural ponds and marshes along river side or

within the city. This poses an increased threat of ground water contamination as well as destruction of natural ecosystem of river beds. Dumping to fill shallow lands within the city is also practiced widely to reclaim certain land and use it for construction of buildings later. This poses a threat to stability of soil especially if large buildings are constructed on these reclaimed lands.

The hot and dry climatic conditions favour the dry landfill erection in most of the cities. The dry weather further reduces the smell and leachate production in the waste dump.

At appropriate locations each city needs one or more landfill facilities to dispose the collected waste. Appropriate landfills in accordance with local needs and conditions should be developed to have safe waste disposal.

Although 'disposal' of waste is the responsibility of TMAs as per Legislation, their capacity is very weak and for issues like land allocation they rely on the district government. Therefore the district governments should identify and if possible provide the land for landfill facility. The area is mainly on river flood plains with high water table and extensive water logging for agricultural purpose. Therefore it is never easy to get the most suitable place for landfill and a partial compromise on all critical factors is needed.

Landfill

A secure landfill is a carefully engineered depression in the ground (or built on top of the ground, resembling a football stadium) into which wastes are put. All proposed landfill facilities should be able to operate for next 15-20 years. Enough land should be available for main structure, buffer zones and management offices. Proposed landfill will have special cells for industrial and hospital waste properly lined while wherever conditions allow, concept of dry economical landfill site should be encouraged.

Based upon waste generation rates and population increase in next 15 years, it is supposed that there will be 3 meters of waste depth/height. Higher depth/height is not recommended due to difficulties in operations like compaction using dozers. The density can safely be taken as 750kg/m^3 at landfill site.

An appropriate final disposal facility for waste will decrease the threat to environment and people. The final disposal facility should be prioritized over all other phases of the system improvement plan and its construction should start on first place. It should be completed along with the completion of waste transfer stations wherever required. However it should never be completed after 100% efficiency is acquired in primary or secondary waste collection because increased primary and secondary waste collection and non-availability of final disposal sites will further increase the problems of authorities with increased waste amounts without proper final disposal facilities.

Critical Elements of a Landfill

There are five critical elements in a secure landfill: a bottom liner, a leachate collection system, a gas collection system, a cover, and the natural hydro-geologic setting. The natural setting can be selected to minimize the possibility of wastes escaping to groundwater beneath a landfill. The three other elements must be engineered. Each of these elements is critical to success.

Again considering the climatic conditions of the area with less precipitation, need for bottom liner is decreased for the site receiving household waste only. Bottom liner is suggested in only 25% of total landfill area where hazardous hospital and industrial waste would be dumped with higher risks of contamination. However in cases where underground water table is not very deep and landfill is built as the last option then this liner should be applied to whole site. Similarly least Leachate collection system is suggested due to very low amount of Leachate produced and low precipitation. Gas collection vents would however be required due to high proportion of organic waste.

Conclusion

The cities under study in Northern Sindh (Pakistan) are facing rapid population increase along with increased industrial activities. The cities lack basic infrastructure like water, waste water, health and solid waste systems.

Primary collection is mainly done by sweepers who collect the waste either from door steps of the producer or from the streets where the producers throw the waste randomly. The efficiency of the system can be improved either by increasing the number of sweepers with better monitoring or encouraging producers to bring waste to some predefined secondary storage points.

There is a need of erection of number of secondary storage points. These should be user friendly designed with preference given to three sided walled concrete enclosures. These should not be very large otherwise they will get converted to permanent waste dumps.

Waste transport is currently done using tractor trolleys. These have advantages over other vehicles in the region as their maintenance is easy, economical and local know-how is available about them. However there is a need to increase the number of such vehicles to help the authorities to lift 100% of the waste.

Final disposal is currently wild dumping method mainly in the marsh lands and in shallow lands within the cities. This practice is harming the natural eco-system especially when waste is dumped in marsh lands. The dry and hot climate reduces the risk of leachate and smell and thus the establishment of dry landfill, without geo membrane is a promising option for the area.

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