NCR Planning Board
Asian Development Bank

Capacity Development of the National Capital Region Planning Board (NCRPB) – Component B

(TA No. 7055-IND)

Solid Waste Management Master Plan for Khurja

April 2010

Contents

1. INTRODUCTION

A. Background

1. The National Capital Region Planning Board, constituted in 1985 under the provisions of NCRPB Act, 1985, is a statutory body functioning under the Ministry of Urban Development, Government of India. NCRPB has a mandate to systematically develop the National Capital Region (NCR) of India. It is one of the functions of the Board to arrange and oversee the financing of selected development projects in the NCR through Central and State Plan funds and other sources of revenue.

2. On Government of India's request, Asian Development Bank (ADB) has formulated the technical assistance (TA) to enhance the capacities of National Capital Region Planning Board and its associated implementing agencies. Component B of TA relates to improving the capacity of the implementing agencies in project identification, feasibility studies and preparing detailed engineering design. As part of this model project reports and tool kits were prepared to guide and assist the implementation agencies in preparation of project reports.

3. This is the SWM Master Plan for Khurja, prepared using the SWM tool kits prepared under the TA for formulation of SWM Master Plans.

B. About this Master Plan

4. This Master Plan is prepared based on the baseline data provided by Khurja Municipality. No primary or field surveys were specifically conducted for this purpose. This SWM Master Plan is organized into four sections including this introductory section:

   (i) Section 2 provides a brief profile of Khurja Town
   (ii) Section 3 describes the existing solid waste management system in Khurja
   (iii) Section 4 presents the proposed solid waste management system for Khurja with capital cost estimates

2. PROFILE OF KHURJA TOWN

A. General

5. Khurja is a small industrial town in Bulandshahr district of Uttar Pradesh State. Geographically it is located at 28º15'N and 77º50'E, about 83 km from Delhi. The town is well connected with Delhi, State Capital Lucknow and other important cities by roads and railways.

6. Khurja is the largest ceramic industrial cluster in India and is known as a ceramic city. In local language "Khurja" means waste land. With the economic development in the country, the ceramic industries at Khurja have grown significantly with the increasing demand for ceramic products. At present there are 494 ceramic units in the town involved in manufacturing of ceramic products like stone ware crockery, sanitary ware, insulators, hospital ware, chemical porcelain, electro ceramics, kiln furniture, special ceramics, decorative wares, toys, figurines and bone china. Recently, Government of India has identified the Khurja Ceramic Cluster as the growth center for Export.

7. The population of Khurja Town as per census 2001 was 98,610. The municipal area of Khurja is 1,666 ha (16.66 sq. km), which is divided into 25 wards for administrative purpose.

Table 2-1: Population Growth of Khurja

Year	Population	Decadal growth rate	Annual Average Growth Rate
1991	80,305	-	-
2001	98,610	22.79 %	2.07 %

3. EXISTING SOLID WASTE MANAGEMENT SYSTEM

A. General

8. Municipal solid waste management is an obligatory function of the urban local bodies in India. As per the definition provided by the Municipal Solid Waste (Management and Handling) Rules, 2000 of Government of India, municipal solid waste (MSW) includes commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. With growing population and increasing waste generation, solid waste management has become a major environmental issue. ULBs across India face similar challenges in handling and disposal of municipal solid waste: lack of adequate financial and human resources, poor technology and lack of public participation to list a few.

9. Solid waste management in Khurja is the responsibility of Khurja Municipality. Existing solid waste management system of Khurja is presented in this section.

B. Solid Waste Generation – Quantity and Characteristics

10. Spreading over an area of 3.54 sq. km, the Khurja Municipal Area is divided into 25 municipal wards for administrative purposes. Khurja Nagar Palika undertakes solid waste management in all 25 wards. As per the current estimates of the Khurja Nagarpalika, about 40 tons of solid waste is generating daily, at a per capita waste generation rate of 313 gm per day per person (projected population of 2009 is 1,25,000). The main solid waste generation sources are residential, commercial and institutional establishments, vegetable and meat markets, hospitals, hotels and restaurants, and construction and demolition waste (debris) and waste generation from street sweeping. The length of municipal roads is around 113 km. Due to a large number of small scale industrial units (mostly Ceramic based) in the town, industrial solid waste also enters illegally into municipal solid waste. The source of waste generation is presented in **Table 3-1**.

11. As per the current estimates (2009) of the KNP, about 28.4 tons of solid waste is generated daily in Khurja. With the projected current population 120,000 (2010), the per capita waste generation works out to be 237 gm/day. The main solid waste generation sources are residential, commercial and institutional establishments, vegetable and meat markets, hospitals, hotels and restaurants, and construction and demolition waste (debris).

Table 3-1: Solid Waste Generation Sources in Khurja

S. No	Source	Quantity (tons)	% of Waste
1	Residential	9.3	23.3
2	Commercial	5.8	14.5
3	Hotels	1.5	3.8
4	Institutions	0.8	2.0
5	Hospitals	0.9	2.3

6	Markets (Vegetable, Fruit & Meat)	3.0	7.5
7	Construction and Street Sweeping	5.2	13.0
8	Garden Waste	0.6	1.5
9	Industrial	7.9	19.8
10	Others waste	5.0	12.5
	Total	**40.0**	**100.0**

Source: Khurja Nagarpalika

12. *Composition of Waste*. No data on composition of waste generated in Khurja is available. A study conducted in Ghaziabad in 2009 indicated the composition as: biodegradable - 56%, recyclable - 28%, and inert and other waste – 16%. Based on a study conducted by NEERI in 2005 in 59 cities across India, the following Table provides waste composition in the towns of similar population size as Khurja (1-5 lakhs population).

Table 3-2: Composition of Waste in Indian Cities of 1-5 lakh population

S. No	Composition	Value/Fraction
1	Compostable Matter	34% – 62%
2	Recyclable Fraction	13% - 36%
3	Moisture Content	24% - 63%
4	C:N ratio	14 – 37

Source: "Assessment of Status of Municipal Solid Wastes Management in Metro Cities and State Capitals", study conducted in 59 cities by NEERI/CPCB in 2005

13. In absence of waste composition data from Khurja, average values based on the above is considered:

- Compostable matter – 56%
- Recyclable fraction – 15%
- Inert and other waste – 29%

C. Solid Waste Collection & Transportation

14. There is no proper solid waste collection system in Khurja. There is no door-to-door collection, and there are no community dust bins provided in the town for waste collection. There are a large number of open collection points where people dump waste. Due to lack of proper collection system, all households throw waste onto the streets, drains and open spaces within the localities creating unhealthy conditions. Most open drains in the city are choked due to indiscriminate solid waste disposal.

15. One of the major activities of the solid waste management is street sweeping, which is time consuming and labor intensive. Due to open drain system, regular desilting of drains is also necessary. Since there is no proper system, throwing and indiscriminate disposal of waste on to streets is prevalent and the collection of waste is mainly through street and road sweeping. KNP carries out both street sweeping and drain desilting activities in all 25 wards. Sweepers use traditional short-handled brooms to sweep, and collect and transport

community bins/intermediate collection points using wheel barrows. The sweeping is carried on the basis of a single-tier system by forming "beats". Each beat is allocated to a sanitation worker/sweeper. Sweepers work in single shift.

16. *Transportation of Solid Waste*. Waste collected through street sweeping is collected and manually lifted into vehicles for transportation to disposal along the roads on the outskirts of the town. Of the total generated 40 tons, KNP collects and transports over 67 percent.

Table 3-2: Details of Transportation Vehicles

Description	Owner Ship	Nos.	Vehicle Capacity	Trips / Day	Total Quantity
			Tons	*Nos.*	*Tons*
Tractor-Trolley	Municipality	3	1	2	6.0
Mechanical Loader	Municipality	2	-	-	-
Hydraulic tippers	Municipality	1	3	1	3.0
Auto Rickshaws	Municipality	4	0.5	2	4.0
Bhaisa Buggi (bullock cart)	Municipality	16	0.5	2	16.0
JCB	Municipality	2	-	-	-
Hand Carts	Municipality	34	-	-	-
Total		**62**	**-**	**-**	**29.0**

Source: Khurja Nagarpalika

D. Solid Waste Processing & Disposal

17. There is no scientific solid waste processing or disposal facility in the town; there is no disposal site and the waste collected is disposed off along the roads on the outskirts of the town by crude open dumping method. This practice is very unhealthy and environmentally unsafe.

E. Institutional and Financial Aspects

18. Safe disposal of solid waste generated in an urban area is an obligatory function of the respective urban local body - it is KNP in case of Khurja. For the purpose of solid waste management, Khurja is divided into two sanitary zones covering all 25 wards. KNP employed 155 sanitary workers in Zone-1 (wards 1 to 13) and 114 in Zone-2 (wards 14 to 25).

19. Total expenditure (including establishment, O&M and private contractor) on SWM during 2008-09 was Rs. 307 lakhs. This is very high considering just about 27 Tons of waste being collected and transported daily. The total cost, however, appears also include capital cost.

20. *Private Sector Participation in SWM*. There is no private sector participation in SWM in Khurja.

F. Service Level of Existing SWM System

21. Based on the above discussion, service levels of solid waste management system in Khurja are presented in the following Table.

Table 3-3: Solid Waste Management – Service Level Indicators

Description	Value	Remarks
Per capita waste generation	313 gm/day	No proper estimates of waste generation are available with KNP
Collection performance	67%	Acceptable is over 95%.
Door-to-door waste collection coverage	Nil	No door-to-door waste collection system in Khurja
Average distance between dust bins	-	There are only 50 dust bins (Open type) covering total road length of 113 km. Acceptable spacing is 100 m.
Waste segregation percentage	Nil	Not practiced. Waste is collected and disposed unsegregated, although street rag pickers collect recyclable waste from dust bins, streets and disposal area.
Waste collection frequency	Frequency varies from a day to 1 month	This refers to waste collection and disposal from community dust bins/open points. It is necessary that biodegradable waste is collected and disposed daily. Since waste is not segregated, total waste generated shall be disposed daily.
Collection type	Multiple and manual collection	Multiple waste collection and handling is often inefficient and some waste left on ground at each point. Manual waste handling is unhealthy.
Road length per sweeper		Data not available
Disposal	No safe disposal facility	Waste is disposed by crude open dumping method along major roads. Due to non availability of disposal site.
Private sector participation in SWM	Nil	No private sector participation in SWM activities in Khurja
O & M expenditure on SWM	-	Details not available

Source: Analysis

4. PROPOSED SOLID WASTE MANAGEMENT SYSTEM

A. Projected Population and Waste Generation

22. **Table 4-1** shows the projected population of Khurja Town from 2011 to 2041. Considering the potential growth of the town, geometric growth method has been used for population projection.

23. The present per capita waste generation is worked out at 237 gm per day (based on the projected current population and waste present water generation data). To account for increase in waste generation due to economic development, an annual increase of 1.41 percent per annum is considered in per capital waste generation. This was suggested in a study conducted by NEERI.

24. The present waste generation is 28.4 tons per day, which will increase to 83 tons per day in 2041 (**Refer Table 4-1**).

B. Proposed Solid Waste Management System for Khurja

25. Master Plan report is prepared with an objective to formulate a suitable integrated solid waste management system (ISWM), to a design period of 30 years (2011-2041). The proposed SWM system is described below:

Component	Proposed System Details
SWM service	Provide SWM services 7-days a week throughout the year
Door-to-door collection	• Initiate daily door-to-door collection; cover 100 % houses in 5 years (2011-16) • Preferably, engage a private agency or NGO for door-to-door collection (DTDC) • Separate sanitary workers shall carryout DTDC • Use auto tippers (in areas with wide roads) & Pushcarts in other areas. o Pushcart with 4/6 containers – 250 households; 1 sanitary worker o Auto Tipper – 1,800 households; 2 - workers (driver and sanitary worker) • Collect wet/biodegradable waste and other waste in separate containers
Street sweeping	• Streamline street sweeping activities to cover all the roads/streets • Segregate streets/roads based on the following street sweeping frequency o Daily (main/important areas of the town & high density areas) o Alternative day o Weekly twice o Weekly once o Fortnightly (undeveloped/least developed fringe areas) • Divide streets into street sweeping beats; o Allocate 1 beat per sweeper for sweeping/drain desilting. o Fix beat length between 400 -600 m depending on the population density; divided roads to be considered as two roads

Component	Proposed System Details
	o Complying with this norm, ULB can manage as per the local requirement such as assigning the desilting and sweeping works to two different sweepers o Provide a wheel barrows/pushcart with containers to each sweeper
Litter bins	• Provide litter bins on main roads and commercial areas (1 bin in 50 m road length)
Temporary storage/ secondary collection	• Waste collected through DTDC & street sweeping shall be deposited in waste container bins for further collection & transport. Use following norms: o Use closed metal containers (3.0 m3 /4.0 m3 capacity) o Provide 1 bins for 1-1.5 ton waste generation/day o Biodegradable/wet/mixed waste shall be collected daily o Other waste can be on alternative day, if the bin is not filled in a day
Waste Transportation	• Containers shall be transported using dumper placer vehicles (modified tractor trolley for with lifting, transport and unloading arrangement for twin bins) • Number of trips per day – 8 trips i.e. 16 bins per day per vehicle • Prepare route for each dumper placer vehicle to transport waste to disposal site
Waste collection from Bulk generators	• DTDC will generally cover all residential and mixed residential areas; in other exclusive areas (like markets) waste shall be collected through containers o Use closed metal container bins (3.0 m3& 4.5 m3 capacity) o Provide 1 bin for 1-1.5 ton waste generation/day • Collect waste from establishments like hotels/function halls etc using on fixed schedule and transport directly to site. Collect user charge based on quantity • Collect construction waste separately on demand. Collect user charge • Utilize existing vehicles (tractors) for this; use auto tippers in narrow lanes
Waste processing & disposal	• Develop an integrated waste processing & disposal facility • Composting for biodegradable material • Recyclable material to recycling industries • Other waste and rejects of compost to sanitary landfill • Select a suitable site sufficient of 30 years • Facility shall be developed on PPP

26. With the above recommendation, the equipment, vehicles, land requirement for compost and landfill facility, man-power requirements of proposed SWM system and capital cost estimates are worked out using the toolkit for "preparation of SWM master plan". The input data and necessary assumptions used to run the tool kit are presented in the following Table. The outputs are presented in **Table 4-1 to Table 4-5.**

27. Land requirement is estimated for 20 years and 30 years design life – it is however recommended that the ULB should look for a site sufficient for 30 years. A suitable site - away from habitations, forest areas, water bodies, places of important cultural, historically or religious interest, shall be selected. The site should be at least 20 km away from Airfield. There should not be any major issues related to social, resettlement, environment and geotechnical matters.

28. Cost of land required for processing and disposal facility is not included in the cost estimates. It is suggested that the ULB should look for an appropriate government waste land, even if it away from the town.

INPUT DATA FOR SPREAD SHEET BASED SWM MASTER PLAN TOOL

Input for Tool	Data/Details
Population	Year Population Households 1951 1961 1971 1981 1991 80,305 2001 90,610 16,435
Current Waste Generation	Year Population Quantity *no. s* *ton* 2010 120,000 28.4
Waste Composition	Biodegradable waste 56% Recyclable waste 20% Inert & other waste 24%
Street Sweeping	Total road length 36.36 km Length of main/market roads 5 km Proposed Street sweeping frequency Roads swept daily 100% of roads Roads swept alternative day Nil Roads swept weekly Nil Roads swept fortnightly Nil Average beat length 400 metre/sweeper
Population Projections	Geometric Growth Method (GM)
Appropriate size of container bins	4.5 m3 containers 40% 3.0 m3 containers 60%
Door-to-Door Collection	% households covered by Auto Tipper 40% % households covered by Push Carts 60%

Table 4-1: Projected Population & Waste Generation

Year	Population	Decadal Growth Rate	Households	Waste Generation
	No,s		*No,s*	*Tons*
2001	98,610	41.87%	16,435	
2011	139,900	22.82%	23,317	34
2016	155,044		25,841	40
2021	171,827	22.82%	28,638	48
2026	190,427		31,738	57
2031	211,041	22.82%	35,174	68
2036	233,886		38,981	81
2041	259,205		43,201	96

Table 4-2: SWM Collection & Transportation Vehicles/Equipment Requirement (2011-2041)

Vehicles/Equipment			2011-16	2016-21	2021-26	2026-31	2031-36	2036-41
Containerized Push Carts for D2D Collection								
	Gross Requirement	no,s	62	69	76	84	93	103
	To be Procured	no,s	62	69	76	84	93	103
Auto Tippers for D2D Collection								
	Gross Requirement	no,s	5	6	6	7	8	9
	To be Procured	no,s	5	1	-	6	2	1
Push Carts for Street sweeping								
	Gross Requirement	no,s	313	316	320	324	328	333
	To be Procured	no,s	313	316	320	324	328	333
Litter Bins								
	Gross Requirement	no,s	125	127	128	130	131	133
	To be Procured	no,s	125	127	128	130	131	133
Closed Containers (3 m3 capacity)								
	Gross Requirement	no,s	23	27	33	39	46	54
	To be Procured	no,s	23	4	29	10	36	18
Dumper Placers (twin containers of 3 m3)								
	Gross Requirement	no,s	2	2	3	3	3	4
	To be Procured	no,s	2	-	1	2	-	2
Closed Containers (4.5 m3 capacity)								
	Gross Requirement	no,s	11	12	15	17	21	24
	To be Procured	no,s	11	1	14	3	18	6
Dumper Placers (twin containers of 4.5 m3)								
	Gross Requirement	no,s	1	1	1	2	2	2
	To be Procured	no,s	1	-	-	2	-	-

Table 4-3: Details of Processing and Disposal Facility

Particulars								
A. Compost Plant								
Design Life (Years)	20	30						
Waste Fraction Composted (%)	56%	56%						
Ultimate Design Capacity (ton/d)	38	54						
Land Required for compost (ha)	1.5	1.5						
Equipment required	Backhoe Loader-1, Tipper Truck-2, Tipper Tractor -2, Water Tanker (3000 lt)-1, Weight Bridge (20 MT)-1, Plant & Machinery-1							
B. Landfill Facility			2011-16	2016-21	2021-26	2026-31	2031-36	2036-41
Design Life (years)	20	30						
Waste Fraction Land filled (%)	30%	30%						
Design Capacity (tons)	110,216	210,793						
Land required for landfill (ha)	2.0	3.7						
Landfill cell area required (sq. m)	12,399	23,714	2,348	2,791	3,317	3,943	5,098	6,216
Equipment required	Backhoe Loader-1, Bull Dozer-1							
Total Land Requirement (20 Years)		3.5 ha (Compost + Landfill)						
Total Land Requirement (30 Years)		5.2 ha (Compost + Landfill)						

Table 4-4: Requirement of Sanitary Workers (D-to-D Collection & Sweeping)

Particulars	2011-16	2016-21	2021-26	2026-31	2031-36	2036-41
For Sweeping & Drain Cleaning	293	296	299	303	307	311
For D-2-D collection (Auto Tipper)	13	14	15	17	19	21
For D-2-D collection (Push Carts)	66	73	81	90	99	110
Total (collection & street sweeping)	372	383	395	410	425	442

Table 4-5: Capital Cost Estimates

Particulars	Total (2011-2041)	2011-16	2016-21	2021-26	2026-31	2031-36	2036-41
		Rs. Lakhs					
Equipment & Vehicles (Collection & Transportation)							
Containerized Push Carts for D2D Collection	48.70	6.20	6.90	7.60	8.40	9.30	10.30
Auto Tippers for D2D Collection	37.50	12.50	2.50	-	15.00	5.00	2.50
Push Carts for Street sweeping	193.40	31.30	31.60	32.00	32.40	32.80	33.30
Litter Bins	38.70	6.25	6.35	6.40	6.50	6.55	6.65
Closed Containers (3 m3 capacity)	60.00	11.50	2.00	14.50	5.00	18.00	9.00
Dumper Placers (twin containers of 3 m3)	42.00	12.00	-	6.00	12.00	-	12.00
Closed Containers (4.5 m3 capacity)	34.45	7.15	0.65	9.10	1.95	11.70	3.90
Dumper Placers (twin containers of 4.5 m3)	27.00	9.00	-	-	18.00	-	-
Total - Collection & Transportation	*481.75*	*95.90*	*50.00*	*75.60*	*99.25*	*83.35*	*77.65*
Landfill Facility							
Equipment							
Backhoe Loader	40.00	20.00				20.00	
Bull Dozer	120.00	60.00				60.00	
Sub-total	160.00	*80.00*	-	-	-	*80.00*	
Civil Works							
Landfill Cell Development	237.14	23.48	27.91	33.17	39.43	50.98	62.16
Other infrastructure (roads, drains, fencing, building, etc	25.94	13.56				12.38	
Sub-total	263.08	*37.04*	*27.91*	*33.17*	*39.43*	*63.36*	62.16
Total - Landfill Facility	*423.08*	*117.04*	*27.91*	*33.17*	*39.43*	*143.36*	*62.16*
Compost Plant							
Equipment							
Backhoe Loader	40.00	20.00				20.00	
Tipper Truck	48.00	24.00				24.00	
Tipper Tractor	16.00	16.00					
Water Tanker (3000 lt)	6.00	3.00				3.00	
Weight Bridge (20 MT)	20.00	10.00				10.00	
Plant & Machinery	200.00	100.00				100.00	
Sub-total	330.00	*173.00*	-	-	-	*157.00*	
Civil Works							
Interal roads, drains, tipping floor, office building, store,	75.00	75.00				-	
Total - Compost Plant	*405.00*	*248.00*	-	-	-	*157.00*	-
Total	1,309.83	460.94	77.91	108.77	138.68	383.71	139.81