



**MINISTRY OF LOCAL DEVELOPMENT  
HIS MAJESTY'S GOVERNMENT OF NEPAL**



**JAPAN INTERNATIONAL  
COOPERATION AGENCY**

# **ACTION PLAN ON SOLID WASTE MANAGEMENT**

**September 2005**



**Bhaktapur Municipality**

# Action Plan on Solid Waste Management of Bhaktapur Municipality

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## Abbreviations

### <Organizations>

BKM	Bhaktapur Municipality
HMG/N	His Majesty's Government of Nepal
JICA	Japan International Cooperation Agency
KMC	Kathmandu Metropolitan City
KRM	Kirtipur Municipality
LSMC	Lalitpur Sub-Metropolitan City
MOLD	Ministry of Local Development
MTM	Madhyapur Thimi Municipality
NGO	Non Governmental Organization
SWMRMC	Solid Waste Management and Resource Mobilization Center
T/F	Task Force
TWG	Technical Working Group

### <Metric Units>

g	Gram
g/L	Gram per liter
ha	Hectare
kg	Kilogram
kg/day	Kilogram per day
kg/d-capita	Kilogram per day per capita
km	Kilometre
km <sup>2</sup>	Square Kilometer
L	Liter
mm	Millimeter
m <sup>2</sup>	Square Meter
m <sup>3</sup>	Cubic Meter
mg/L	Milligram per liter
m	Meter
oC	Centigrade

### <Currency>

JPY	Japanese Yen
Rs	Nepalese Rupee
US\$	US Dollar
t	Ton
t/d	Ton per day

### <Others>

A/P	Action Plan
BCC	Behavior Change Communication
CBO	Community Based Organization
CEO	Chief Executive Officer
CKV	Clean Kathmandu Valley
CSO	Civil Society Organization
EIA	Environmental Impact Assessment
F/R	Final Report
FY	Fiscal Year

HH	Household
HRD	Human Resource Development
LF	Landfill
L/T	Long-term
LFS	Landfill site
M & E	Management and Evaluation
OFP	Overall Facility Plan
OJT	On the Job Training
O & M	Operation and Maintenance
OVI	Objectively Verifiable Indicators
PSO	Private Sector Organization
PPP	Public-Private Partnership
PR	Public Relations
S/T	Short-term
STV	secondary transportation vehicle
SW-C	Solid Waste Compost
SWM	Solid Waste Management
TOR	Terms of References
T/S	Transfer Station
UGR	unit generation rate
WPF	waste processing facility

## **CHAPTER 1 INTRODUCTION**

### **1.1 Background of the Study**

Solid waste management (SWM) in The Kathmandu Valley faces great challenges not only in relation to the management system but also in gaining public awareness and participation of the people. In order to improve the current situations, His Majesty's Government of Nepal (HMG/N) and the Government of Japan have launched on a joint study titled "The Study on the Solid Waste Management for the Kathmandu Valley (the Study)" with the technical assistance of the Japan International Cooperation Agency (JICA). The Study commenced in January 2004 (Magh 2060<sup>1</sup>) and ran for a total of 20 months until August 2005 (Bhadra 2062).

### **1.2 Objectives of the Study**

The objectives of the Study were;

1. To formulate Action Plans (A/Ps) on solid waste management for five municipalities in the Kathmandu Valley, namely Kathmandu Metropolitan City (KMC), Lalitpur Sub-Metropolitan City (LSMC), Bhaktapur Municipality (BKM), Madhyapur Thimi Municipality (MTM), and Kirtipur Municipality (KRM), and
2. To pursue technology transfer regarding SWM for the Nepalese counterpart (C/P) personnel.

Through the formulation of the A/Ps, which aimed to strengthen management capability for the solid waste of each municipality and encourage public participation for solid waste management, the management ratios<sup>2</sup> of solid waste are expected to increase, toward the target year of 2015. In particular, capacity development of the Nepalese C/P personnel for planning and management of solid waste was carried out over the study period, which included the implementation of a series of pilot projects.

### **1.3 Study Area**

The Study covered the jurisdiction of the five municipalities in the Kathmandu Valley, namely KMC, LSMC, BKM, MTM and KRM. In addition, "Okharpauwa" where a landfill site is proposed was also covered.

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<sup>1</sup> Nepalese Year

<sup>2</sup> Management ratio is the ratio of "the quantity of waste" that is managed by waste generators or municipalities in the appropriate ways such as source reduction, recycling, appropriate collection, treatment and disposal after it has been generated from the sources to "the total quantity of generated waste".



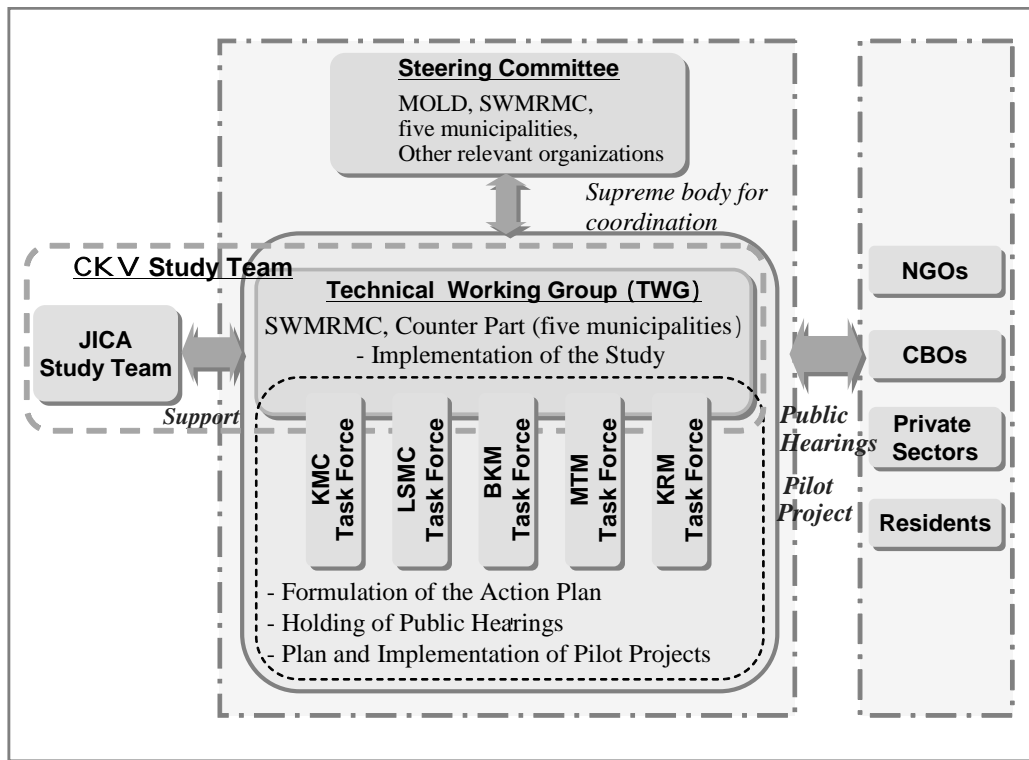
### 1.4 Target of the Study

In the Study, solid waste was broadly classified into four categories by generation source, i.e. 1) Municipal solid waste, 2) Industrial solid waste, 3) Medical solid waste, and 4) other solid waste including agricultural and construction waste.

The target solid waste of the Study was mainly municipal solid waste, non-hazardous waste that would be collected by the Municipality. However, the Study also made recommendations for industrial, medical and other solid wastes, but the management of night soil was not included in the Study.

### 1.5 Organization and Staffing of the Study

The Study established three implementation organizations on the Nepalese side, which are the Steering Committee (ST/C), Technical Working Group (TWG) and Task Force (T/F). The implementation organizations of the Study and their roles, tasks and members are shown in Figure 1.5-1 and Table 1.5-1, respectively.



**Figure 1.5-1 Implementation Organization of the Study**

Source: JICA Study Team

**Table 1.5-1 Roles, Tasks and Members of Organizations of the Study**

Organi- zation	Roles	Tasks	Members
ST/C	Coordination of relevant organizations	<ul style="list-style-type: none"> <li>- To confirm the overall policies and progress of the Study</li> <li>- To confirm and approve the contents of the reports to be submitted to the Nepalese side by the JICA Study Team</li> <li>- To discuss and approve the contents of the action plan to be prepared during the Study and to make a commitment to implement the action plan as policy makers</li> <li>- To coordinate the concerned organizations for SWM in the Kathmandu Valley and exchange information and opinions between the organizations of central and local governments</li> </ul>	<ul style="list-style-type: none"> <li>- Ministry of Local Development (MOLD)</li> <li>- SWMRMC</li> <li>- Five municipalities</li> <li>- Ministry of Environment, Science and Technology (MOEST) (formerly MOPE)</li> <li>- Ministry of Physical Planning and Works (MOPPW)</li> <li>- Ministry of Industry, Commerce and Supplies (MOICS)</li> <li>- Ministry of Education and Sports (MOES)</li> <li>- Ministry of Agriculture and Cooperative (MOAC)</li> <li>- Ministry of Health and Population (MOHP)</li> <li>- Members of TWG (as observers)</li> </ul>
TWG (C/P)	Implementation of capacity development and technology transfer from the JICA Study Team	<ul style="list-style-type: none"> <li>- To carry out the Study together with the JICA Study Team.</li> <li>- To prepare necessary documents and materials which are to be discussed at the ST/C</li> <li>- To organize and operate a T/F</li> </ul>	<ul style="list-style-type: none"> <li>- MOLD</li> <li>- SWMRMC</li> <li>- Staff of KMC</li> <li>- Staff of LSMC</li> <li>- Staff of BKM</li> <li>- Staff of MTM</li> <li>- Staff of KRM</li> </ul>
T/F	Coordination of opinions within the relevant departments, formulation of action plan, formulation and implementation of pilot projects	<ul style="list-style-type: none"> <li>- To formulate an Action Plan of the municipality and conduct pilot projects under the support from the JICA Study Team.</li> <li>- To coordinate opinions among the relevant sections of each municipality</li> <li>- To carry out Public Hearings with an aim to collect opinions from the residents</li> </ul>	<ul style="list-style-type: none"> <li>- Members of TWG</li> <li>- Planning relevant section</li> <li>- Environmental and Public Relations relevant sections</li> <li>- Community mobilization/development section</li> <li>- Financial section</li> <li>- NGOs/CBOs</li> <li>- Private sectors</li> <li>- Intellectuals</li> </ul>

Source: JICA Study Team

## 1.6 Acronym and Slogan of the Study

Based on the discussions of the TWG members, the Study adopted the acronym “CKV” which stands for “Clean Kathmandu Valley” to make the Study easier to promote and to be identifiable by relevant organizations and residents of the Kathmandu Valley as part of the public relations activities.

The Study also put up a slogan, “Sapha Sahar Hamro Rahar” in Nepalese, which means “clean city is our desire”.

Both the acronym and slogan have been spreading gradually by relevant organizations.

## CHAPTER 2 CONDITIONS OF MUNICIPAL SOLID WASTE MANAGEMENT OF BHAKTAPUR MUNICIPALITY

### 2.1 Outline of Bhaktapur Municipality

Bhaktapur Municipality (BKM) is well known as the city with an old history. The core area of the municipality has been designated as World Heritage since 1979, and it attracts a large number of tourists.

The municipality is spread over an area of nearly 7 km<sup>2</sup> and it is divided into 17 wards administratively. The predominant land use in the municipal area is agricultural accounting for 75% in the 2001 census. The residential area, including the historic core zone and commercial zone, is about 17%. The monumental protected zone is about 8 ha within the historic core zone.

It is estimated that nearly 73,000 people live inside the municipality as from 2001 national census, and population growth from 1991 was 1.7% annually. The number of households and average size of households are about 12,000 and 6 persons/HH, respectively. The predominant ethnic group is Newari which is 95% of the total municipal population.

### 2.2 Waste Generation and Stream

#### (1) Waste Quantity

The TWG members of BKM summarized the current situations of waste quantity as follows:

Waste Unit Generation Rate:	0.303 kg/day-capita
Total Waste Generation:	22 tons/day

The result of this first waste quantity survey in the dry season by the JICA Study Team in BKM with samples from 12 households, three commercials and one point in the street is shown below. About 0.7 to 1.0 L of waste per person with 200 to 230 g/L of bulk density is generated on average.

**Table 2.2-1 Result of Daily Waste Generation Quantity Survey of Households (BKM: Dry Season)**

Income Level	Weekdays			Weekends		
	Waste generation per person weight (g)	Waste generation per person volume (L)	Bulk density (g/L)	Waste generation per person weight (g)	Waste generation per person volume (L)	Bulk density (g/L)
High	184	1.0	184	198	1.0	198
Middle	160	0.7	229	149	0.7	213
Low	133	0.8	166	177	0.8	221
Average	159	0.8	199	166	0.8	208

Source: JICA Study Team

From commercial areas, it was observed that 0.3 to 1.4 kg/day was generated from each surveyed restaurant with 240 to 340 g/L of bulk density. From municipality offices, 1.5 to

1.6 kg/day of waste were generated with 160 to 270 g/L of bulk density. In the street, about 3.1 kg of waste are collected per day per each 100 m and bulk density was 186 g/L.

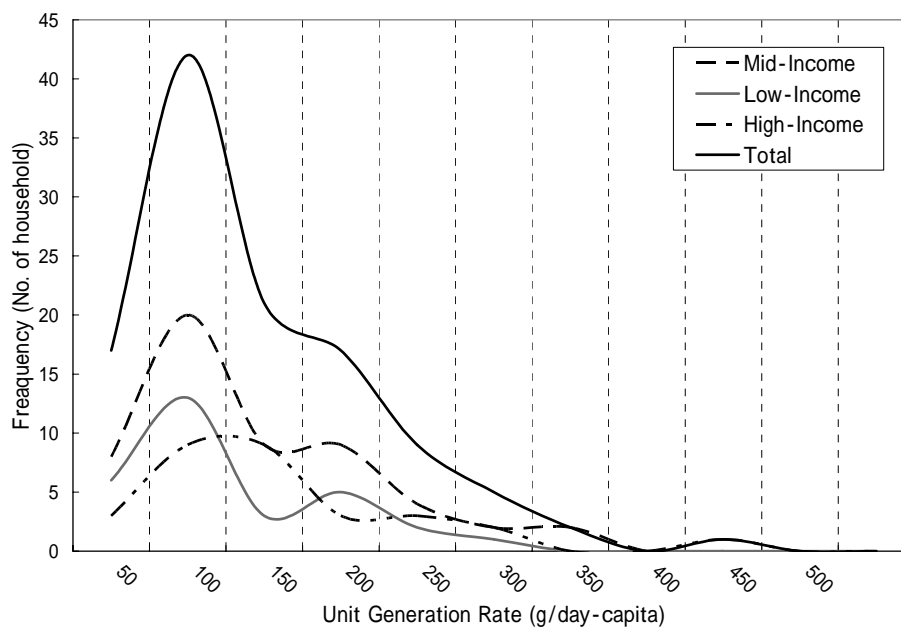
The second waste quantity survey in dry season was conducted in BKM in September 2004, sampled at 120 households, 21 commercials and four points in the street. The result of this detail waste quantity survey of households in BKM is shown in Table 2.2-2, but analysis for volume and bulk density will be finalized by the end of June 2005.

**Table 2.2-2 Result of Daily Waste Generation Quantity Survey at Household (BKM: Wet Season)**

Income Level	Weekdays			Weekend		
	Waste generation per person weight (g)	Waste generation per person volume (L)	Bulk density (g/L)	Waste generation per person weight (g)	Waste generation per person volume (L)	Bulk density (g/L)
High	134	0.9	145	124	1.0	119
Middle	116	0.9	137	135	0.9	145
Low	92	0.6	146	109	0.7	156
Average*	115	0.8	141	126	0.9	140

Note: \* This is the average for only the surveyed households, it does not reflect the actual dispersion of income level  
Source: JICA Study Team

Figure 2.2-1 shows the frequency distribution of UGR at different income levels of surveyed households. A peak of unit generation rate for surveyed households for each income level is shown around 50 to 100 g/day-capita. There is no household who generates the waste more than 500 g/day-capita.



**Figure 2.2-1 Frequency Distribution of UGR of Households in BKM**

Source: JICA Study Team

(2) Waste Quality

Waste quality data given by TWG members of BKM and surveyed by the JICA Study Team are shown in the following table. From households, more than 80% is kitchen waste and plastic and paper items represents around 3 to 7% each.

**Table 2.2-3 Waste Quality (BKM)**

Items	Households			Commercial	
	BKM data	Study		Dry Season	Wet Season
		Dry Season	Wet Season		
Kitchen waste	75%	83.6% (90.3%)	87.4% (85.1%)	41.2% (28.3%)	74.6% (68.3%)
Paper	3.25%	6.0% (2.8%)	3.2% (3.5%)	19.1% (28.3%)	14.7% (26.4%)
Textile	3%	1.5% (0%)	0.7% (1.3%)	1.5% (0%)	1.5% (0.1%)
Wood/leaves	-	1.5% (2.8%)	1.1% (1.3%)	8.8% (8.7%)	0.4% (0.0%)
Plastic	3.4%	7.5% (4.2%)	3.2% (3.9%)	2.9% (32.6%)	4.4% (2.8%)
Rubber/leather	-	0% (0%)	0.0% (0.0%)	10.3% (0%)	0.0% (0.0%)
Metal	0.3%	0% (0%)	0.1% (0.8%)	10.3% (2.2%)	1.5% (0.5%)
Glass	1.5%	0% (0%)	1.6% (1.9%)	5.9% (0%)	2.6% (1.6%)
Ceramics	-	0% (0%)	0.0% (0.0%)	0% (0%)	0.0% (0.0%)
Others	11.4%*	0% (0%)	2.6% (2.1%)	0% (0%)	0.1% (0.3%)
Bulk density	225 g/L	199 g/L (208 g/L)	141 g/L (140 g/L)	284 g/L (192 g/L)	182 g/L (207 g/L)
Water content	-	45% (44%)	65% (62%)	39% (28%)	54% (62%)

Note: Lower numerical value in parenthesis is data on weekends and upper on weekdays

Total value of each composition is not always 100% because each one was rounded off.

\* In which, construction debris was 11.1%

Source: JICA Study Team, May 2004 for Dry Season, June 2005 for Wet Season

### 2.3 Collection and Transportation

TWG members of BKM summarized the current situation of waste collection and transportation as follows.

Spot collection :

-- Within the core areas : 72 (Approx.)  
 --\*Along the surrounding areas : 28 (Approx.)  
 Total: 100 (Approx.)

\*(Araniko Highway-Jagati-Kamalbinayak- Sallaghari Treatment pond- Araniko Highway)

Time and Motion of Collection:

-- 6 hr to 9 hr / 9 hr to 12 hr / 12 hr to 16 hr/& 16 hr to 19 hr

-- Total No. of trips = 30.00 Trips/day

Street Sweeping & Cleansing: 3 times per day in main roads  
( -January, 2005) (6:00 a.m., 12:00 noon, 4:00 p.m.)  
2 times per day in other roads  
(6:00 a.m., 12:00 noon)  
(February, 2005- ) 2 times per day  
(4:30 a.m. to 7:30 a.m., 4:30 p.m. to 8:30 p.m.)  
Tipan Tapan (Waste Collectors) 9:00 a.m. to 4:00 p.m.

Vehicles & Tools for Collection

Pick up van: 8 (capacity : 1.30 Cum. - 1 Ton )  
Power Tailor Tractor: 2 (capacity : 1.68 Cum. )  
Hand Cart: 88 (capacity : 0.16 Cum. )  
Kharpan (basket): 30 sets (capacity : 0.06 Cum. )  
Plastic Buckets: 50 (capacity : 0.01 Cum.)

Heavy Equipments

Backhoe Loader: 1 (6 ton, KOMATSU, JAPAN Procured in 1998)  
Mini Chain Dozer: 1 (6 ton, KOMATSU, JAPAN Procured in 1998)

Present Problems

Sorting of organic & non organic wastes at the source (household level) is not effective.  
Conventional waste collection system – being not able to collect organic & non organic wastes separately.

In addition to the above, 26 permanent sweepers work in two shifts in Ward Nos. 2, 9, 10, 12, 16 and 57 sweepers in contract works in three shifts in Ward Nos. 1, 3, 4, 5, 6, 7, 8, 11, 13, 14, 15 and 17. Since February 2005, as other municipalities in the Valley, BKM has shifted its collection system to night/early-morning collection.

The pick up truck that is currently used in BKM for waste collection is small enough that it can pass through the narrow streets in the historic area, but the mechanism of van's bed does not have a hydraulic dumping device. Therefore, the municipal worker unloads the waste from the van with great effort.

Table 2.3-1 shows the result of the Time and Motion survey conducted by the JICA Study Team on April 15 and 16 2004 on 4 selected routes.

**Table 2.3-1 Result of Time and Motion Survey in BKM**

Vehicle	Average Collection/ Dumping Time in min	Total Distance Travel in km	Average Speed of Vehicle in moving km/hr	Average Speed of vehicle*	Return Distance in km	Average Speed on Return km/hr	Total Time for One Trip in min
Pick Up Truck	5.6	8.1	13.0	5.7	0.9	2.9	61.6


Source: JICA Study Team

## 2.4 Solid Waste Minimization Activities

### (1) Composting

In addition to a few composting activities at the household and community level, the Bhaktapur composting facility has been operating for 20 years as described in Table 2.4-1. Composting activity started as a part of recycling and reduction of waste with support from GTZ in 1984. The process of composting is a simple manual field heaping method and the municipality has been bearing the expenses and selling the produced compost at a low price. This is the reason why the composting facility is still operating. However, recently houses have been constructed close to the composting facility and residents are complaining against offensive odors from the composting facility. Though a belt conveyor for collecting recyclable materials has been broken and not used for long time, recyclable materials are collected directly from unloaded waste by staff in the yard.

**Table 2.4-1 Operating Condition of Bhaktapur Composting Facility**

No.	Items	Contents
1.	Composting method	Manual field heaping method 
2.	Starting time	Year 1984
3.	Waste disposal amount	About 3 to 3.5 tons/day
4.	Waste collection	Collected by municipality (mixed waste) (Rainy season is high volume, while dry season is low).
6.	Waste separation	Collected by municipality at facility site
7.	Composting duration	47 days
8.	Operation & maintenance of the facility	Operation by municipality
9.	Workers	16
10.	Operation time	6:00-9:00, 12:00-16:00, Total 7 hours
11.	Site area	About 30 × 85 2,500 m <sup>2</sup>
12.	Selling price/ amount	100 Rs/m <sup>3</sup> (700 kg) ( Cost 200 Rs/m <sup>3</sup> , 207 tons for (FY2004/05)
13.	Expenditure	Rs 715,000 (FY2004/05)

Source: JICA Study Team

### (2) Recycling

#### 1) Recycling by Independent recyclers and Kabadi Shops

In BKM, there are six kabadi shops dealing in iron (tin/steel), paper, plastic and glass. Independent recyclers collect recyclable materials door-to-door by bicycle or rickshaw and take them into kabadi shops. Table 2.4-2 shows market price of recyclable materials dealt with by buyers in BKM.

**Table 2.4-2 Market Price of Recyclable Materials in BKM**

	Buyer 1			Buyer 2		
Since establishment	8 months			2 years		
No. of employees	4			7		
Collection of materials	Amount (monthly)	Transaction prices		Amount (monthly)	Transaction prices	
		Buying	Selling		Buying	Selling
Paper	100kg	6-10 Rs/kg	6.5-10.5 Rs/kg	200 kg	10 Rs/kg	11 Rs/kg
Plastic	80kg	20 Rs/kg	22 Rs/kg	100 kg	22 Rs/kg	24 Rs/kg
Metal	2 tons	10-15 Rs/kg	10.5-15.5 Rs/kg	3 tons	15 Rs/kg	16 Rs/kg
Glass 1 (beer bottles)	4,000 nos.	2.5-3.5 Rs/kg	3.6 Rs/kg	6,000 nos.	3.5 Rs/kg	3.75 Rs/kg
Glass 2 (whiskey bottles)	2,000 nos.	1 Rs/no.	1.15 Rs/no.	3,000 nos.	1 Rs/no.	1.15 Rs/no.

Source: Hearing Survey by JICA Study Team, 2004 (March 28, 2004)

## 2) Recycling by Waste Pickers

The number of waste pickers at the Hanumante River is less by far than that at the Bagmati River dumping site and only ten or less waste pickers can be identified in a day. BKM does not manage waste pickers who are conducting their waste picking activities individually.

Out of recycling buyers in BKM, only one kabadi shop receives materials from waste pickers. Other kabadi shops tend to refuse to buy materials from waste pickers because the quality of materials picked up from the street or landfill site is inferior to that of materials from the generation source.

## 3) Recycling Activities Promoted by the Municipality, NGOs/CBOs and Private Sectors

At the Bhaktapur Composting Facility, during the composting process, plastic materials separated from incoming waste, most of which are plastic bags are collected together and sold to a recycle buyer. The income from recycling of plastic materials is about 7,000 to 8,000 Rs/months.

In addition, BKM has operated a paper recycling facility where a total of seven female staff members consisting of one responsible municipal officer and six workers have been working since 1999. They have been collecting used paper, mainly from the municipal or private offices. The recycling process is as follows:

- Collected used paper is dissolved in water
- Dissolved paper is skimmed off
- Skimmed paper is dried
- Dried paper is processed into envelopes or paper bags and sold to consumers.

Recycled paper from the facility is now being used mainly by BKM office, Khwopa College, Khwopa Engineering College and Khwopa Polytechnic College. Average net income from sales of recycled paper is Rs 1,500/month after expenditures of around Rs 46,000/month.

On the other hand, a NGO, Prayatna-Nepal located in BKM has conducted unique activities for promoting reuse and recycling. They have conducted some training for children and teachers to teach them how to make some products from reusable material. They



sometimes conduct several exhibitions to display the products from reusable material for promotion.



Training for Children

Products from Reusable material

At Exhibition

## 2.5 Final Disposal

In BKM some of the collected waste is sent to the composting facility (about 10% daily) while the majority is directly dumped in the Hanumante River and along its banks. There are two main dumping points, the first west of the city at the city's main entrance and the second east of the city in the vicinity of the closed dump site. No cover soil is applied. BKM does not have any staff assigned at the disposal site. Waste pickers have free access to the dumped waste. Pigs and cattle graze on the disposed waste. Open burning is observed at the site.

## 2.6 Social Aspects

### (1) Major Findings of Household Behavior and Attitude Survey on SWM<sup>1</sup>

#### 1) Priorities of Public Services

Waste collection was ranked as the third priority (13% of sample HHs) while water supply (46%) and drainage/sewerage (14%) were considered as more important needs regarding public services and utilities for improvement.

#### 2) Waste Disposal and Management

Table 2.6-1 illustrated that the majority (50%) of HHs in BKM disposed of their waste at municipality's designated disposal sites. A total of 40% of sample HHs disposed of waste by door-to-door collection services. Composting was relatively a popular disposal practice and 12% of sample HHs adopted it. A total of 6% of HHs reported they practiced open dumping on roads or vacant land. Close to 80% of sample HHs said that a female adult was responsible for both handling waste and taking out waste for disposal. Children were also considerably involved in handling waste (almost 20% of sample HHs responded). 17% of HHs surveyed disposed of waste as soon as it arose and 13% HHs once every 2 or 3 days, but 69% did it daily. The nature of the place for waste storage was completely different from other municipalities. A total of 63% of sample HHs stored waste in the kitchen while

<sup>1</sup> In the case of BKM, 6 out of 17 wards were selected based on the core area, sub core area and fringe area. A total of 126 sample HHs were selected.

25% of HHs stored it in the backyard. Baskets were used by 60% of sample HHs, which was considered as the most popular container.

**Table 2.6-1 Waste Disposal Practice among HHs Surveyed (BKM)**

Sample HH nos.	126#	115%
Dispose of waste by door-to-door collection service	50	40%
Dispose of waste by putting into Municipal or Communal Container	5	4%
Dispose of waste at Municipality's designated disposal site	63	50%
Dispose of waste by open dumping out side the house	7	6%
Dispose of waste by open combustion	2	2%
Dispose of waste by burying in the ground	2	2%
Dispose of waste by Composting	15	12%
Dispose of waste by giving it for recycling	0	0%
Dispose of waste by using as animal feed	1	1%

Note: Considering more than one method was reported by the respondents, the summation of responses exceeds 100%.  
Source: JICA Study Team, 2004 "Interview and Questionnaire Survey on Household, Establishment and NGOs/CBOs regarding Solid Waste Management in the Kathmandu Valley"

### 3) Existing Waste Collection Services

As illustrated in Table 2.6-2, the majority of HHs surveyed (94%) responded that waste collection services were available in their areas and they used these services. A total of 53% of sample HHs carried their waste to a specific site while 44% of HHs used door-to-door collection services. Since BKM was fully responsible for such door-to-door collection services, neither private companies nor NGOs/CBOs were involved in them. A total of 94% of HHs out of those who used any collection services noted that these services were available on a daily basis. A total of 57% of HHs surveyed said that they paid for services. Most of them reported that they were very or somewhat satisfied with these services. Except those who were very satisfied, 18 HHs addressed the main reasons for less satisfaction as follows; a) waste collection and sweeping were not properly done (39%) and b) waste collection and sweeping were irregular (28%).

**Table 2.6-2 Availability and Use of Waste Collection Service in BKM**

Sample HH nos.	126#	100%
Service available and used	119	94%
Service available and not used	2	2%
Service not available but required	5	4%
Service neither available nor required	0	0%

Source: JICA Study Team, 2004 "Interview and Questionnaire Survey of Households, Establishments and NGOs/CBOs regarding Solid Waste Management in the Kathmandu Valley"

### 4) Waste Reduction and Recycling

A total of 56% of sample HHs responded saying that they have knowledge about separation and actually separating waste, mostly into two categories. On the other hand, 20% of HHs noted they neither had knowledge nor practiced source separation of waste in spite of implementation of source separation by BKM. It was assumed that an effective information dissemination and awareness program had not been carried out by BKM to promote source separation. The level of attitudes towards cooperation for source separation varied from one to another. The proportion of HHs who were very willing to cooperate with recycling (61%) was the largest group in the five municipalities. On the contrary, the proportion

(20%) of HHs who were less willing or not willing (7%) to do was also the highest among the five municipalities. The reasons for less willingness or unwillingness to cooperate for separation included; a) inconvenient and difficult to separate, b) not clear on necessity of recycling system, and c) not clear on benefits from recycling system. Regarding disposal of recyclable materials, 57% of sample HHs that responded are selling their recyclable materials to the buyer. Almost 40% of sample HHs did not sell their recyclable items although buyers visited the house. The major items collected for sale were glass and papers, followed by tin. The level of knowledge about composting was relatively high indicating that 81% of sample HHs know what compost is. This figure was the highest among the five municipalities. The majority of these respondents noted that they themselves learned how to make composting. However, less than 30% of sample HHs reported having actual experience in making composts, and most of them composted their waste in an open space or organic field (91% of respondent sample HHs). A total of 75% of those having no experience have shown no interest in making compost. The major reasons for unwillingness to compost include; a) unclear regarding needs for composting (29% of respondent sample HH) and b) inconvenient and difficult to compost (22%).

#### 5) Public and Community Involvement

The perception that SWM was the duty of the municipality was still prevailing among sample HHs in BKM. This might result from the fact that BKM has executed various activities without collaboration with other organizations. Waste is actually being collected by BKM alone. Close to 30% of HHs noted that they themselves should be responsible for SWM. As a result, a negligible 2% of HHs took initiatives towards SWM. However, the large majority of HHs, including those who have already paid, had positive attitudes for paying a service charge for SWM. Most of them reported that an affordable monthly payment would be Rs 11-30 or less than Rs 30. The main reasons for unwillingness to pay were described as follows; a) could not afford to pay, and b) it is the duty of the Municipality. Almost 63% of sample HHs have not participated in CBOs' activities for SWM. However, close to 95% of HHs interviewed considered that these CBOs' activities related to SWM were necessary or somewhat necessary. The major activities in which those who were willing to participate included; a) campaign for raising awareness, b) any activities related to SWM, c) clean up program, and d) education program on SWM.

**Table 2.6-3 Perception of Responsibility for SWM in BKM**

Sample HH nos.	126#	100%
Government/Ministry of Local Dev.	4	3%
Municipality	60	48%
Sweepers	15	12%
Yourselves	35	28%
Our Communities/CBOs	0	0%
Private Company	11	9%
NGO	0	0%
Do not know	0	0%
Others	1	1%

Source: JICA Study Team, 2004 "Interview and Questionnaire Survey on Households, Establishments and NGOs/CBOs regarding Solid Waste Management in the Kathmandu Valley"

(2) Municipality's Programs regarding Community Mobilization on SWM

BKM introduced a fee for cleaning of Rs 12 per year per house in all wards in 1999 and Rs 15 per shutter in market areas in 2004. BKM also distributed 2 buckets per house in all wards to promote source separation in 2002. Since BKM has not promoted specific community mobilization or awareness programs along with these initiatives, they have been far from satisfactory. Based on this experience, the BKM selected the implementation of source separation in target wards as part of the Pilot Projects under the Study (see Section 8.5.1 A-1).

(3) NGOs/CBOs' Programs regarding Community Mobilization on SWM

Although there are Guthis<sup>2</sup> and youth clubs in BKM, it is said that few of them have been working in SWM. The following two organizations were interviewed under the Study.

**Table 2.6-4 Major NGOs/CBOs Working in the Field of SWM in BKM**

Name of NGOs/CBOs	Year of foundation	Number of staff	Working Areas
Prayatna-Nepal	2000	18 volunteers	Recycling training/education for children, teachers
Kathmandu 2020	1995	1 paid and 1,500 volunteers	3R program for SWM

Source: JICA Study Team, 2004 "Interview and Questionnaire Survey on Households, Establishments and NGOs/CBOs regarding Solid Waste Management in the Kathmandu Valley"

## 2.7 Managerial Condition

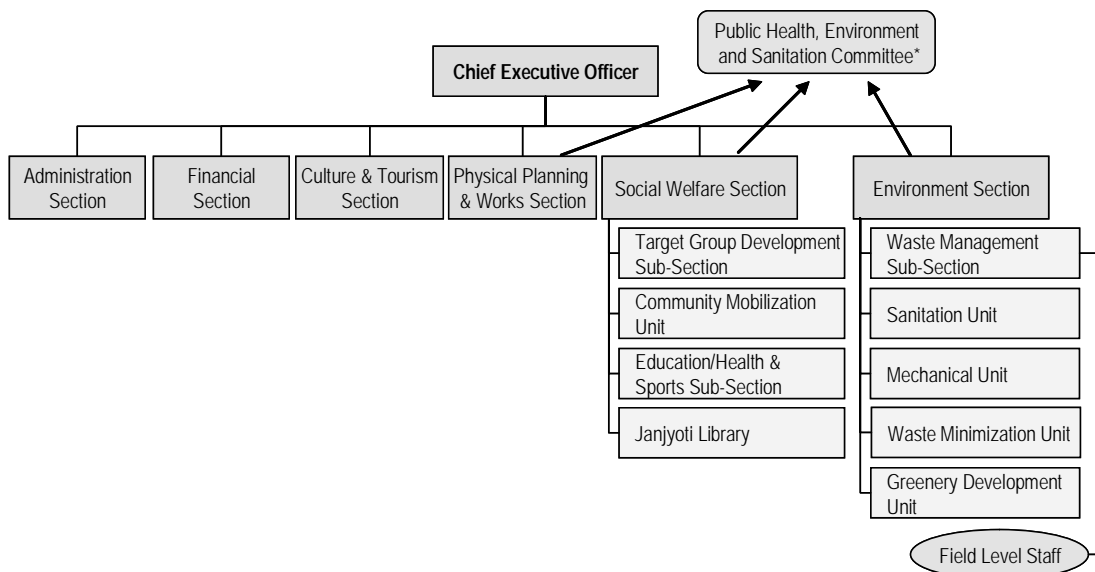
(1) Organizational Structure and Managerial Practices

1) Organizational Structure

BKM office's existing structure consists of four sections and 13 sub-sections. There is a sub-section responsible for sanitation activities under the Social Welfare and Sanitation Section.

In December 2004, the BKM Board and Council approved a new organogram based on the restructuring exercise of the municipality office. The existing four sections would be replaced by six sections introduced by the newly approved organogram. It is envisaged that the current Sanitation Sub-section is going to be placed under a newly established Environment Section with four newly established units as shown in Figure 2.7-1. In addition, a new Community Mobilization Unit will be set up under the Social Welfare Section.

<sup>2</sup> Guthis are social and religious organizations that form the backbone of Newar social or religious order. In Bhaktapur where Newar culture is strongly prevailing, many Guthis exist in the community.



**Figure 2.7-1 Newly Approved Organizational Structure of BKM SWM Related Sections and Sub-Sections**

Source: BKM, 2005

## 2) Managerial Practices

SWM activities in BKM have for long been compartmentalized under the responsibility of the Sanitation Sub-Section. SWM tasks concentrate on waste collection, street cleaning, and operation of the Bhaktapur Composting Facility and the Paper Recycling Factory. Since BKM does not operate any large-scale SWM facilities, such as landfill site, nor have any community mobilization program, not many other sections of the municipalities are involved in SWM. However, within the last few years, BKM has become more active in promoting the development of a sanitary landfill site in Taikabu and more recently in the expansion of the Bhaktapur Composting Facility. Under the leadership of the CEO, the Planning and Technical Section Staff (now Environment Section) are playing key roles together with the Social Welfare and Sanitation Section (now Social Welfare Section). For the expansion of the Bhaktapur Composting Facility, two committees were formed: one for land acquisition for the new facilities and the other for technical assessment. Both committees report directly to the Municipal Board.

BKM had a very active Public Health, Environmental and Sanitation Committee operating under the Municipality Board. This committee, consisting of Municipal Board Members, performed as a forum to deliberate policy and operational matters related to public health, the environment and sanitation issues. In addition, during the fiscal year 2003 to 2004, the Committee received its own budget to introduce SWM public education activities in support of school programs and nighttime literacy classes. This Committee, as in other municipalities, stopped activities when the politically appointed Ward Chairpersons stepped down in May 2004.

(2) Human Resources

The total number of SWM related staff under the Social Welfare and Sanitation Section is 219 persons, or about 50% of all municipal staff. The breakdown of human resources is as follows:

**Table 2.7-1 SWM Related Staff of the Social Welfare and Environment Sections**

Staff Category	Number of persons
Sweepers (permanent staff) including toilet cleaners, drainage cleaners, vendor control, cemetery	48
Sweepers (contract base staff)	57
Waste Collectors (Tipan Tapan)	47
Employees for Composting Facility	16
Waste Loaders	20
Drivers	11
Senior Inspectors	17
Registration	1
City Inspector (Sub-Section Chief)	1
Officer (Social Welfare Section Chief)	1
Total	219

Source: BKM, 2005

1) Senior Officers and Mid-Level staff

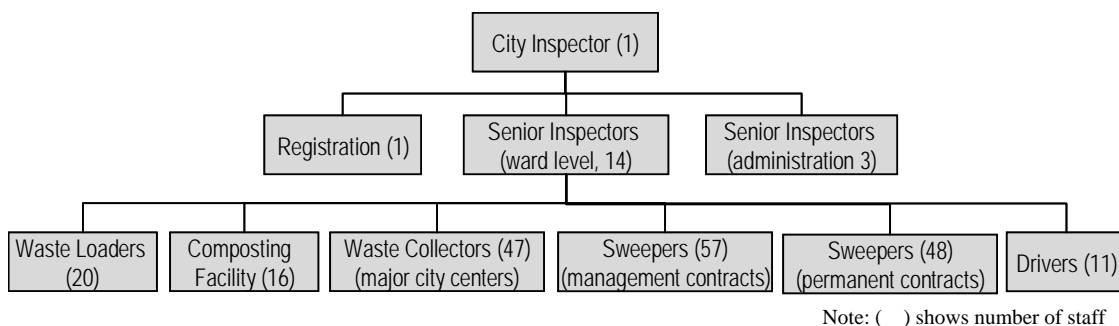
The Chief of the Social Welfare and Sanitation Section has been well trained in management skills but does not have a SWM technical background. BKM's Planning and Technical Section is well staffed with three engineers, of which one is a sanitation engineer. With the organizational restructuring and the recent municipal prioritization of SWM facilities development, closer cooperation is expected between the two sections.

The head of the Sanitation Sub-Section is a graduate of the six-month UDLE SWM Training Program, and has been trained in various cleaning and public health programs. On the other hand, the Ward Inspectors, although many are well educated and some hold university degrees, do not have adequate comprehensive knowledge about SWM issues.

2) Field Level Staff

BKM has several unique features in its field level SWM staff. First of all, out of the 105 sweepers, 57 sweepers are employed on contract basis covering 12 out of 17 wards. The sweepers assigned at the ward level mainly conduct street cleaning and transportation of waste to the collection stations. Some sweepers have other specific duties such as cleaning of public toilets or sewerage/rain drainage cleaning. Both permanent status sweepers and contract-based sweepers usually are working in two shifts (4:30 to 7:30, 16:30 to 20:30).

In addition, BKM has hired a troop of waste collectors, namely *tipan tapan* who go around the major streets and tourist areas to pick up littered waste with their carts and brooms. Waste collectors are organized into two groups with different shifts, and ensure that the main streets are cleaned at all times of the day. Figure 2.7-2 summarizes the structure of BKM field staff.



**Figure 2.7-2 Structure of BKM Field Level Staff**

Source: BKM, 2005

## 2.8 Financial Condition

BKM estimates direct expenditure for SWM services as shown in Table 2.8-1.

**Table 2.8-1 Expenditures for SWM in BKM**

Fiscal Year (Nepalese Year)	Budget for SWM	Actual Expenditures for SWM	
	(Rs)	(Rs)	% of Total Actual Municipal Expenditures
2000/01 (2057/58)	16,115,000	13,315,325	14 %
2001/02 (2058/59)	17,400,000	14,854,949	12 %
2002/03 (2059/60)	15,600,000	14,867,440	13 %
2003/04 (2060/61)	16,180,000	14,851,000	12 %

Source: BKM TWG members, 2004

BKM spent 12-13% of the total municipal expenditure on SWM services. This percentage is not very high compared with that of KMC (30-35%) and LSMC (25%) at this moment.

## 2.9 Issues and Constraints on Municipal Solid Waste Management

The analyzed issues and constraints on SWM in BKM are summarized as follows.

### (1) Collection and Transportation

- BKM has faced some difficulties with their night time and early morning collection system like KMC and LSMC, because of limited collection hours and working in the dark.
- BKM couldn't introduce the source-separated collection for more efficient operation of the waste processing facility in the past.
- The waste transported to the dumping site on trucks has to be unloaded manually because the existing small van does not have a tipping function.
- BKM has high operational cost for quite frequent waste collection by sweepers and littered waste pickers called "tippan tapan" to promote the World Heritage Site.

(2) Solid Waste Minimization Activities

- BKM has continued composting in their waste processing facility for more than 20 years, though there is a room for improvement for managing the facility such as making better quality compost and increasing the compost sales price based on better quality compost.

(3) Final Disposal

- The collected waste is dumped at the Hanumante River dumping site except for about 10% of the collected waste that is being transported to the waste processing facility.
- BKM has neither any staff assigned nor any equipment like excavators or bulldozers at the dumping site. No cover soil is applied.

(4) Social Aspects

- BKM has not worked with other organizations such as NGOs/CBOs or private sectors in the field of SWM. Consequently, BKM has a very limited network with the external stakeholders involved in SWM.
- BKM has rarely focused on community mobilization activities or community-based SWM activities although it has provided collection services.
- There was little public participation in SWM activities at the community level because there are many households who considered SWM as the duty of the municipality.

(5) Managerial Conditions

- The BKM organizational culture is very unique in the sense that it is almost egalitarian in nature. Staff, regardless of rank, are empowered to participate quite actively in discussions, despite the presence of higher officers. On the other hand, such internal processes could sometimes obstruct timely decision-making.
- BKM tends to be skeptical of the involvement of the private sector in any municipal program including SWM because of strong bias against involving external actors including NGOs.



## CHAPTER 3 FUTURE FRAMEWORK FOR ACTION PLAN

### 3.1 Socio-economic Framework (Projection of Future Population)

In Nepal, the official document which can be an aid to project future socio-economy at the national level is the Tenth Plan (Poverty Reduction Strategy Paper) 2001/02 (2058/59<sup>1</sup>)-2006/07 (2059/60), May 2003, National Planning Commission (NPC) of HMG/N. The Tenth Plan is the government's main medium-term strategic planning document which provides sharply focused strategies for poverty alleviation.

This Tenth Plan discussed two alternative scenarios. The Normal Case scenario aims to reduce the overall poverty ratio from 38% estimated at the end of the Ninth Plan (2001/02) to 30% by 2006/07, while an alternative Lower Case scenario was 33%. This lower case scenario was used as the basis for formulating the budget and the Medium Term Expenditure Framework (MTEF) FY2003/04-05/06.

On the other hand, at the Valley level, the Kathmandu Valley Town Development Committee (KVTDC) under the Ministry of Physical Planning and Works (MOPPW) and the Department of Urban Development and Building Construction (DUDB) has a responsibility for preparing a physical development plan of the Kathmandu Valley.

The Kathmandu Valley Town Development Plan (KVTDP) 2020 was prepared in the year 2002 by KVTDC to establish a broad regional framework plan (strategic plan) for the Kathmandu Valley integrating both land use and the urban transportation network, which guides the valley's future growth in a planned manner.

The KVTDP 2020 had estimated that if a gross density of 300 persons per hectare could be achieved within the existing urban areas, the demand for urban land in the 20 years would be slightly over 3,600 ha. However, considering the difficulty in effecting public perception about apartment housing and overturning the current trend of owner occupied single housing, demand for urban land could be much higher than envisaged.

Since the 2001 national census data has become available recently, the JICA Study Team together with the TWG members examined these annual growth rates taking into account the actual growth rate between 1991 and 2001, and has decided to adopt this KVDTC study's rates except for MTM. For MTM, the actual growth rate between 1991 and 2001 was assumed to continue up to 2015 because MTM has relatively large potential for urbanization in land use in the future.

The projected future population based on the 2001 population is shown in Table 3.1-1.

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<sup>1</sup> Nepalese Year

**Table 3.1-1 Projected Population of Five Municipalities**

Municipality	Actual Population	Projected Population	Annual Growth Rate (%)	
	2001 (2058)*	2015 (2072)	2001-2011 (2058-2068)	2011-2015 (2068-2072)
KMC	671,846	1,055,591	3.32	3.18
LSMC	162,991	260,790	3.44	3.35
BKM	72,543	117,380	3.52	3.44
MTM	47,751	83,696	4.09	4.09
KRM	40,835	54,400	2.07	2.07
Total Municipality	995,966	1,571,857	3.34	3.24
VDCs	525,498	603,891	0.95	0.84
Total Valley	1,521,464	2,175,748	2.61	2.54

Note: \*Nepalese Year

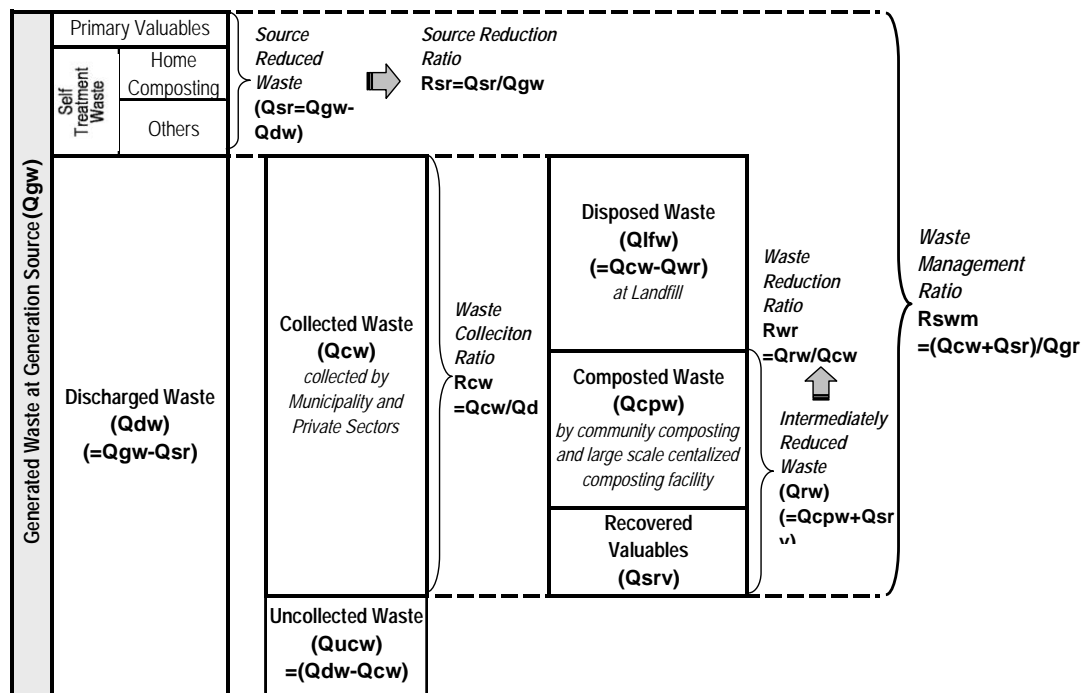
Source: Draft Kathmandu Valley Development Plan 2020, KVTDC, July 2000

JICA Study Team

### 3.2 Solid Waste Management Ratio

For clear understanding of the solid waste management, the definition of waste index was proposed as follows and as shown in Figure 3.2-1.

- a) Generated waste: Material that has become useless and valueless for the owner if it is to keep it at the source
- b) Discharged waste: Part of generated waste that is discharged out from the owner's territory
- c) Self treatment waste: Part of generated waste that is treated, disposed of or utilized within the owner's territory
- d) Collected waste: Part of discharged waste that is collected by the municipality or a private sector operator
- e) Uncollected waste: Part of discharged waste but not collected and disposed of somewhere
- f) Disposed waste: Part of collected waste that is disposed of at the designated final disposal site
- g) Primary Valuables: Materials that become useless but may be valuable for the owner in exchange for cash or for some recyclable collector. The owner intends to separate that material from the waste and bring it directly to recycling dealers for sale or to a municipal/community recycling center. Private recyclable collectors can also visit each generation source to pick up those valuables as their business activity. Returnable bottles for deposit refund are also included in this category.
- h) Secondary Valuables (Recovered Valuables): Valuable materials that are collected and recovered for reuse and recycling after waste is discharged, from the various stages such as from streets, collection points, transfer stations, waste treatment facilities, or final disposal sites. This includes the recyclable waste collected by recyclable waste pickers.



**Figure 3.2-1 Definition of Waste Management Ratio**

Source: JICA Study Team

It was proposed to introduce the concept of “Solid Waste Management Ratio” in the Study. Solid Waste Management Ratio can be estimated by the following formula.

$$\frac{\text{(Collected waste quantity + Source reduced waste quantity)}}{\text{Generated waste quantity}}$$

One of the major purposes of solid waste management is to reduce the uncollected waste amount for improvement of the cleanliness, beautification and sanitation of the city. The wastes other than such uncollected waste are the waste reduced at source and that collected from the source. This means that the solid waste is managed by some organization like the municipality, the private sector, or the waste generator itself. Therefore, the “Solid Waste Management Ratio” has been set up as the waste index that collectively shows how much waste can be managed appropriately in various ways.

### 3.3 Projection of Future Generation of Solid Waste

#### 3.3.1 Future Waste Generation without Measures

Considering the existing data of waste generation quantity in the Kathmandu Valley by various past studies, the result of the waste quantity and quality survey done by the Study, and an assumption of an annual increasing rate of unit generation rate which of 2%, the waste generation quantity of each municipality is estimated to be as shown in the following table.

**Table 3.2-1 Projected Solid Waste Generation Quantity**

Municipalities	Population		Municipal UGR (kg/d-capita)		Average daily generated quantity (tons/day)		
	Year (Nepalese Year)	2004 (2061)	2015 (2072)	2004 (2061)	2015 (2072)	2004 (2061)	2015 (2072)
KMC		741,008	1,055,591	0.416	0.519	308.4	547.9
LSMC		180,397	260,790	0.416	0.519	75.1	135.4
BKM		80,476	117,380	0.316	0.394	25.5	46.2
MTM		53,853	83,696	0.266	0.332	14.3	27.8
KRM		43,424	54,400	0.266	0.332	11.6	18.1
Total 5 municipality		1,099,158	1,571,857	-	-	434.9	775.4

Source: JICA Study Team

### 3.3.2 Scenario Analysis

The 2% of annual increasing rate of waste unit generation predicted in the previous section is based on the future economic growth in the Kathmandu Valley as well as other country's experiences. In this assumption, total generated waste will be increased up to 1.8 times more than it is at present. Therefore, waste reduction at source such as home composting or material recycling activities is very important to reduce the waste generation. In the Kathmandu Valley, such source reduction activities have just been started promotion together with community development activities, and further waste reduction at source can be expected. Considering these circumstances, the following scenarios for the Study<sup>2</sup> was proposed and it is expected that for reach municipality will make an effort to reduce the waste at source to shift to Scenario 2 from Scenario 1 by promoting source reduction activities under the concept of waste management ratio.

*Scenario 1: without measures (with 2% annual increase of the unit generation rate)*

*Scenario 2: with measures for source reduction by home composting and source recycling.  
Target reduction ratio in 2015 is around 85% of total generated quantity.*

<sup>2</sup> Since there is no existing data or record that can be used to estimate the annual increasing rate of waste unit generation in the past, the JICA Study Team suggested that all municipalities to carry out regular waste generation quantity surveys, at least once a year, to get an understanding of the changes of unit generation rate from the practical experience during the Study.

## CHAPTER 4 UMBRELLA CONCEPT FOR FORMULATION OF ACTION PLAN

### 4.1 Umbrella Concept of Solid Waste Management in the Kathmandu Valley

Action plans (A/Ps) of each of the five municipalities should be developed reflecting their characteristics in terms of solid waste flow, waste quality and quantity, collection methods, waste minimization activities and the associated requirements such as promotion of public awareness and behavior change, and organizational and institutional arrangements. However, it is recommended that some activities to be included in the respective A/Ps should be conducted in a valley-wide in order to maximize the effect of these activities. In addition, in terms of facilities and equipment for intermediate treatment or landfill, the developments need to be done taking into consideration potential for inter-municipal coordination and sharing of these facilities and equipment so that development loads as well as investment and O&M costs be minimized. Table 4.1-1 indicates the components of the A/Ps that need to be discussed for each respective municipality or that may be combined for more than one municipality (zone).

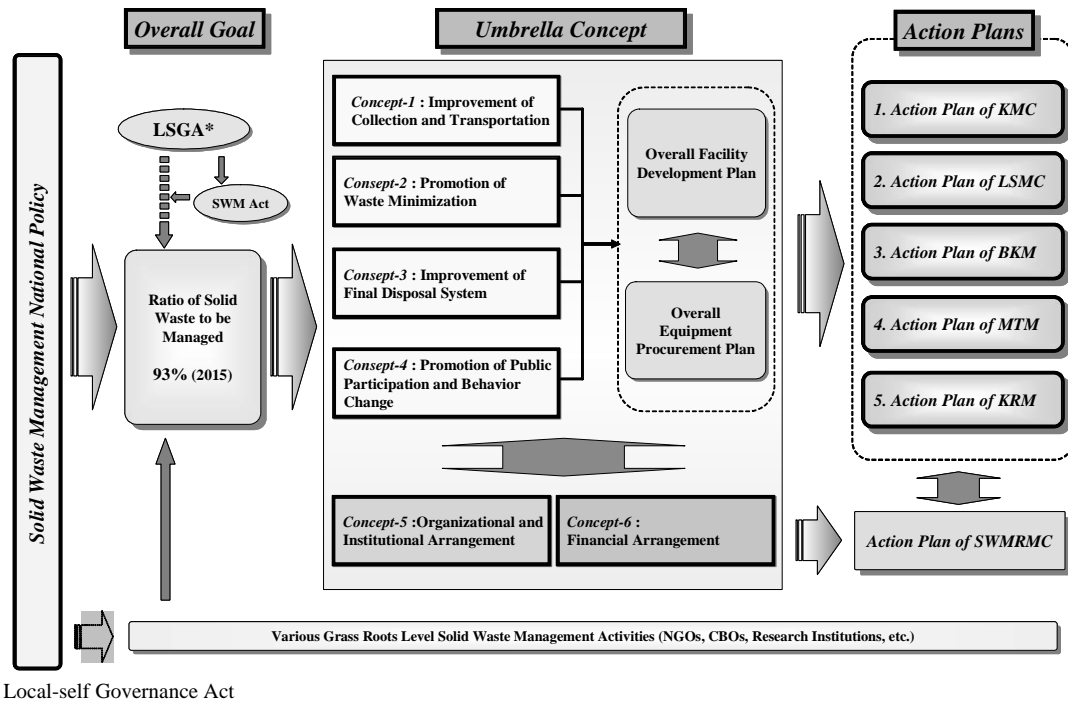
**Table 4.1-1 Components of Action Plans**

Components of A/Ps	Individual Municipality or Zone
1. Primary and secondary collection	Individual municipality
2. Transportation (transfer haul)	Individual municipality or zone
3. Waste minimization (composting and recycling)	Individual municipality or zone
4. Waste disposal	Zone
5. Public participation and behavior change	Individual municipality and zone
6. Organizational and institutional arrangement	Individual municipality and zone

Source: JICA Study Team

In this connection, a basic concept common for all five municipalities, *an umbrella concept of solid waste management in the Kathmandu Valley (Umbrella Concept)*, has been proposed to clarify the administrative responsibilities of each municipality and to show a basic direction (road map) for effective solid waste management.

As parts of the Umbrella Concept, four basic concepts, i.e. improvements of collection and transportation and final disposal system, and promotion of waste minimization and public participation and behavior change have been proposed. In order to achieve these basic concepts, an overall facility plan (OFP) and overall equipment plan (OEP) in the Kathmandu Valley have been discussed. In addition, the directions for financial arrangement as well as organizational and institutional arrangement including the involvement of the private sector regarding SWM have been proposed. The overall framework of the Umbrella Concept is shown in Figure 4.1-1.



\* Local-self Governance Act

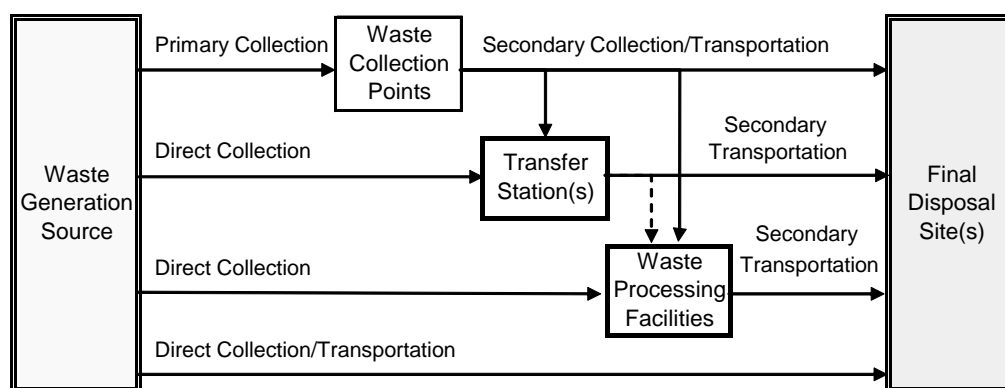
**Figure 4.1-1 Overall Framework of the Umbrella Concept of the Kathmandu Valley**

Source: JICA Study Team

## 4.2 Basic Concept for Improvement of Collection and Transportation

### 4.2.1 Collection and Transportation Practices and Coverage Improvement

The collection and transport systems are broadly identified in the Kathmandu Valley in the as shown in Figure 4.2-1.



**Figure 4.2-1 Definition of Collection and Transportation**

Source: JICA Study Team

Accordingly, a basic concept for improvement of collection and transportation are summarized in the Table 4.2-1.

**Table 4.2-1 Basic Concept for Improvement of Collection and Transportation**

Activity	Basic Concept	Descriptions
Primary Collection	Decrease of street sweepers	Number of municipal sweepers: less than present
	More utilization of private sector	Share of private sector for primary collection: 60% in KMC, LSMC, 100% in KRM.
	Improvement of waste collection point	No direct manual loading point with shovels in the Valley
Direct Collection	Promoting of Door to Door collection	Preparation of private door to door collection service guideline
	Promoting bell collection system	Bell collection in all the collection area except the area of Door to Door collection and container collection
Secondary Collection	Abolishment of municipal tractor	100% of municipal tractors will be replaced by small sized compaction trucks
Secondary Transportation	Procurement of new secondary transportation vehicles	The existing equipment will also be replaced by the same type of new vehicle.
Others	Introduction of source-separated collection	In BKM, all waste to the existing composting facility should be separated at the generation source. In future including other municipalities, at least 50% of waste is separated at the source and the rest is separated at the facility by waste pickers.
	Improvement of mechanical workshop	All the equipment should be maintained appropriately with minimum cost.

Source: JICA Study Team

#### 4.2.2 Collection and Transportation Facilities (Transfer Stations)

The streets of the five municipalities are mostly narrow and cannot accommodate large collection trucks, making smaller collection trucks, tractors and tri-cycles more suitable. These small trucks need to be served by small transfer stations or mini transfer points (depos) and are directly related to the primary collection activities.

As for larger transfer stations, as a basic concept, KMC should push forward with construction of another transfer station in Balaju in addition to the improved Teku T/S, and LSMC should secure the land and construct a temporary transfer station in Afadol and then should utilize a waste processing facility as a transfer station.

### 4.3 Basic Concept for Promotion of Solid Waste Minimization

#### 4.3.1 Promotion of 3Rs Activities

In order to realize effective SWM, it is important that the residents should promote 3Rs activities as follows:

- Reduce: To minimize generated or discharged waste
- Reuse: To use goods or materials that can still be used a number of times
- Recycle: To recover waste as raw material and use it for reproduction

In order to promote 3Rs activities smoothly, cooperation of the private sector and support from municipalities are needed as shown below:

- 1) Cooperation of Private Sector
  - Produce and sell easy-to-recycle goods
  - Produce and sell long-life goods
  - Minimize packing and packaging for goods
  - Improve quality of recyclable and recycled goods and develop new products
- 2) Support by Municipality
  - Increase awareness for reduction of waste to residents and private sector
  - Establish more recycling centers (places for purchasing recyclable materials)
  - Develop and improve distribution pipeline for recyclable materials
  - Provide subsidies for the private sector involved in recycling activities
  - Develop legislation to establish a recycling-based society

#### 4.3.2 Promotion of Waste Processing and Composting

Since approximately 70% of the generated solid waste is organic, composting has been actively conducted in the Kathmandu Valley. Composting activities can be broadly divided into three types as discussed in Table 4.3-1.

**Table 4.3-1 Composting Activities conducted in the Kathmandu Valley**

No.	Items	Composting Plant	Community Composting	Home Composting
1	Experience in the Kathmandu Valley	Composting plant in Bhaktapur Old composting plant in Teku	Compost chamber in Thimi 3,000 L compost bins in KMC	100 L compost bins of KMC Vermi-composting
2	Source separation of organic waste	Necessary for plant operation	Necessary for community composting operation	Necessary at each house
3	Waste collection and transportation to facility	Wide collection area and long distance transportation	Limited collection area and short distance transportation	Not necessary
4	Separation of non compostable material at facility site	To be required	To be required	Not necessary
5	Operating labor	Many exclusive operators are required.	Exclusive operators not required.	Household members operate
6	Operation and maintenance technique	Harder than community composting	Harder than domestic composting	Easy
7	Installation area	Large area with public consensus is required.	Limited area with community consensus is required	Small space is required in house
8	Investment cost	Large	Medium	Little
9	Running cost	Medium	Little	Little
10	Advantage for public participation	Getting produced compost or revenue by selling compost	Getting produced compost or revenue by selling compost	Getting produced compost or revenue by selling compost
11	Other related	Selection of installation area Financial balance	Cooperation of community	Expansion of number of cooperative households

Source: JICA Study Team



Considering necessary investment and O&M costs, ease of operation and environmental impact, home composting is considered to be the most practical in the Kathmandu Valley. For community composting, a pit method is recommended because of ease of operation and maintenance. For planning purposes, the suitable method or best combination of the above three types of composting should be examined.

From the viewpoint of reduction of waste transportation cost, a composting plant should be constructed in or near the city area of KMC or LSMC. The windrow method should be adopted because Nepal has experience in operation of the BKM composting plant with this method. This method may be enhanced through:

- Separated waste being received at the composting plant as much as possible.
- At the sorting area, uncompostable materials being removed manually, while compostable materials are piled up at the fermentation yard by using a wheel loader.
- During composting the heap being turned over several times and exposed to air for accelerating fermentation
- After about 60 days, raw compost being screened for the final product to be ready

### **4.3.3 Considerations to Waste Pickers**

Waste pickers, one third of the estimated number of 2,500 who are below 15 years of age, are considered as the primary recyclable waste collectors. The main items salvaged by waste pickers are plastic bags and milk and oil pouches. The government and related authorities need to harness their contribution and efforts.

In several places, it was observed that waste pickers help with loading and unloading works. However, sometimes waste picking activities may obstruct waste collection or landfilling works and scatter the waste on the roads. It is apparent that waste pickers are working in a dirty, dangerous and health-hazard environment. Furthermore waste pickers are alienated from social communities and sometimes subject to many forms of discrimination. There is also a specific linkage between waste work and children. As the market for recyclables have increased, a number of children previously involved in begging have turned to rag-picking/scavenging as a means of survival.

For improvement of effective SWM in the Kathmandu Valley, the following consideration should be given to waste pickers.

- Improve working conditions among waste pickers
- Disseminate effectively information targeting waste pickers
- Gradually abolish child labor as waste pickers
- Incorporate waste pickers within new SWM facilities

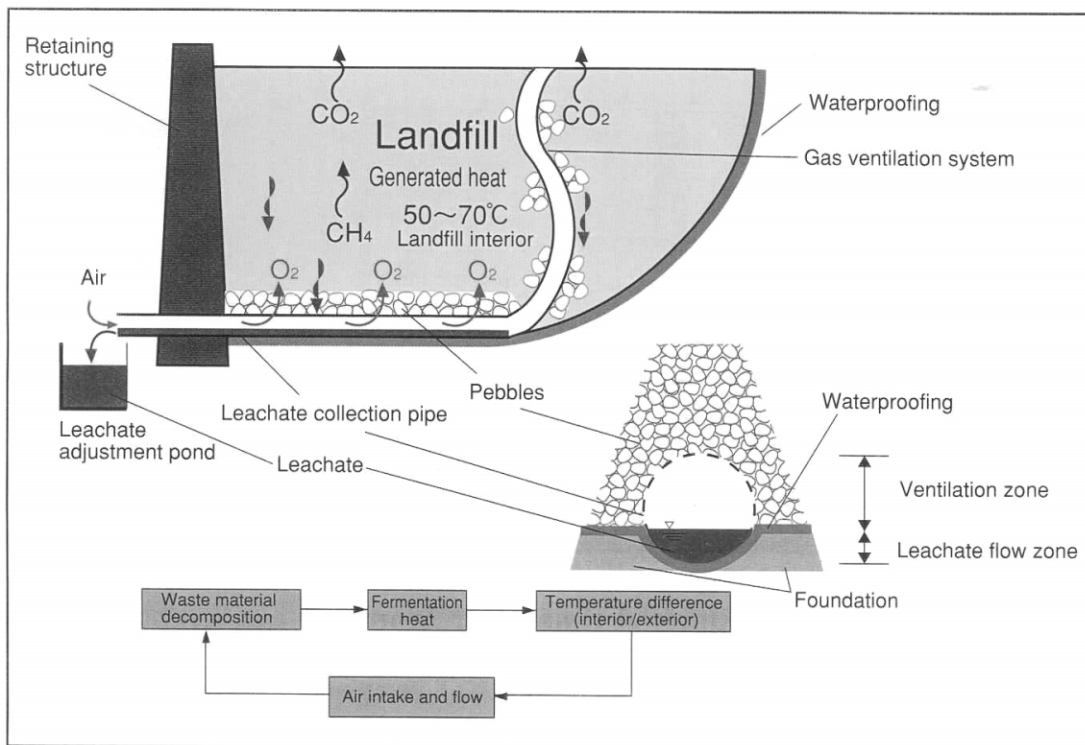
## **4.4 Basic Concept for Improvement of Final Disposal System**

### **4.4.1 Landfill System**

The new landfills for the valley should be developed under clear standards. Two of these standards; landfill type and landfill level are described hereafter.

(1) Semi-aerobic Landfill Type

Anaerobic decomposition of organic matter produces methane and water, and the decomposition is slow and leachate content is large. On the other hand, under aerobic decomposition, organic matter decomposes into carbon dioxide and water and the decomposition is rapid. Aerobic decomposition requires a supply of oxygen to be pumped into the landfill, but this is a costly system. To cope with these problems, a particular type of semi-aerobic landfill known as “Fukuoka Method” was developed as a joint project of Fukuoka City and Fukuoka University. The semi-aerobic system is schematically presented in Figure 4.4-1.



**Figure 4.4-1 Schematic Presentation of Semi-aerobic System**

Source: The Fukuoka Method, Fukuoka City Environmental Bureau

It is proposed to develop the landfills using the semi-aerobic system. The Sisdol S/T-LF has been designed under this concept and has started operation since June 2005. The operation of the Sisdol S/T-LF should be carefully monitored to determine the suitability of the semi-aerobic landfill system.

(2) Landfill Level

In past JICA studies in other developing countries, four landfill levels have been discussed as shown in Table 4.4-1. Level 4 offers the best countermeasures for mitigation of impact on the environment and therefore it is proposed that the Nepali decision makers aim to achieve that level in future. However considering the issues of high construction and operation costs for leachate treatment facilities and liner installation, and difficulty in treating the resulting chemical wastes from the leachate treatment, level 3 may be acceptable in the short term.

**Table 4.4-1 Sanitary Landfill Levels**

Facility	Level 1	Level 2	Level 3	Level 4
Description	Controlled tipping	SLF with bund and daily cover	SLF with leachate recirculation	SLF with leachate treatment facilities
Soil cover	O (Periodic)	O	O	O
Embankment		O	O	O
Drainage facility		O	O	O
Gas venting		O	O	O
Leachate collection			O	O
Leachate re-circulation			O	O
Leachate treatment				O
Liners				O

Source: JICA Study Team

In the case of the Sisdol S/T-LFS, it is expected to be operated for only 3-4 years and therefore application of natural liner and leachate re-circulation with natural attenuation treatment was recommended. This may be considered as Level 3 (+).

#### 4.4.2 Post Closure Management of Landfill Sites

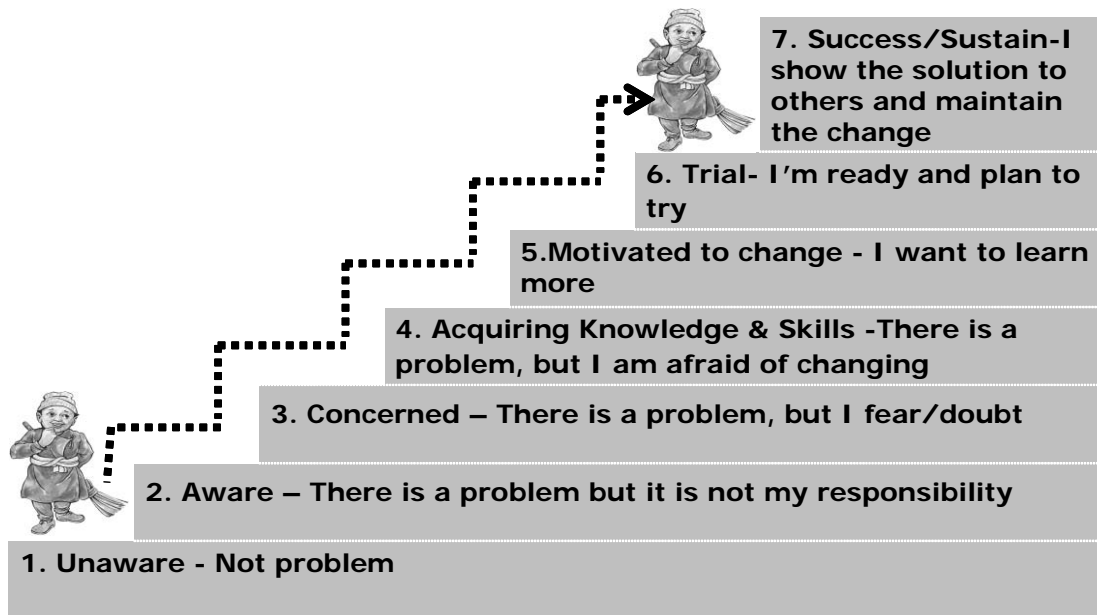
Management aspects with respect to closed landfills include collection and monitoring of landfill gas and leachate, landfill settlement, land use and access control and dissemination of information on the use of the site as a landfill.

A detailed mapping of the dump sites along the Bagmati River should be prepared and the priority sections for safe closure identified. For these sites river bank slope reformation, and installation of leachate collection pipes, landfill gas vents and storm water drains are considered.

### 4.5 Basic Concept for Public Participation and Behavior Change

#### 4.5.1 Public Awareness and Behavior Change for Effective SWM

A successful SWM requires various forms of community mobilization and participation. The following Figure 4.5-1 provides a framework of stages of behavior change of the people. Most people go through these steps, sometimes moving forward or backward and sometimes skipping steps. Even when people adopt new behaviors, they may revert to old behaviors, at least under certain circumstances.



**Figure 4.5-1 Behavior Change Stages**

Note: The process of changing behaviors and attitudes may happen in the sequence. Most people move back and forth between steps before achieving success. Source: JICA Study Team, adopted from “A manual for communication for water supply and environmental sanitation programs” (UNICEF, 1999), and “How to create effective communication project” (AIDSCAP/FHI/USAID).

Behavior Change Communication (BCC) is considered to be an effective component of a comprehensive SWM program. It can impart information and knowledge regarding environment friendly behaviors and SWM issues and promote essential attitude change. It can also contribute to creating a demand for relevant information and services related to SWM, and to improving skills and sense of self-efficacy, which are required to stimulate behavior change. In order to integrate a BCC component into A/Ps effectively, the following steps<sup>1</sup> need to be taken.

- 1) Identification of the Program’s Goal and Target Group/Audience
- 2) Formative BCC Assessment and Definition of Behavior Change Objectives
- 3) Development of Messages
- 4) Communication Channels
- 5) Pre-testing
- 6) Implementation, Monitoring and Evaluation

#### **4.5.2 Mass Communication and Education**

Mass communication and education is a useful approach that reaches large groups of people quickly and effectively. It includes mass media, small media including print media, social marketing and public/educational events. However, producing awareness programs on SWM through mass media is relatively expensive. Thus, it requires inter-municipality

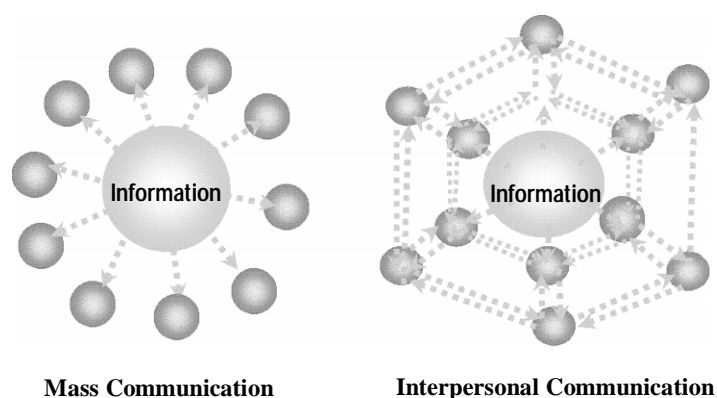
<sup>1</sup> These steps have been developed by FHI (“BCC for HIV/AIDS A Strategic Framework, FHI/USAID, 2002) and adopted by a number of BCC programs and projects in the world. Since they can be applied to SWM programs, Interpersonal Communication and BCC Skill Training conducted as part of Pilot Project D-1 for municipal staffs also highlighted and recommended these steps.

coordination among the five municipalities and technical as well as financial support from SWMRMC/MOLD, or other external organizations. On the other hand, since print media such as brochures, posters and flip charts are not so expensive, each municipality can produce them with their own financial resources. Social marketing, which uses similar commercial marketing techniques for stimulating public behavior change, is useful for promoting commodities with effective messages on SWM.

Public events are effective to disseminate basic information on SWM quickly and increase the level of knowledge on SWM among a large number of people. It is expected that all municipalities in coordination with SWMRMC carry out these events at least once a year on an occasion such as Earth Day or Environment Day according to their A/P for SWM.

### 4.5.3 Interpersonal Communication and Education

An approach using Interpersonal communication and education is recognized as an effective two-way communication channel that encourages the interactive dialogue between individuals or among group members. Figure 4.5-2 illustrates the difference between interpersonal and mass communications. The interpersonal communication and education approach, based on personal communication sources and channels, can disseminate, improve and reinforce the acquired knowledge, skills, attitude and behavior between individuals or among diverse group members.



**Figure 4.5-2 Difference between Mass Communication and Interpersonal Communication**

Source: JICA Study Team

## 4.6 Overall Facility Plan in the Kathmandu Valley

### 4.6.1 Principle for Overall Facility Plan in the Kathmandu Valley

The principles adopted to develop the OFP were threefold:

Principle 1 : Waste Hierarchy; The SWM facilities should contribute to a more balanced SWM system that first works to reduce the waste at source, re-use, recycle and recover, treat and finally dispose of the waste.

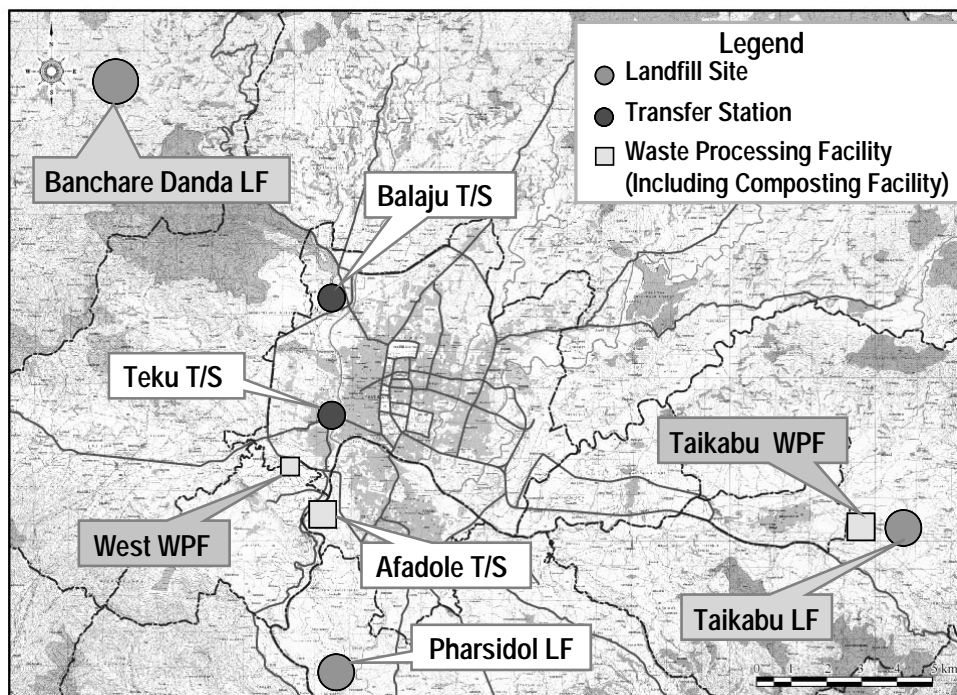
Principle 2 : Sustainable Facilities; Facilities should be sustainable both financially and technically and should suit the existing Nepalese conditions.

**Principle 3 : Urgent Implementation:** To avoid delays in providing needed facilities, a step-wise approach was adopted. The past studies and plans were taken into consideration as much as possible.

#### 4.6.2 Alternative Evaluation of OFP

As a first step, a short list of candidates for long-term landfill sites (L/T-LFSs) was prepared based on the 1998 study by the Department of Mines and Geology (DOMG). It is noted that six years have passed since the implementation of that study and development has been rapidly progressing. The four candidate sites, Pharshidol South, Pharshidol North, Taikabu, and Okharpouwa, for development of long-term sanitary landfill were selected. Ranking of these sites was made taking into account field visits and available information.

The facilities to be incorporated in the formulated alternatives mostly reflect existing plans and nine alternatives, based on the number of landfills, were analyzed. Alternatives 1a, b and c call for one sanitary landfill to serve the whole the Kathmandu Valley with provision of WPFs. Alternatives 2a, b and c call for two landfills to be developed. Alternative 2c is an offshoot of Alt. 2b but without WPFs. Alternatives 3a and b provide three landfills, and once more Alt. 3b is an offshoot of Alt. 3a but without WPFs. Alternative 4 has each individual municipality developing its own SWM facilities in the absence of the Umbrella Concept. Figure 4.6-1 shows the locations of these facilities.



**Figure 4.6-1 Facilities Incorporated in the Alternatives 1-3**

The developed alternatives are described in the following Table 4.6-1.

**Table 4.6-1 Alternatives Formulation**

Alt	LF	WPF	T/S	Comments
1a	Okharpauwa	West Taikabu	Teku Balaju Taikabu	<u>Alt. 1a:</u> examines one landfill for the total valley, located outside the valley and the effect of waste reduction by two composting facilities. Three transfer stations are required.
1b	Taikabu	West Taikabu	Teku Balaju	<u>Alt. 1b:</u> locates one landfill within the valley at Taikabu LF candidate site which is under EIA process. WPF is proposed on an unidentified site west of the two cities to reduce transfer haul distances.
1c	Pharsidol	West Taikabu	Teku Balaju	<u>Alt. 1c:</u> locates the sole landfill for the valley at a site proposed in the Pharsidol area, Pharsidol of LSMC, and close to the municipalities.
2a	Okharpauwa Taikabu	West Taikabu	Teku Balaju	<u>Alt. 2a:</u> proposes two landfills, in Okharpauwa outside the valley and Taikabu. Two WPFs are also proposed.
2b	Taikabu Pharsidol	West Taikabu	Teku Balaju	<u>Alt. 2b:</u> proposes two landfills, Taikabu and Pharsidol, both located within the valley, and two composting facilities.
2c	Taikabu Pharsidol		Teku Balaju West	<u>Alt. 2c:</u> is an offshoot of Alt. 2B without WPFs, in order to study the effect of waste reduction.
3a	Okharpauwa Taikabu Pharsidol	West Taikabu	Teku Balaju	<u>Alt. 3a:</u> proposes three landfills and two WPFs.
3b	Okharpauwa Taikabu Pharsidol		Teku Balaju Afadole	<u>Alt. 3b:</u> is an offshoot of Alt. 3A without the WPFs, in order to study the effect of waste reduction.
4	Okharpauwa Taikabu Pharsidol Thimi Kirtipur	Aletar Afadole Taikabu Thimi Kirtipur	Teku Balaju	<u>Alt. 4:</u> proposes that each municipality achieves its targets through construction of its individual composting facility and sanitary landfill.

Source: JICA Study Team

The main comparison items considered were:

- SWM aspects: How the alternative reflected the proposed waste hierarchy and satisfied the “Proximity Principle”<sup>2</sup>
- Transportation aspects: The transfer haul costs represent the largest portion of the O&M cost and this is reflected in the ton • km produced by each alternative

### 4.6.3 Overall Facility Development Plan in the Kathmandu Valley

Since the analysis indicated that two landfills and two WPFs would provide stable and sustainable SWM service for the Kathmandu Valley, Alt. 2b or 2a should be considered.

<sup>2</sup> The principle whereby waste should be treated and disposed of nearby the generation area as much as possible to nourish responsibility of the waste generator for its management, uphold environmental justice, and decrease transportation costs

In terms of waste transportation and related costs; Alt. 2a would entail an added O&M cost of Rs. 278.9 million over the period of 2007 to 2015 or average Rs.24.9 million annually. On the other hand Alt. 2a holds an edge over Alt. 2b in terms of the site allocation. Out of the two sites required to be identified, EIA for Taikabu site is already in process and barring any unforeseen circumstances is expected to be found suitable for construction of the landfill there. This study has narrowed the candidates for the remaining landfill site to two sites; in Pharsidol and the Banchara Danda site in Okharpauwa.

Pharsidol north site was preferred over Banchara Danda in view of the shorter transport distance and other factors. However three major issues may delay the development of this site. These are the Pharsidol wellfields, the direction of Tribhuvan Airport runway and the close proximity of the culturally important village of Khuipa. A long time may be required to resolve these issues. On the other hand the major advantage that Banchara Danda site has is the commitment of the Central Government to develop this site as a landfill (as underlined in the Government's National Plan). Social and cultural issues are much less critical here and development is expected to be much faster. However the Government needs to carefully discuss with the beneficiaries of the site, namely KMC and LSMC on how to bridge the high haulage costs. The Overall Facility Plan (OFP), therefore, has been developed based on Alt. 2a in order to expedite the process of developing long-term landfill by building on all the effort that has been applied so far and also to clarify the costs incurred.

Accordingly the OFP is discussed in Zone A (KMC, LSMC and KRM) and Zone B (BKM and MTM) as shown in Table 4.6-2.

**Table 4.6-2 Overall Facility Plan under the Umbrella Concept**

Facilities		Descriptions
<b>ZONE A – KMC, LSMC and KRM</b>		
1	Sisdol LF	
	(1) Valley 1	Valley 1 will be operated for about 12-14 months
	(2) Valley 2	Valley 2 to be developed and operated for about 12 months
	(3) Post closure	Upon completion of disposal operations at Sisdol proper site closure will be implemented and environmental monitoring will continue until as required
2	Bagmati River Dumping Site	Bagmati River dumping site will cease operation once the new transfer trucks arrive (around Oct. 2005) and all the waste is transported to Sisdol LF. For a couple of years thereafter, safe closure works will be implemented along the Bagmati River banks where waste has been deposited.
3	Banchara Danda L/T-LF	This LF is expected to be developed within the next three years. It will be operated as a Level 3, semi-aerobic landfill.
4	West WPF	A WPF, basically for compost production but that will also include recyclable materials separation facilities to be developed west of KMC and LSMC and within 7-10 Km distance. The facility will be developed in three phases, starting with an input capacity of 100 t/d and reaching 300 t/d. Residues will be transported from the plant to the landfill
5	Teku T/S	Teku T/S has been improved with a capacity of 200 t/d (40 t at peak hour). Tipping at the station will continue to be mixed with some loading by wheel loaders.
6	Balaju T/S	Balaju T/S will be developed on the allocated land within 2006. It will be a split level unloading system without compaction. It will have a capacity of 120 t/d.
7	Afadole Temporary T/S	For the first 2-3 years of the Action Plan period, a temporary T/S will be developed for LSMC waste at Afadole. Upon completion of the waste processing facility the LSMC waste will be transported there.



Facilities		Descriptions
<b>Zone B – BKM and MTM</b>		
1	Hanumante River dumping site	For the next 2-3 years waste will continue to be dumped at Hanumante River bank, with the application of cover soil.
2	MTM temporary LF	The solid waste collected in the central areas will be transported to Teku T/S, while remaining waste will be disposed of a temporary landfill with the application of cover soil.
3	Taikabu LF	The Taikabu LF will be developed within the next 2-3 years as a Level 3, semi-aerobic landfill.
4	Taikabu WPF	Within the same Taikabu LF site, a compost plant will also be developed. The plant will have an initial capacity of 10 t/d and expand to 15 t/d.

Source: JICA Study Team

#### 4.6.4 Facility Operation Schedule and Cost Estimation

Bearing in mind that Sisdol LF has a short life of around 3 years, the operation schedule for the facilities has been prepared. Figure 4.6-2 shows the operation schedule, while the estimated costs for the period of 2005 to 2015 are shown in Table 4.6-3.

YEAR	Short-term			Mid-term		Long-term				
	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
<b>ZONE A - KMC, LSMC and KRM</b>										
1	Sisdol S/T-LF									
	(1) Valley 1									
	(2) Valley 2									
2	Banchare Danda L/T Sanitary LF									
3	West Waste Processing Facility									
	(1) Phase 1 (100 t/d)									
	(2) Phase 2 (200 t/d)									
	(3) Phase 3 (300 t/d)									
4	Teku T/S									
5	Balaju T/S									
6	LSMC Temporary T/S (Afadole)									
<b>ZONE B - BKM and MTM</b>										
1	Hanumante River Dumping Site (BKM)									
2	Temporary LF (MTM)									
3	Taikabu LF									
4	Taikabu WPF									
	(1) Phase 1 (10 t/d)									
	(2) Phase 2 (15 t/d)									

**Figure 4.6-2 Operation Schedule of Overall Facility in the Kathmandu Valley**

Source: JICA Study Team

**Table 4.6-3 Estimated Costs of the Facility Plan (million Rs)**

SN	Facility	Investment Costs
<b>1</b>	<b>Improvement/Development of Transfer Station</b>	
	1.1 Teku T/S (Improvement)	2.0
	1.2 Balaju T/S	44.2
	1.3 Afadol Temporary T/S	19.7
	<b>Sub-total 1</b>	<b>65.9</b>
<b>2</b>	<b>Development of Waste Processing Facility</b>	
	2.1 West WPF (including equipment)	219.8
	2.2 Taikabu WPF (including equipment)	80.2
	<b>Sub-total 2</b>	<b>300.0</b>
<b>3</b>	<b>Development/Closure of Landfill</b>	
	3.1 Sisdol LF (Closure of Valley I and development of Valley II)	26.4
	3.2 Banchare Danda LF (including equipment)	906.1
	3.3 Taikabu LF (including equipment)	272.0
	<b>Sub-total 3</b>	<b>1,204.5</b>
<b>4</b>	<b>Closure of Dumping Site</b>	
	4.1 Bagmati River dumping site (Closure)	5.0
	4.2 Hanumante River dumping site (Closure)	0.5
	4.3 MTM temporary LF (Closure)	0.2
	<b>Sub-total 4</b>	<b>5.7</b>
	<b>TOTAL</b>	<b>1,576.1</b>

Source: JICA Study Team

## 4.7 Overall Equipment Procurement Plan in the Kathmandu Valley

### 4.7.1 Basic Concept of Overall Equipment Procurement Plan

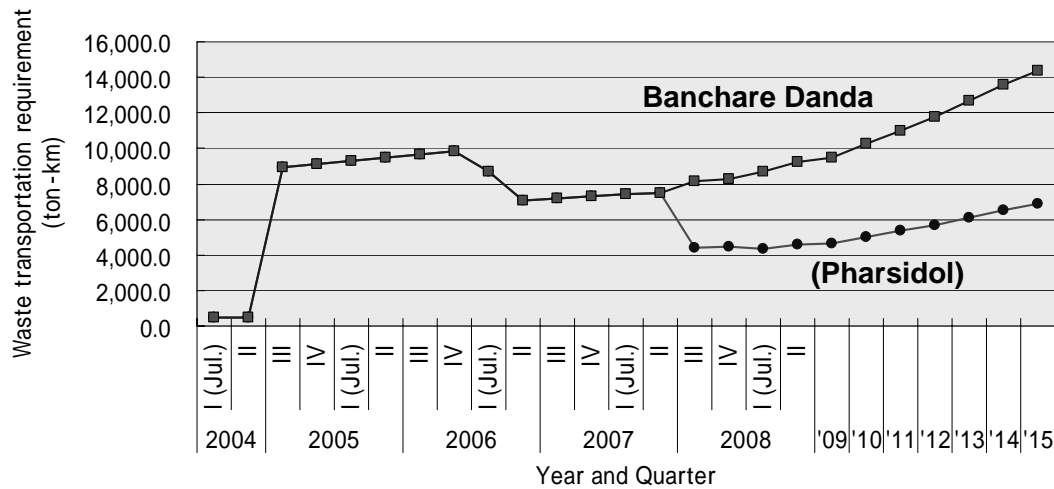
The equipment to be procured for implementing the OFP is mainly divided into the equipment for secondary transportation, LF operation, T/S operation, WPF operation and there is maintenance for that equipment.

Considering that operation has already commenced at Sisdol S/T-LF, the first priority should be given to the procurement of secondary transportation equipment because no suitable large-capacity vehicles are presently available for effective operation. As for the equipment for landfill operation, the current equipment may be utilized in Sisdol S/T-LF. Therefore, the immediate priority for procurement of this equipment is a little bit lower than for the secondary transportation vehicles, although in the near future replacement of that aging equipment will be necessary.

### 4.7.2 Secondary Transportation Vehicle

The total transportation requirement increases explosively up to about 9,000 ton-km per day when the Sisdol S/T-LF starts accepting all collected waste from KMC and LSMC. The requirement then decreases step by step by shortening the transportation distance or reducing the waste quantity by each facility's operation as shown in Figure 4.7-1. From the second quarter of 2007, the upper curve shows the ton.km produced in case of Banchare Danda LF

while the lower graph depicts the ton.km in case of Pharsidol North LF. In the case of Banchare Danda LF, 25 secondary transportation vehicles (STVs) are required.



**Figure 4.7-1 Future Projection of Transportation Requirement**

Source: JICA Study Team

#### 4.7.3 Heavy Equipment for Landfill and Transfer Station Operation

The equipment available in KMC and LSMC and required for the landfills to be developed under the OFP, such as compactor (one unit), dozers (two units) and excavator (one unit), are very old and were procured over 16 years ago (with the exception of one dozer procured over 9 years ago). On the other hand wheel loaders, required for the transfer stations and WPFs are relatively new and may be used in the new facilities to be developed under the OFP. Therefore, KMC and LSMC should concentrate on procurement of dozer and compactor for the landfills.

#### 4.7.4 Workshop Equipment

Daily or regular maintenance and minor repair work of light vehicles such as tractor trailer and tippers are implemented at the KMC mechanical workshop, while repair or maintenance work for large vehicles or heavy equipment are carried out outside. However, because the LSMC mechanical workshop is not adequate to maintain all vehicles and equipment, some major maintenance work for LSMC should be considered to be entrusted to KMC. As for STVs, as special devices such as hydraulic parts are not available at the KMC workshop, such special work may be entrusted to the private sector or the STV manufacturers.

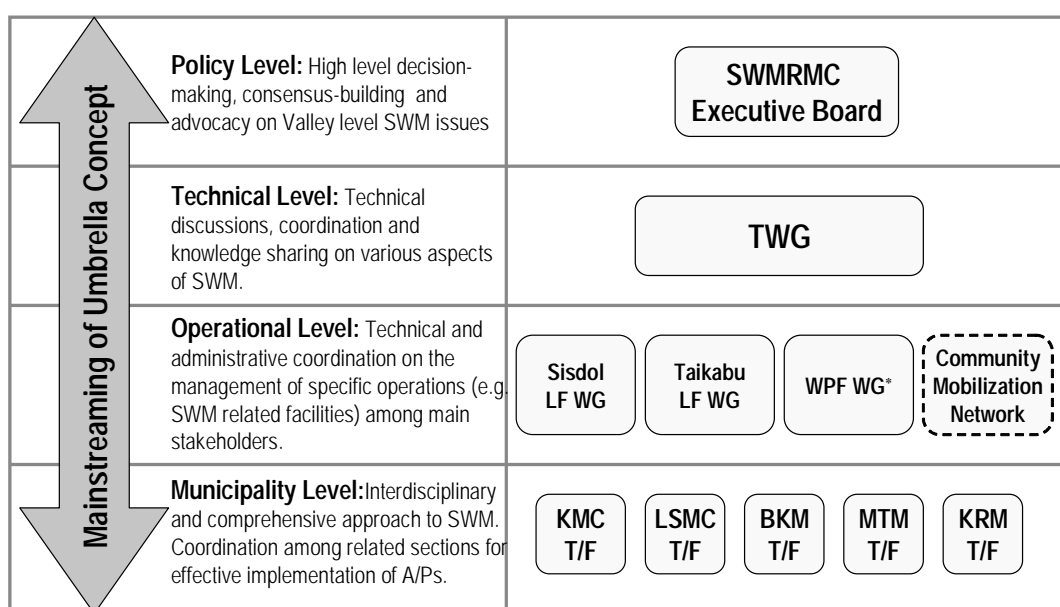
#### 4.8 Basic Concept for Organizational and Institutional Arrangement

Institutionalization of the Umbrella Concept is critical in ensuring the sustainability of its operation, and subsequently its implementation. It is worthy to highlight those issues of

lack of institutional mandates and unclear demarcation of responsibilities among SWMRMC, KMC, and LSMC that are some of the major constraints that lead astray policy dialogue on SWM for over a decade. The principles of the Basic Concept for Organizational and Institutional Arrangement for the Umbrella Concept are:

- Institutional/organizational arrangements should build on existing organizational set up.
- There should be clarity in the mandate and terms of reference for each of the institutions.
- Linkages among various levels of institutions should be identified.
- The specific role and mandate of SWMRMC should be determined.

The basic concept is conceptualized in Figure 4.8-1. Institutional and organizational arrangement is divided into four levels, each with specific significance in guaranteeing the smooth implementation of the Umbrella Concept.



\* In case of adoption of public-private partnership approach in development and operation of WPF, this WG will be responsible for Supervision and Management of operations.

**Figure 4.8-1 Basic Concept for Institutional and Organizational Arrangement as Umbrella Concept**

Source: JICA Study Team

For not only monitoring the implementation of the Umbrella Concept but also preparing the A/Ps based on reliable data, formulation of the solid waste data management system should be quite crucial with the following Basic Concept.

- At the commencement stage, a semi-manual system should be introduced, and then it will be gradually upgraded to an online system or other advanced system
- Each municipality and SWMRMC should modify the common database program based on the data that should be managed respectively
- The data at each municipality should be finally concentrated at SWMRMC to monitor the overall SWM progress and to prepare the SWM white paper

## 4.9 Basic Concept for Financial Arrangement

### 4.9.1 Estimated Cost to be Allocated for Umbrella Concept

Costs for the Umbrella Concept consist of investment cost and incremental operation and maintenance (O&M) cost which are estimated separately by each zone and summarized in Table 4.9-1. The total cost until FY2014/15 is estimated at Rs 2,559 million; consisting of Rs 1,742 million on investment and Rs 817 million on incremental O&M.

**Table 4.9-1 Estimated Cost for the Umbrella Concept (million Rs)**

Cost Items	Zone	2005/06 (2062/63)	2006/07 (2063/64)	2007/08 (2064/65)	2008/09 (2065/66)	2009/10 (2066/67)	2010/11 (2067/68)	2011/12 (2068/69)	2012/13 (2069/70)	2013/14 (2070/71)	2014/15 (2071/72)	Total
I. Investment Cost	A	129.0	859.4	141.2	78.8	89.1	18.4	0.0	17.6	13.0	5.0	1351.5
	B	298.3	34.1	18.0	3.8	2.1	3.2	6.4	24.5	0	0	390.4
	Total	427.3	893.5	159.2	82.6	91.2	21.6	6.4	42.1	13.0	5.0	1,742.0
1. Collection & Transportation	A	6.3	59.9			33.8	7.2		8.4		5.0	120.5
	B			17.7	3.8	2.1	3.2	6.4	4.3			37.5
	Total	6.3	59.9	17.7	3.8	36.0	10.4	6.4	12.6	0	5	158.1
2. Transfer Station	A	65.9										65.9
	B											0
	Total	65.9	0	0	0	0	0	0	0	0	0	65.9
3. Waste Processing Facility	A	14.3	150.4		45.9				9.2			219.8
	B	80.2										80.2
	Total	94.5	150.4	0	45.9	0	0	0	9.2	0	0	300.0
4. Landfill (including closure works)	A	34.8	649.1	141.2	32.9	55.3	11.2			13.0		937.6
	B	218.1	34.1	0.3					20.2			272.7
	Total	252.9	683.2	141.5	32.9	55.3	11.2	0	20.2	13.0	0	1210.2
5. Workshop	A	7.8										7.8
	B											0
	Total	7.8										7.8
II. Incremental O & M Cost	A	45.5	56.1	59.2	74.7	78.2	70.2	77.2	78.7	72.1	75.0	686.8
	B	2.8	9.7	13.9	14.7	15.4	14.4	14.8	15.2	14.6	15.2	130.6
	Total	48.3	65.8	73.0	89.4	93.7	84.6	92.0	93.9	86.7	90.1	817.5
1. Collection & Transportation	A	27.8	36.8	43.2	58.7	63.9	57.0	63.6	67.1	60.1	63.0	541.1
	B	2.3	2.6	6.8	7.7	8.4	7.7	8.0	8.5	7.9	8.4	68.2
	Total	30.0	39.4	50.0	66.4	72.2	64.7	71.6	75.6	68.0	71.4	609.3
2. Transfer Station	A	3.2	4.9	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	36.5
	B											0.0
	Total	3.2	4.9	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	36.5
3. Waste Processing Facility	A			-1.6	-1.6	-3.3	-3.3	-3.3	-4.9	-4.9	-4.9	-27.9
	B		-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-5.6
	Total	0	-0.6	-2.3	-2.3	-3.9	-3.9	-3.9	-5.5	-5.5	-5.5	-33.5
4. Landfill	A	12.4	12.4	12.0	12.0	12.0	12.0	12.4	12.0	12.4	12.4	122.3
	B	0.0	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	64.3
	Total	12.4	19.6	19.2	19.2	19.2	19.2	19.6	19.2	19.6	19.6	186.6
5. Public Awareness /Community Mobilization	A	1.8	1.8	1.8	1.8	1.8	0.9	0.9	0.9	0.9	0.9	13.5
	B	0.4	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.2	3.0
	Total	2.2	2.2	2.2	2.2	2.2	1.1	1.1	1.1	1.1	1.1	16.5
6. Institutional/ Organizational Strengthening	A	0.3	0.3	0.3	0.3	0.3						1.3
	B	0.2	0.2	0.2	0.2	0.2						0.8
	Total	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	2.0
III. Total (= I + II)	A	174.5	915.5	200.4	153.5	167.3	88.6	77.2	96.3	85.1	80.0	2038.3
	B	301.1	43.8	31.8	18.5	17.6	17.6	21.2	39.7	14.6	15.2	521.1
	Total	475.6	959.3	232.2	172.0	184.9	106.2	98.4	136.0	99.7	95.1	2559.4

Source: JICA Study Team

### 4.9.2 Concept for Cost Sharing Among the Organizations Concerned

#### (1) Concept for Cost Sharing between Municipality and Government

The municipalities are continuously facing financial difficulties because the revenue amount is not enough to satisfy the increasing costs of municipality services. In addition, the

municipalities may face serious financial problems when the Local Development Tax fades out by December 2013. Although KMC and LSMC have started to strengthen their revenue systems, much remains to be done. Accordingly the Government (SWMRMC) is required to bear the costs for development of landfill, transfer station, waste processing facility and closure of LF. On the other hand, municipalities should bear the rest of the costs from their own revenues, i.e. equipment procurement and O&M costs. The costs for public participation and behavior change, and institutional and organizational arrangement should also be borne by the respective municipalities.

Consequently, the cost sharing concept under the Umbrella Concept is summarized as shown in Table 4.9-2, but external financial support may be expected for some areas.

**Table 4.9-2 Cost Sharing Concept under the Umbrella Concept**

Action Plan	Component	Municipality	Government	Ref: External Sources
Transport & Haulage	Vehicles and Container Carrier	Full	-	Expected
	Container	Full	-	-
	O&M	Full	-	-
Transfer Station	Construction	-	Full	-
	Improvement works	-	Full	-
	Equipment	Full	-	Expected
	O&M	Full	-	-
Compost Plant	Land acquisition	-	Full	-
	Construction	-	Full	-
	Equipment	Full	-	Expected
	O&M	Full	-	-
Landfill	Land acquisition	-	Full	-
	Construction	-	Full	Expected
	Equipment	Full	-	Expected
	Closure	-	Full	-
	O&M	Full	-	-
Workshop	Facilities	Full	-	-
	Machinery & equip.	Full	-	-
Public Awareness/community mobilization		Full	-	-
Institutional/organizational strengthening		Full	-	-

Note: Full means full share, and Expected means financial aid to be expected

Source: JICA Study Team

Based on the above concept, the costs to be shared by SWMRMC and the municipalities can be estimated as shown in Table 4.9-3. SWMRMC should bear 56% of the total cost, while 44% should be borne by the municipalities.

**Table 4.9-3 Costs for SWMRMC and Municipalities (million Rs)**

Zone	Activities	SWMRMC	Municipalities		
		Facilities	Equipment	O&M	Total
A	Transportation	-	120.5	541.1	661.6
	Transfer Station	65.8	-	36.5	36.5
	WPF	203.8	16.0	-27.9	-11.9
	Landfill	892.4	45.2	122.3	167.5
	Workshop	-	7.8	-	7.8
	Public Awareness	-	-	13.5	13.5
	Institutional	-	-	1.3	1.3
	Total	1,162.0	189.5	686.8	876.3
B	Transportation	-	37.5	68.2	105.7
	WPF	38.2	42.0	-5.6	36.4
	Landfill	218.8	53.9	64.3	118.2
	Public Awareness	-	-	3.0	3.0
	Institutional	-	-	0.8	0.8
		Total	257.0	133.4	130.7
	Total	<b>1,419.0</b>	322.9	817.5	<b>1,140.4</b>

Source: JICA Study Team

## (2) Concept for Cost Sharing among the Municipalities

In principle, equipment procurement cost and incremental O&M cost become burdens on municipalities. Each municipality has to bear the cost originally generated by the municipality itself. Meanwhile, the costs generated by joint work among municipalities should be principally discussed and decided among the municipalities concerned. However, the costs generated by joint work is proposed to be separated to each municipality concerned on the basis of solid waste amount transported from the municipality to the destinations of transfer station, WPF and landfill.

### 4.9.3 Concept for Necessary Financial Procurement of Each Municipality

Judging from the actual financial capacity of municipalities, it is difficult to expect municipalities to cover the entire costs. The municipalities need to develop sources of funds as follows:

- 1) Enhancement of revenue generation capability especially on Property Tax
- 2) Utilization of the Reserve Fund
- 3) Other alternatives
  - Introduction of Public Private Partnership on SWM to reduce the SWM cost
  - Introduction of new charges on SWM services

## CHAPTER 5 ACTION PLANS ON SOLID WASTE MANAGEMENT OF BHAKTAPUR MUNICIPALITY

### 5.1 Solid Waste Stream for Action Plan

The most elementary but indispensable process to develop the Action Plan (A/P) on solid waste management is “to clarify the solid waste stream” as well as “to clarify the solid waste amount”. Under the Umbrella Concept for the solid waste management in the Kathmandu Valley, there are some remarkable turning points, i.e. facilities development such as waste processing facilities and long-term landfill sites, up to the target year of 2015, which should be taken into consideration in preparation of waste stream flow. In order to formulate the A/P, solid waste flow of BKM was prepared as per attached in Appendix 2. The waste management ratios were set as main targets of the A/Ps based on the solid waste stream flows.

### 5.2 Vision and Target

The vision of BKM has been determined as **“To support for promoting Bhaktapur city as a tourist destination through better Solid Waste Management”** as a result of a series of discussions at the T/F meetings and public hearings. As for the target, BKM has adopted various indicators in addition to the management ratio, i.e. collection area, population receiving collection service and disposal ratio to a sanitary landfill site as shown in Table 5.2-1.

**Table 5.2-1 Target of BKM**

Present Situation	Targets		
	Short-term	Mid-term	Long-term
	C: 2005/06 – 2007/08	2008/09 – 2010/11	2011/12 – 2014/15
	N: 2062/63 – 2064/65	2065/66 – 2067/68	2067/68 – 2071/72
Management ratio (amount) : 75% (19 t/d) Collection ratio (area) : 25% Population Served : 78% Disposal ratio to SLF site:0%	Management ratio (amount) : 80% (24 t/d) Collection ratio (area) : 35% Population Served : 82% Disposal ratio to SLF site:0%	Management ratio (amount) : 85% (30 t/d) Collection ratio (area) : 50% Population Served : 86% Disposal ratio to SLF site:72 %	Management ratio (amount) : 90% (42 t/d) Collection ratio (area) : 65% Population Served : 90% Disposal ratio to SLF site:72%

Source: BKM Task Force

### 5.3 Approaches, Strategies and Necessary Activities

The approaches, strategies and necessary activities established by BKM are shown in Table 5.3-1 and implementation schedule of short-term activities is shown in Table 5.3-2.



**Table 5.3-1 Strategies and Necessary Activities (BKM)**

Approaches	Strategies	Necessary Activities		
		Short-term (2005/06-2007/08)	Mid-term (2008/09-2010/11)	Long-term (2011/12 – 2014/15)
		(2062 Shrawan – 2065 Ashadh)	(2065 Shrawan – 2068 Ashadh)	(2068 Shrawan – 2072 Ashadh)
A: Improvement of Collection and Transportation	A-1: Revision of collection system	A-1-S1: Procurement of a garbage tipper and tricycles	A-1-M1: Revision of waste collection route and extension of collection service areas to new urban settlements out of the core area	A-1-L1: Continuation of mid-term activities A-1-L2: Operation of transfer station
	A-2: Promotion of source separated collection (by community mobilization)	A-2-S1: Promotion of source separation and collection of organic kitchen waste by formulating users groups at local household level A-2-S2: Promotion of source separation and collection from hotels and restaurants	A-2-M1: Promotion of source separation and collection of organic kitchen waste at source by formulating users groups at local level and facilitated, bound with terms and conditions by the Municipality	A-2-L1: Continuation of mid-term activities
B. Promotion of Waste Minimization	B-1: Improvement and extension of existing composting facility (inclusive of transfer station)	B-1-S1: Procurement of a 10 t/d capacity excavator or backhoe loader, and waste sorting device B-1-S2: Land acquisition of extension area B-1-S3: Infrastructure development (open trussed shade, garage, parking area, weighbridge, sorting area, screening area, etc.)	B-1-M1: Commencement of operation of extended municipal composting facility (Phase I) along with marketing of compost produced with informative packing system	B-1-L1: Commencement of operation of extended municipal composting facility (Phase II) along with marketing of compost produced with informative packing system
	B-2: Waste minimization by community mobilization (community based solutions towards SWM)	B-2-S1: Promotion of waste minimization by making people well known with various methods of waste reduction at sources (e.g. home compost bins and vermi-composting, gift and educational training tools for school children from waste) B-2-S2: Installation of small scale bins/container at or nearby open waste collection spots or nearby ward office for keeping unusable broken glass, bulbs, tube lights etc. which are nuisance to municipal compost, and monitoring and operation by the local people	B-2-M1: Continuation of short-term activities	B-2-L1: Continuation of mid-term activities
	B-3: Trial of community level composting	-	B-3-M1: Introduction of closed chamber composting in new urban settlements out of the core area on pilot basis (Tole/Ward Basis) by formulating users groups at local level	B-3-L1: Continuation of mid-term activities
C. Improvement of Final Disposal System	C-1: Development of sanitary landfill site	C-1-S1: Topographical survey and soil investigation C-1-S2: Completion of EIA procedure C-1-S3: Detail design of the site with mitigation measures as recommended by EIA study - including waste processing facility within the landfill site along with leachate treatment facility and buffer zone C-1-S4: Land acquisition and resettlement of the directly affected dwellers in and nearby the site C-1-S5: Construction of the access road	C-1-M1: Completion of the access road construction C-1-M2: Completion of the site construction (Phase I area) C-1-M3: Formulation of the Environmental Monitoring Committee for the regular/periodic monitoring of the site C-1-M4: Commencement of Operation & Management of the site (Phase I area) along with waste processing facility	C-1-L1: Completion of the site construction (Phase II area) C-2-L2: Commencement of Operation & Management of the site (Phase II area) along with waste processing facility C-1-L3: Follow up of the Environmental Monitoring Committee's Activities regularly and periodically for proper Operation & Management of the site
	C-2: Procurement of equipment and vehicles for the operation of the site		C-2-M1: Procurement of heavy equipment (Garbage Tipper, Backhoe Loader, Roller, Mini -excavator, waste-sorting device, weighbridge, etc.)	
	C-3: Involvement of affected people in the development works of the site	C-3-S1: Establishment of local committee for social consensus for the development of the site C-3-S2: Consideration of community development works	C-3-M1: Implementation of community development works	C-3-L1: Continuous implementation of community development works

Approaches	Strategies	Necessary Activities		
		Short-term (2005/06-2007/08)	Mid-term (2008/09-2010/11)	Long-term (2011/12 – 2014/15)
		(2062 Shrawan – 2065 Ashadh)	(2065 Shrawan – 2068 Ashadh)	(2068 Shrawan – 2072 Ashadh)
	C-4: Implementation of research study	C-4-S1: Implementation of research study to define the leachate quality of the dumped waste at the current dumping site & the past dumping site for comparative analysis (on contamination of natural water body by solid waste disposal & liquid waste)	C-4-M1: Continuation of short-term activities	
D. Raising of Public Participation and Behavior Change	D-1: Implementation of public awareness and education on SWM	D-1-S1: Development of training tools/materials for community participation	D-1-M1: Continuation of short-term activities	D-1-L1: Continuation of short-term activities
		D-1-S2: Dissemination of information regarding SWM inclusive collection system (leaflets, brochures, calendars, advertisements in halls before starting of film show)	D-1-M2: Continuation of short-term activities	D-1-L2: Continuation of mid-term activities
		D-1-S3: Implementation of mass communication and education program (distribution of stickers, posters, drama play, competition among children group-drama, original stage drama during Gaijatra festival, drawing wall paintings, cleansing at the local communities)	D-1-M3: Continuation of short-term activities	D-1-L3: Continuation of mid-term activities
			D-1-M4: Periodic orientation classes on community based SWM in various schools in BKM D-1-M5: Mass meeting and procession at least once a year on Environment Day (June 5)	D-1-L4: Periodic orientation classes on community based SWM in various schools in BKM D-1-L5: Mass meeting, procession at least once a year on Environment Day (June 5)
	D-2: Promotion of interpersonal communication and education on SWM	D-2-S1: Promotion of Interpersonal Communication and Education program with arrangement of agreement with NGO such as selection of target communities, orientation workshop, baseline information survey in regard to existing knowledge, attitude, practices on SWM, counselor training camp for youth, teachers who support children's activities on SWM at the targeted communities	D-2-M1: Continuation of short-term activities	D-2-L1: Continuation of mid-term activities
E. Organizational and Institutional Arrangement	E-1. Organizational restructuring and strengthening	E-1-S1: Implementation of training on SWM based on the TNA E-1-S2: Finalization of organizational restructuring for SWM	E-1-M1: Recruit desired manpower for long-term SLF for proper management & operation E-1-M2: Establishment of Mechanical Section (MS)/Subsection (MSS)	E-1-L1: Extension of Mechanical Workshop Facilities
	E-2: Management of solid waste data by database	E-2-S1: Collection of relating data for SWM E-2-S2: Arrangement of the collected data in the database	E-2-M1: Establishment of data collection system E-2-M2: Continuous solid waste data arrangement in the database	E-2-L1: Continuous solid waste data arrangement by database
F. Others	F-1: Delegation of authority to communities and private sector	F-1-S1: Involvement of CBOs in collection and transportation of organic waste from households, hotels & restaurants on pilot basis (on Toile/Ward basis)	F-1-M1: Involvement of CBOs in collection and transportation of organic waste from households, hotels and restaurants (on Toile/Ward basis)	F-1-L1: Involvement of CBOs in collection and transportation of organic waste from households, hotels and restaurants (on Toile/Ward basis)
	F-2: Optimization of management efficiency and establishment of cost-effective SWM	F-2-S1: Commencement of private sector participation in SWM on pilot basis with different approaches - Case I: Only street sweeping by community level workers - Case II: Door to Door service - Case III: Both I & II - Case IV: Collection of Organic Waste from Hotels & Restaurants - Case V: Collection, transportation & Sale of Recyclable/Reusable Waste	F-2-M1: Expansion of private sector participation in SWM	F-2-L1: Expansion of private sector participation in SWM with different approaches



Strategies	Short-Term Activities	Responsible Section	Related Organizations (Department, Section, NGO/CBO)	2005/2006				2006/2007				2007/2008				
				I (July 16)	II	III	IV (July 16)	I (July 17)	II	III	IV (July 16)	I (July 17)	II	III	IV (July 15)	
				2062/2063				2063/2064				2064/2065				
				Shrawan			Ashadh	Shrawan			Ashadh	Shrawan			Ashadh	
	C-1-S3: Detail design of the site with mitigation measures as recommended by EIA study - including waste processing facility within the landfill site along with leachate treatment facility and buffer zone	Physical Planning and Works Sec.	Environment Sec., SWMRMC, MTM													
	C-1-S4: Land acquisition and resettlement of the directly affected dwellers in and nearby the site	Physical Planning and Works Sec.	Environment Sec., SWMRMC, MTM													
	C-1-S5: Construction of the access road	Physical Planning and Works Sec.	Environment Sec., SWMRMC, MTM						Survey & Design			Construction				
C-3: Involvement of affected people in the development works of the site	C-3-S1: Establishment of local committee for social consensus for the development of the site	Environment Sec.	Physical Planning and Works Sec., SWMRMC, MTM													
	C-3-S2: Consideration of community development works	Environment Sec.	Physical Planning and Works Sec., SWMRMC, MTM													
C-4: Implementation of research study	C-4-S1: Implementation of research study to define the leachate quality of the dumped waste at the current dumping site & the past dumping site for comparative analysis (on contamination of natural water body by solid waste disposal & liquid waste)	Environment Sec.	Physical Planning and Works Sec., SWMRMC, MTM													
D-1: Implementation of public awareness and education on SWM	D-1-S1: Development of training tools/materials for community participation	Social Welfare & Sanitation Section (CMU)	Relevant sections or units in other municipalities such as CMU in KMC and CDS in LSMC													
	D-1-S2: Dissemination of information regarding SWM inclusive collection system (leaflets, brochures, calendars, advertisements in halls before starting of film show)	Social Welfare & Sanitation Section (CMU)	Ward offices, NGOs, CBOs													
	D-1-S3: Implementation of mass communication and education program (distribution of stickers & posters, drama play, competition among children group-drama, original stage drama during Gaijatra festival, drawing wall paintings, cleansing at the local communities)	Social Welfare & Sanitation Section (CMU)	Ward offices, Schools													

Strategies	Short-Term Activities	Responsible Section	Related Organizations (Department, Section, NGO/CBO)	2005/2006				2006/2007				2007/2008			
				I (July 16)	II	III	IV (July 16)	I (July 17)	II	III	IV (July 16)	I (July 17)	II	III	IV (July 15)
				2062/2063				2063/2064				2064/2065			
				Shrawan			Ashadh	Shrawan			Ashadh	Shrawan			Ashadh
D-2: Promotion of Interpersonal communication and education on SWM	D-2-S1: Promotion of Interpersonal Communication and Education program with arrangement of agreement with NGO such as selection of target communities, orientation workshop, baseline information survey in regard to existing knowledge, attitude & practices on SWM, counselor training camp for youth, teachers who support children's activities on SWM at the targeted communities	Social Welfare & Sanitation Section (CMU)	Ward Offices, NGOs, CBOs												
E-1. Organizational restructuring and strengthening	E-1-S1: Implementation of training on SWM based on the TNA	Physical Planning and Works Sec.													
	E-1-S2: Finalization of organizational restructuring for SWM	CEO													
E-2: Management of solid waste data by database	E-2-S1: Collection of relating data for SWM	Environment Sec.													
	E-2-S2: Arrangement of the collected data in the database	Environment Sec.													
F-1: Delegation of authority to communities and private sector	F-1-S1: Involvement of CBOs in collection & transportation of organic waste from households, hotels & restaurants on pilot basis (on Tole/Ward basis)	Environment Sec.	CBOs												
F-2: Optimization of management efficiency and establishment of cost-effective SWM	F-2-S1: Commencement of private sector participation in SWM on pilot basis	Environment Sec.	CBOs, NGOs, Private sectors												

Legend  : Continuous activities  
 : Intermittent activities  
 : Spot activities

CMU: Community Mobilization Section

## 5.4 Financial Plan

As shown in Table 5.4-1, total SWM cost, summing up current SWM cost and Action Plan cost, amounts to Rs 347million over the period until the target year of 2014/15. On the other hand, total own revenue, summing up actual revenue and projected revenue increase, amounts to Rs 1,268 million. Thus, the ratio of total SWM cost to total own revenue results in 27%, which is higher than current ratio of 12% but not very much high if compared to ratio of KMC and LSMC. Consequently, it is suggested that BKM bears entire Action Plan cost by taking all means available, for instance by reducing other expenditures, applying to donation of Reserved Fund, etc.

**Table 5.4-1 Ratio of SWM Cost to Municipality Own Revenue (BKM)  
(million Rs)**

Items	2005/06 2062/6	2006/07 2063/6	2007/08 2064/6	2008/09 2065/6	2009/10 2066/6	2010/11 2067/6	2011/12 2068/6	2012/13 2069/7	2013/14 2070/7	2014/15 2071/72	Total
I. Own Revenue	127.3	128.1	129.0	128.9	129.0	128.4	126.6	125.4	124.5	121.4	1,268.7
1. Actual Revenue	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	1,265.0
2. Projected Revenue Increase	0.8	1.6	2.5	2.4	2.5	1.9	0.1	-1.1	-2.0	-5.1	3.7
II. SWM Cost	58.6	45.2	40.6	27.2	27.5	27.4	30.7	43.0	23.7	24.0	347.8
1. Current SWM	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	150.0
2. Action Plan	43.6	30.2	25.6	12.2	12.5	12.4	15.7	28.0	8.7	9.0	197.8
<b>III. Ratio (= II/I)</b>	46%	35%	31%	21%	21%	21%	24%	34%	19%	20%	27%

Note: 1) Actual revenue is amount of FY 2004/05 which is assumed to continue the same amount, 2) Projected revenue increase consists of Local Development Fee, Gov. subsidy and Property Tax, 3) Current SWM cost is the cost presented in Chapter 3 which is assumed to continue the same amount..

Source: JICA Study Team

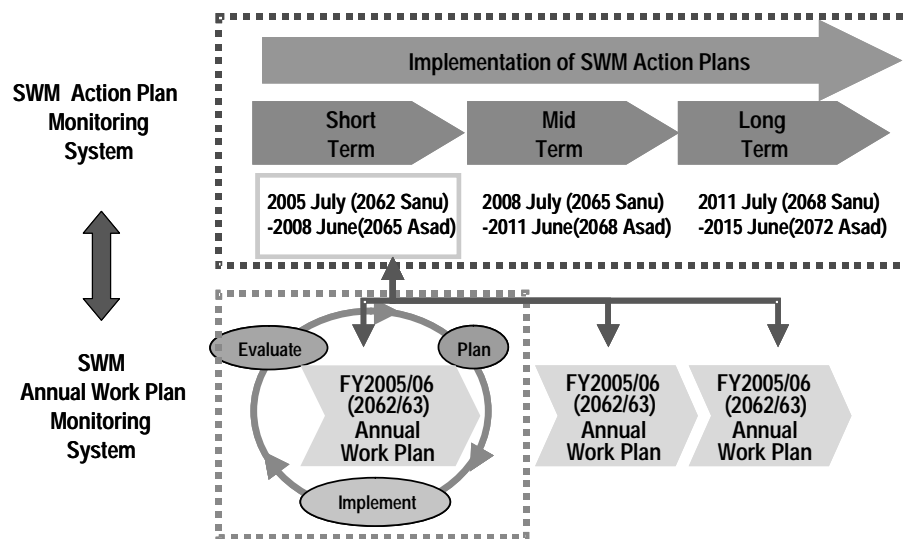
## 5.5 Monitoring and Evaluation Plan for Action Plans

The A/P is a long-term strategic plan to be implemented starting fiscal year 2005/06 (2062/63) to 2014/15 (2071/2072). In order to ensure that the Action Plan is implemented in an effective and sustainable manner, monitoring and evaluation systems need to be put in place that bind together both individual and collective achievements of SWMRMC and the five municipalities. Such systems should be installed both at the municipal level, as well as the Valley level, in line with the institutional arrangements as discussed under the Umbrella Concept.

In the case of the A/Ps, OVIs were identified with target for the year 2015. Through the implementation of the A/Ps, collectively, the municipalities and SWMRMC will aim to increase the total solid waste management rate from existing 76% to 93%. Each municipality's target, solid waste management ratio, is as specified within the respective A/Ps.

**Monitoring:** Monitoring of A/P implementation should be conducted at two levels. First, the solid waste management ratio should be calculated at individual municipalities, to measure the effectiveness of SWM activities as indicated in the targets of the respective A/Ps. It is suggested that each municipality's benchmark the target solid waste management ratio that they should achieve by the end of short, medium and long term activities of the A/Ps. Every three or four years, the actual percentage of the solid waste management rate should be measured against the benchmarked target ratio to assess progress.

The second level of monitoring of the A/Ps should be conducted when each municipality formulate their respective annual work plans, which in fact is a breakdown of activities as identified for short, medium, and long term. Based on the existing policy priorities, availability of resources, influences from external factors, and lessons learned from the past implementation of activities, the contents of A/Ps themselves should be reviewed and modified. This process should allow enough flexibility so that the activities stipulated in the A/Ps could be changed, dropped or added insofar as the overall effect of the SWM program would increase the solid waste management ratio. Furthermore, this exercise would serve to update the A/Ps so that it would enhance the relevance of the A/Ps for continued sustainability. The linkage between the Action Plan monitoring system and Annual Work Plan is as illustrated in Figure 5.5-1.



**Figure 5.5-1 Linkage between Action Plan Monitoring System and Annual Work Plan**

Source: JICA Study Team

**Evaluation:** During the benchmarked years of 2008 and 2011, which are also the final fiscal years within short and mid terms, respectively, end of term evaluations are recommended to holistically review the A/Ps implementation from the perspectives such as relevance, effectiveness, efficiency, impact and sustainability of municipal activities. In 2015, the final evaluation should be conducted to examine whether the ultimate target of 93% solid waste management ratio was achieved, and to draw best practices and lessons learned for future SWM programs.

For the end of term evaluations, it is envisaged that a joint evaluation team be formed for each municipality among the representatives from municipal T/Fs, SWMRMC, and MOLD. The results of the evaluations should be disclosed and shared with other municipalities at TWG and other forums so that the major lessons learned and recommendations could be shared with a wider audience.

# APPENDICES

- APPENDIX 1      Members of Technical Working Group and Task Force
- APPENDIX 2      Solid Waste Stream Flow of BKM (Current and Future)
- APPENDIX 3      Annual Work Plan of Fiscal Year of 2005/06 (2062/63)  
Proposed by Task Force (BKM)



## **APPENDIX 1**

### ***Members of Technical Working Group and Task Force***

## APPENDIX 1 MEMBER OF TECHNICAL WORKING GROUP AND TASK FORCE

*Technical Working Group (Total 18 members)*

*As of July 20, 2005*

Organizations	Name	Designation / Organizational Position
MOLD	Mr. Babu Ram Gautam (Mr. Prem Raj Giri up to Nov, 2004)	Under Secretary
SWMRMC	Mr. Surya Man Shakya (Chairperson up to June 23, 2005)	Former General Manager
	Mr. Ashok Shahi (Chair person after June 24, 2005)	Acting General Manager
	Mr. Ram Sharan Maharjan	Civil Engineer
	Mr. Nirmal Darshan Acharya	Civil Engineer
KMC	Mr. Rajesh Manandhar	Chief, Solid Waste Management Section
	Mr. Kiran Ulak	Engineer, Solid Waste Management Section
	Mr. Purusotam Shakya	Chief, Mechanical Section
LSMC	Mr. Rudra Prasad. Gautam	Chief, Public Works Division
	Mr. Pradeep Amatya	Chief, Environment and Sanitation Section
BKM	Mr. Laxman Kisiju	Chief, Planning and Technical Section
	Mr. Moti Bhakta Shrestha	Chief, Social Welfare & Sanitation Section
	Mr. Dinesh Rajbhandari	Sanitation Engineer, Planning and Technical Section
MTM	Mr. Satya Narayan Shah	Chief, Planning and Technical Section
	Ms. Krishna Kumari Shrestha	Assistant, Community Development and Sanitation Section
	Mr. Surendra Shrestha	Junior Engineer, Planning and Technical Section
KRM	Mr. Anuj Pradhan	Chief, Solid Waste Management Unit
	Mr. Gyan Bazra Maharjan	Assistant, Solid Waste Management Unit/Accounting

*Task Force of BKM (Total 9 members)*

*As of July 20, 2005*

Name	Designation / Organizational Position
Mr. Badrinath Ghimire	CEO
Mr. Laxman Kisiju	Chief, Planning and Technical Section
Mr. Moti Bhakta Shrestha	Chief, Social Welfare & Sanitation Section
Mr. Dinesh Rajbhandari	Sanitation Engineer, Planning and Technical Section
Mr. Dilip Kumar Suwal	Chief, Sanitation Sub-section
Mr. Krishna Prashad Suwal	Assistant, Social Welfare & Sanitation Section
Mr. Revid Kusma	Chief, Store Sub-section
Ms. Ambika Dhauvadel	Chief, Administration Section
Ms. Ratnamaya Shrestha	Chief, Financial Section

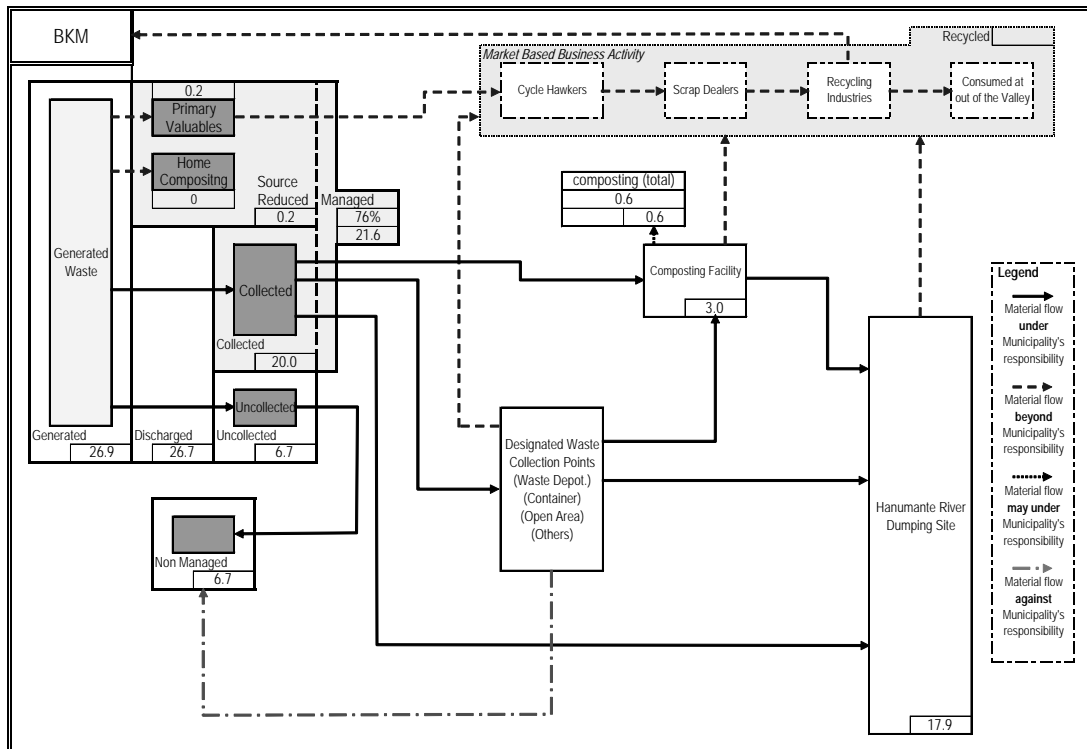
## **APPENDIX 2**

### ***Solid Waste Stream Flow of BKM (Current and Future)***

## APPENDIX 2 SOLID WASTE STREAM FLOW OF BKM (CURRENT AND FUTURE)

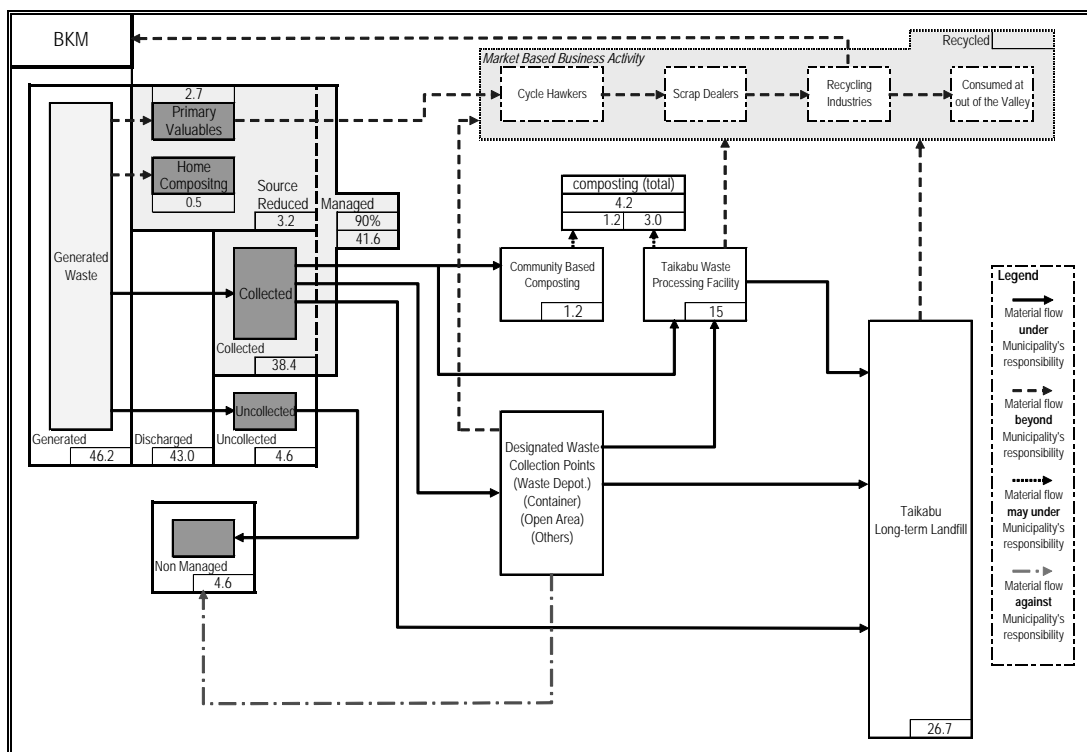
Existing Solid Waste Stream (2005)

Unit: t/day



Future Solid Waste Stream (2015)

Unit: t/day



## **APPENDIX 3**

***Annual Work Plan of  
Fiscal Year of 2005/06 (2062/63)  
Proposed by Task Force (BKM)***











SN	Short-Term Activities to be Conducted in FY 2062/63	Responsible Person (Section)	Proposed Budget (NRs)	2005												2006																																			
				July			August			September			October			November			December			January			February			March			April			May			June			July											
				III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV														
				2062												2063																																			
Shrawan				Bhadra				Aswin				Kartik				Mangsir				Poush				Magh				Falgun				Chaitra				Baisak				Jesha				Ashadh							
<b>E-1-S2 Finalization of organizational restructuring for SWM</b>																																																			
1	Establishment of Environment Section	CEO																																																	
2	Transfer of staff	CEO																																																	
3	Provide TOR to the staff	CEO																																																	
4	Physical improvement	CEO	200,000																																																
5	Approve Task Force TOR	CEO																																																	
6	Drafting SWM guideline (By laws)	Environmental Sec./(TBN)	100,000																																																
<b>E-2-S1 Collection of relating data for SWM</b>																																																			
1	Collection of relating data for SWM	ES/(TBN)																																																	
<b>E-2-S2 Arrangement of the collected data in the database</b>																																																			
1	Arrangement of the collected data in the database	ES/(TBN)																																																	

Legend  
 : Continuous activity  
 : Intermittent activity  
 : Spot activity

PPWS: Physical Planning and Works Section  
SWS: Social Welfare Section  
ES: Environment Section  
TBN: To be named