Solid Waste Management of Kathmandu Metropolitan City

Environment Audit Report, 2015

Abstract

Solid Waste Management (SWM) is very important task directly related to human health and environment. The Kathmandu Metropolitan City (KMC) has the main responsibility for managing solid waste in Kathmandu Metropolitan area. The Ministry of Urban Development (MOUD), Ministry of Federal Affairs and Local Development *(MOFALD), Solid Waste Management Technical Support Centre (SWMTSC) have also roles and responsibilities for managing the municipal waste. The objective of this audit is to assess the environment aspect and efficiency and effectiveness of SWM carried out by the KMC.*

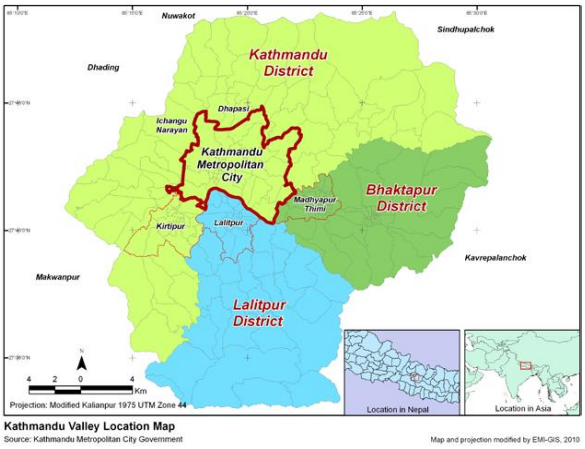
The SWM Act, 2011 and Rules, 2013 comprehensively cover all aspects of the waste stream, i.e., from prevention, collection to final disposal. The audit findings shows that some provisions of SWM Act are not complied resulting no separation of waste at source in efficiency in the waste collection and transportation system. Reduction, recycle and reuse (3Rs) of waste are almost lacking. Engagement of the private organizations in SWM activities could not be formalized and coordinated. Multiple handling of waste and poor condition of access road to landfill site have adversely effected on efficiency of SWM. The Sisdol landfill could not be managed in environment-friendly manner and construction of the new landfill has found in slow pace. The monitoring and follow-up aspects are inadequate. The inefficient and unplanned management of solid waste have posed risk on human and environment. It has also increased the cost of waste handling.

The KMC, the concerned Ministries and the SWMTSC should fulfill their part of responsibilities complying legal provision, providing resources and strengthening monitoring and follow-up mechanism. Increasing public awareness, enforcement of legal provision and construction of physical infrastructure are necessary for ensuring segregation, reuse and recycle of waste. Environment-friendly management of landfill should be ensured, along with improvement of access road to Sisdol landfill site.

Introduction

1. **Background:** The Municipal waste has been increasing day by day due to population growth, rapid urbanization and availability of various physical facilities. Establishment of factories and industries, development and expansion of trade and commerce, adoption of advanced technology and changes in consumption habits have caused increase in waste generation as well as change in nature and composition of solid waste in the Kathamandu Metropolitan City (KMC). The increased volume of domestic waste, industrial waste, chemical waste, health institution related waste or harmful waste in KMC has posed challenges to the environment. As per the Local Self Governmenance Act, 1999, the KMC is responsible for SWM activities within its jurisdiction. As per the Government of Nepal (Allocation of Business) Rules, 2012 the Ministry of Federal Affairs and Local Development (MOFALD) is responsible for formulation, implementation, monitoring and evaluation of policy, plan and program relating to sewerage and sanitation, and the Ministry of Urban Development (MOUD) is responsible for sanitation and drainage. The

SWMTSC is also responsible for providing technical support to manage solid waste properly and environment-friendly.



Kathmandu Valley Location Map
Source: Kathmandu Metropolitan City Government
Map and projection modified by EMI-GIS, 2010

The KMC was established as "Cleaning Office" in 1919 AD. Since its establishment the KMC has been managing solid waste and sanitation activities within municipal territory. It manages street sweeping, waste collection, transportation and final disposal. Informally various Private Sector's Organizations (PSOs) have also engaged in waste collection. The KMC is facing major challenges when it comes to collection of not segregated waste, lack of reduction, reuse and recycling of solid waste. Management of the transfer centre and landfill site in an environment-friendly manner has also become a challenge due to poor condition of the access road to the landfill, inefficient transport system and the involvement of PSOs in waste management activities without obtaining licence.

The Key Performance Indicators

- Strategic and operational plan,
- Waste segregation at source
- Waste collection and transportation
- Reduction, Reuse and Recycle (3Rs)
- Transfer centre and landfill site management
- Institutional and management aspects

According to the SWM Act, the solid wastes need to be managed in a systematic and effective way by reducing at its source, reuse, processing or discharge to maintain a clean and healthy environment through reducing adverse effects that may cause to public health and environment. This is why, the SWM activities carried out by the KMC need to be assessed.

2. **Policy arrangement:** The Solid Waste Management National Policy, 1997 (2053 BS) is the main policy document for managing solid waste. The policy has envisaged the following objectives to be achieved:

- To make solid waste management work simple and effective,
- To minimize environment pollution and adverse effect on public health caused by waste,
- To mobilize waste as a resource,
- To garnish public participation through promoting public awareness,
- To privatize the solid waste management work

Similarly, the thirteenth Periodic Plan (FY2013/14 - 2015/16) has emphasized on co-ordination among the concerned entities for the management of hazardous waste. Concerning the environment degradation, Initial Environmental Assessment (IEA) and Environment Impact Assessment (EIA) should be carried out by the concerned entity or person.

3. **Legal arrangement:** The following rules and regulations are related to the solid waste management of KMC and SWMTSC:

- Solid Waste Management Act, 2011 (2068 BS)
- Solid Waste Management Rules, 2013 (2070 BS)

- Environment Protection Act, 1997 (2053 BS)
- Environment Protection Rules, 1998 (2054 BS)
- Local Self-Governance Act, 1999 (2055 BS)

4. **Objective and goal:** The Ministry of the Urban Development has published a concept paper of clean city programme in 2013 (2070 BS). Proper management of solid waste is one of the main objectives of this programme and the following activities are to be conducted for achieving the main objectives:
   - To make the city clean through proper collection and management of household waste, industrial waste, chemical waste, health care waste and construction material waste,
   - To separate decaying and non-decaying waste at its source and composting the decaying waste at household, community and municipal level,
   - To promote re-use, recycle and processing of the waste,
   - To make necessary arrangements in order to implement "polluter's pay" concept for making solid waste management work effective and self-reliant,
   - To increase public participation in solid waste management,
   - To formulate and implement the policy, standard and directives for solid waste management.

   Similarly, the SWMTSC has fixed annual targets as exhibits in *table 1* for FY 2013/14.

Table 1: *Annual target of the SWMTCS.*

Activities	Unit	Quantity	Budget (Rs.'000)
Capacity extension of the Sisdol landfill site	cu.m.	144,000	40,000
Construction and maintenance of the Sisdol landfill site	m.	30	3,500
Construction of access road from the Sisdol to Bancharedanda	m.	285	49,542
Kolpu Khola control and diversion	m.	250	46,873
Construction of bridge over Kolpu Khola	m.	24	10,000

Source: *The SWMTSC.*

5. **Financial arrangement:** The KMC and the SWMTSC have direct involvement in SWM of Kathmandu valley. The SWMTSC is also responsible to provide necessary technical support for waste management to all municipalities within the country. The annual budget and expenditure of both entities for carrying out solid waste management activities for the past three consecutive year are as depicted in *table 2* given below:

Table 2: *The annual budget and expenditure relating to the solid waste management.*

(Rs.'000)

Fiscal Year	The KMC		The SWMTSC	
	Budget	Expenditure	Budget	Expenditure
2068/69 (2011/12)	462,600	399,990	73,459	67,058
2069/70 (2012/13)	482,960	398,542	60,704	57,799
2070/71 (2013/14)	621,700	403,023	122,786	111,617

Source: *The annual budget of the KMC and the SWMTSC*

Audit objective, scope and methodology

6. **Objective:** The main objective of the audit is to assess the efficiency and effectiveness of the SWM carried out by the KMC and to provide recommendations for the remedy of the weaknesses found. The secondary objectives are as follows:
   - To assess the relevant activities carried out by the KMC, SWMTSC and other concerned entities,
   - To test compliance of the SWM Act & Rules,
   - To assess the collection and transportation system of solid waste,
   - To evaluate the steps taken for reduction, reuse and recycling of solid waste,
   - To assess the operation of transfer station and landfill site,
   - To evaluate institutional and managerial strength of SWM.

7. **Scope:** The scope of audit is related to the SWM activities carried out by the KMC, comprising of collection and transportation system of solid waste, reduction, reuse and recycling of solid waste, operation of transfer centre and landfill site covering the fiscal year 2011/12 to 2013/14. The audit also covers institutional and managerial aspects relating to SWM. The relevant activities of the SWMTSC and other concerned entities are also included in audit scope.

8. **Methodology:** In course of audit, a problem and result oriented approach has been followed in order to achieve the above mentioned audit objectives. The methodology used includes document review, interviews and questionnaires, observation in the field, as well as review of secondary literature. In this regards, policy and legal arrangement related to SWM, operational process, annual progress reports have been reviewed.

   Information has been collected through questionnaires, interviews and discussion with a local club in order to substantiate the matter of potential significance (MOPS) and risk areas identified through the evaluation of risk assessment of SWM activities carried out by the KMC. Similarly, field observation of transfer centre, landfill site and ward no.23, 24 and Durbar square area was done.

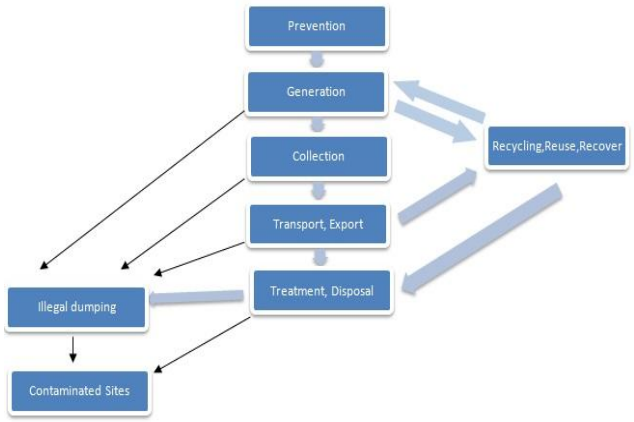
   Interview saw taken with 150 stakeholders of different segments of society namely, householders, waste collectors, drivers and helpers of waste transportation vechicles and people affected by transfer centre.

Major Findings

- **Positive aspects:** Street sweeping service on the main road and historical area, door to door waste collection and transportation, existing of transfer centre and landfill site and conducting awareness programs are found satisfactory as the main strengths of the KMC regarding SWM.
- **Weaknesses and threats:** Lack of people's awareness for waste management, lack of efficient manpower, noncompliance with various provisions of SWM law, delay in decision making, multiple handling of waste, increased volume of waste, frequent strike and bandh and so forth are the main weaknesses and threats to SWM of the KMC.

9. **Waste generation rate and its composition:** The total amount of waste generated in a city and its characteristics (composition) are important factors for planning the solid waste management (SWM) system. Waste generation rate and its composition vary with population growth, life style, economic activities and seasonal events. The survey or other similar activities should be conducted to estimate per capita waste generation, whereby total waste generation can be calculated by multiplying per capita waste by the population, and to determine the composition of waste. As per the data made available by the KMC, the per capita waste generation is 300g/person/day.

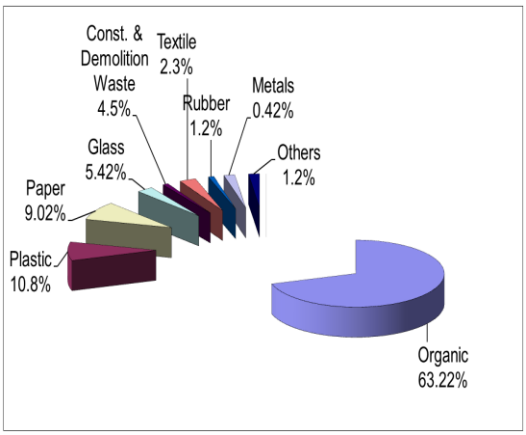
Figure 1: *The waste stream*



Source: INTOSAI Working Group of Environment Auditing: Towards Auditing Waste Management.

Similarly, the amounts of various materials in the waste stream, *Figure 1*, should also be known in order to manage different components separately. Solid Waste Management Act, 2011 prescribe to separate the solid waste into at least organic and inorganic counterparts. For easiness, the inorganic waste can be further segregated into plastics, paper, glass, textile, metals, rubber/leather, inert (sand and stones) and others. The data made available by the KMC shows that the major portion of waste is organic i.e. 63.22%. Plastic and paper comprise major portion of inorganic waste. The *figure 2* exhibits the composition of solid waste in KMC.

Figure 2: *Composition of Solid Waste in the KMC.*



Source: *The KMC's presentation slide.*

Another important waste characteristic is its density. As per SWM Technical Guideline the density of the waste is an important factor for the estimation of the volume of containers or vehicles required for its collection, storage and transportation.

The KMC has not mentioned when the survey and the study was conducted to establish the per capita waste generation and waste composition. So it is difficult to determine whether available data are accurate or not. At the same time, the KMC has not carried out study of waste density.

In the absence of survey, study on waste generation rate, its composition and density, planning of collection, storage, transportation and disposal of waste could be based on unrealistic estimation and may hamper the efficiency and effectiveness of solid waste management.

The KMC should conduct survey and study on waste generation and its characteristics once in every few years so as to estimate total waste in its territory and prepare solid waste management plan on the basis of this estimate.

10. **Collection of Waste:** According to section of 2q of the SWM Act, 2011, solid waste collection means the collection of solid waste from such waste production site, house to house collection, sweeping, depositing, weed uprooting, waste materials from public places, and collection of posters or pamphlets which are pasted without permission at public place. The waste generated in households and other sources should be collected properly and in timely manner. Therefore, the KMC should have efficient waste collection system comprising waste segregation at source, waste collection from source and street sweeping. The provision and practice of waste collecting system of KMC has been observed as follows:

10.1. Section 6 in the SWM Act, has made provision of segregating waste at least into organic and inorganic waste.Waste generators need to store the waste at the source until it gets collected. For assisting recycling and re-use, the waste should be segregated at the source according to its nature. Therefore, the KMC should have policy and program for encouraging the segregation of the waste at source. The 19th municipal council has decided (decision no.10) to distribute compost bin for local resident at 50% subsided rate. As per decision the KMC has distributed 1 thousand 500 compost bin in FY 2011/12. The policy has not continued in FY 2012/13 but as per the 22nd municipal council's decision no.37 in 2013/14 FY 1 thousand 739 compost bin has distributed. During 3 years only 3 thousand 239 compost bin has been distributed which seems insufficient as compared to 1.12 million populations as per 2011 census. Similarly, the 20th municipal council has made decision (decision no.43) regarding the distribution of segregation bin for separating household waste at source at a 25% subsidized rate but the decision has not implemented. The non implementation of decision shows that the KMC has not committed on its decision. The *table 3* shows the activities performed by the KMC during past 3 years.

Table 3: *Activities relating to waste segregation in the KMC.*

Year	Activities	Units
2011/12	Distribution of compost bin	1500 no.
	Distribution of segregation bin	None
	Awareness programs	27 times
2012/13	Distribution of compost bin	None
	Distribution of segregation bin	None
	Awareness programs	45 times
2013/14	Distribution of compost bin	1739 no.
	Distribution of segregation bin	10 no.
	Awareness programs	58

Source: *The KMC.*

Though the number of awareness program has seen increasing during a three years period, it is difficult to ensure the sufficiency of such program in terms of quality and number of participate because noticeable difference before and after the programs could not be found. Therefore, waste segregation at household level or at other source has yet to be introduced in municipal area. The decision no.38 of 22nd municipal council has mentioned phase wise implementation of two waste concepts. However, the KMC has not

implemented this decision to date. The KMC has not initiated a system of collecting organic and inorganic waste separately at the source, as *table 3* shows that only 10 segregation bins have been distributed. Likewise, the SWMTSC has kept stock of 13 thousand 6 hundred and 38 segregation bin procured in FY 2013/14. Such practice has hindered reuse and recycling of waste and makes waste collection more expensive and reduces efficiency.

The KMC should comply the provision of law regarding the separation of waste by launching awareness and other incentive programs. Also the KMC should establish a system that allows waste segregation at the source.

10.2. The responsibility of the KMC to collect household waste within their territory can be met by applying various methods. The KMC has been applying following methods to collect household wastes:

- Door to door collection
- Vehicle collection
- Road based collection

At the same time, the KMC has made informal collaboration with the PSOs to collect household wastes. The *table 4* shows the involvement of KMC and PSOs in waste collection from all wards in KMC.

Table 4: *Involvement of the KMC and private organization in waste collection in KMC.*

The KMC	Private organizations	Jointly
12 wards	1 wards	22 wards

Source: *The KMC.*

Out of 35 wards, the KMC itself has been collecting waste from 12 wards, 1 ward has fully depended on PSOs and in 22 wards the KMC and private sector have jointly collecting the waste. But it has been found that those PSOs are involved without obtaining license as provisioned by the section 13 of the SWM Act.

10.3. As per data provided by the KMC, it has operated 7 trucks, 1 power trailer and 130 manual carts for collecting waste from the source. The KMC has prescribed various 134 routes for waste collection by vehicles throughout the municipal area. According to the KMC the number of vehicles available is insufficient for collecting waste. During the field visit of Environment Department of the KMC at Teku, a number of Hermetic Self Discharging Garbage Trucks are found unused since they were received in 2010. At the same time, during the field visit in ward no. 23 and 24 it was found that a KMC's truck, (given in *figure 3)*, has been used to collect waste from one depot in ward no.24 where the private sector waste collector is responsible for collecting waste because it has been taking service fee from all households within the ward for providing collection service.

Figure 3: *A vechicle collecting waste.*

Source: *Captured during the field visit.*

Based on the above observations, the KMC has not used all vehicles acquired by it and misused by providing undue service to private sector waste collector. Therefore, the KMC has no reason to justify that it has insufficient vehicles for waste collection.

10.4. The household waste should be collected in timely manner. As per information made available by the KMC, it has made schedule to collect household waste. According to the schedule, as mentioned in *table 5*, the KMC has arranged daily collection in all wards.

Table 5: *Waste collection Schedule of the KMC.*

Wards	Frequency of waste collection	Time of waste collection
All 35 wards	Daily	5-8 am in the morning, 1-4 pm in the day time

Source: *The KMC*

The KMC has mentioned that household wastes have been collected daily. During the field visit in ward no.23 some householders said that the KMC has been collecting waste 2 or 3 times a week. As per information made available PSOs are involved in collecting wastes in 23 wards (fully or partially) out of the 35 wards. They have been carrying out the solid waste collecting activities without submitting solid waste management plans, obtaining license from the KMC as per the Act's provision. These organizations have made schedules by themselves.

10.5. As per section 8(1) of the SWM Act, the KMC may make arrangement of necessary containers by prescribing collection centre at every *'tole'* or settlement to make a systematic collection of solid waste. The KMC has not prescribed collection centre within municipal area as per the SWM Act, neither it made arrangement of containers in public place. As per data provided by the KMC the amount of daily waste generation is 524 tons and out of that 516 tons of waste has collected. This means 8 tons waste remained uncollected per day. However, this may be underestimated by the KMC due to lack of scientific recording system. The study on "Solid Waste Management in Nepal" conducted by the Asian Development Bank (ADB) in 2013 (*table 6*) has revealed, that collection efficiency of the KMC is 86.90%. The uncollected waste has disposed either un environmentally, open burning or throwing the waste in surrounding open space and river banks. The study report categorically mentioned that, "Collection, city cleaning, and sweeping is not done on a daily basis except in main markets, along main roads, and in some residential areas. The rest of the areas are served intermittently from twice a week to twice a month or are not served at all. Many areas are neglected due to the inefficiency and inadequacy of the service." However, the data of ADB's report is related to 2 years earlier shows the efficiency of waste collection system of the KMC.

Table 6: *Solid waste generation and collection efficiency in the KMC.*

Average household waste (kg/day)	Average HH size (number of members)	Average per capita HH waste (g/capita/day)	Total HH waste (tons/day)	Total commercial waste (tons/day)	Total institutional waste (tons/day)	Average per capita MSW (g/capita/day)	Total MSW generation (tons/day)	Estimated waste collection (tons/day)	Collection efficiency (%)
1.10	**4.74**	**232.31**	**233.07**	**203.49**	**29.58**	**464.61**	**466.14**	**405**	**86.90**

Source: *Solid waste management in Nepal, 2013, the Asian Development Bank.*

Lack of sufficient awareness and coordination with private sector waste collectors as well as other managerial and institutional weaknesses has caused low efficiency in waste collection. Uncollected waste illegally disposed in open space and in the river or burning openly effect public health as well as the environment and the city appearance. Uncollected waste often ends up in the drain, causing blockage that results in overflowing

roads and other unsanitary conditions. The uncollected waste degrades the surrounding's environment and discouraging efforts to keep city clean and beautiful. Furthermore uncollected waste constitutes a risk to public health and to the environment. The *figure 4* shows the uncollected waste disposed into Bisnumati River.

Figure 4: *The uncollected waste.*

Source: *Captured during the field visit.*

10.6. The Government offices, schools, colleges, business complexes, shops/hotels/restaurants, industries/factories, hospitals/nursing homes are major producers of municipal waste. The KMC has the responsibility to manage such industrial and commercial wastes. Due to a lack of database, the KMC does not have information about how many such entities that are operating in the municipal area. The KMC mentions that it has provided a big sized container service to these entities by charging service fee. As per available information the KMC has provided container services for 28 entities as shown in *table 7*.These numbers are insufficient as only the number institutions and commercial services in Kathmandu is clearly higher. For example the number of sovereign embassies or international organizations in Kathmandu is 27.[1]The study on "Solid Waste Management in Nepal" conducted by the Asian Development Bank in 2013 has mentioned the composition of institutional and commercial waste as per *table 8*. However, the KMC have not provided separate containers to those entities for segregating waste at source. Lack of separate containers has created a risk that hazardous waste, for example bio hazardous waste from hospitals, is mixed with other types of waste. Not proper treatment of such hazardous waste creates a risk of damaging the environment, animals and the population.

Table 7: *The number of Institution and commercial entities getting service from the KMC.*

Type of entity	Number
Government office	11
Business complex	2
Education institution	2
Shop/hotel/restaurant	1
Hospital/nursing home	10
Embassy	2
Total	**28**

Source: *The KMC.*

Table 8: *Solid waste generation and collection efficiency in the KMC.*

(Figure in %)

Sources of waste	Organic waste	Plastics	Papers	Glass	Metals	Textiles	Rubber and leather	Others
Household	64.24	15.69	8.66	3.75	1.72	3.4	1.12	1.15
Institutional	20.29	24.55	44.28	1.37	1.13	3.89	1.14	3.35
Commercial	45.44	24.29	23.29	2.86	2.65	2.65	0	0.45

Source: *Solid waste management in Nepal, 2013, the Asian Development Bank.*

The KMC official has said that the entities other than above have been getting service from private sector waste collectors. The KMC has not been regulating and coordinating the service of private sector waste collector, and it is difficult to ensure whether the private sector is efficiently handling such waste including health institution related waste in an environment friendly manner. Since the KMC has no database of institutional and commercial establishments and only few of such entities are getting the service from it,

[1] http://welcomenepal.com/promotional/useful-contact/embassies-in-kathmandu/

the KMC should expand its coverage as well as regulate and coordinate the service provided by private sector waste collectors. Private waste collectors must have a licence issued by the KMC, which demands that the private waste collectors are done according to environmental rules.

10.7. According to the section 18 of SWM Act, 2011, the KMC may fix service charge and realize from the concerned person, body or organization for making the management of the solid waste on the basis of quantity, weight and nature of solid waste and other matters as prescribed by the Local Body.

The annual budget of the KMC passed by municipal council has proposed to collect sanitation and environment charge of Rs.25 million and Rs.35 million in FY 2012/13 and 2013/14 respectively. However, the KMC could not collect the charges as per estimate. Analyzing the information provided by the KMC, it seems to be able to clean, sweep and collect the waste in core city, main market, along main roads, parks and historical places. Other areas are served by the private sector waste collectors. They are collecting service charge from each service-receivers on the basis of quantity and nature of solid waste. As per information provided by the KMC, it has provided all services (sweeping and waste collection) to 12 out of 35 wards. The remaining 23 wards are dependent upon private sector waste collectors. The KMC has provided free of cost service (except container service) only to the citizens of 12 wards while other citizens living in 23 wards are receiving the same service paying the charge fixed by private sector waste collectors. It seems disparity in service within the KMC. The KMC does not provide the equal service to all citizens within the city.

Figure 5: *Trasfer Centre at Teku.*

Source: *Captured during the field visit.*

It is recommended that as per provision of law and pollutor's pay principle the KMC should charge service fee to all service-receivers on the basis of quantity, weight and nature of solid waste.

11. **Transfer Centre:** The SWM Act section 11, states that the local body may fix any location as a transfer centre to manage the solid waste collected at the primary site taking into consideration that the environment and public health shall not be adversely affected and the necessary provisions shall be made to manage the site against the bad odors. The KMC has operated one transfer centre in Teku having a capacity of 10 thousands ton in open space surrounded by residential area. Teku transfer station was visited by the audit team on August 22, 2014.It is observed that in transfer centre vehicles collecting waste from the sources unload onto the ground and then it is scooped up again by using excavators and placed into a large vehicle, *figure 5*, and transported to Sisdol landfill. The transfer centre was originally constructed with infrastructure for segregating various wastes and composting organic waste. However, it is observed that those infrastructures are not in used due to managerial problems. Being unable to use constructed infrastructure KMC could not strengthened the waste handling efficiency, reduce the transportation cost to landfill site and generate revenue from use of waste resources. The nearby people have complained that they are suffering from much health related problems like symptoms of vomiting, allergy, respiratory problem, bad odour etc. The situation of Teku transfer centre has becomes severe when the Sisdol landfill is closed by

various reasons. During the closure of landfill more waste remained at transfer centre for several days. As per information obtained from the KMC, the landfill site has been closed 51 days (19 days due to festivals, 9 day due to local disturbance, 12 day due to poor road condition and 11 due to other reason) during 15 March 2013 to 14 March 2015 due to poor road condition in rainy season and obstruction of local people for fulfilling their demands. During the visit by the audit team bad odour, littering waste around the centre and direct flow of leachate into the Bishnumati River was observed at Teku Transfer Centre. This cases risk to public health and environment. The KMC has claimed that it has made efforts to control adverse situations by not letting accumulation of waste in transfer centre, by spreading pesticides and anti-odour spray around the centre.

During the audit interview was taken with 48 persons living within 300 m. around the transfer centre. Among them 100 % has said foul odor, 98% has agreed with environment degradation around the centre, 92% has suffered respiratory or other health problem, 94% has said the KMC has not provide health care service to them, 98% has said the KMC could not collect waste in time and 96% has recommended to close the transfer centre.

As per discussion with the KMC in survey phase, it has come to our knowledge that there is land in Balaju for another transfer centre but the KMC could not operate that place as transfer centre due to local pressure. But the KMC has denied giving further information on that.

The KMC should operate the existing infrastructure for segregating various wastes and compost plant according to environmental regulations. The necessary resources should be given for segregating and recycling waste at transfer centre. Conduct feasibility study for transforming the open transfer centre into a closed one by developing necessary infrastructures as well as should make sufficient efforts to control foul odour and leachate flow.

12. **Transportation:** The transportation of waste from the transfer centre to landfill is a crucial part of SWM. The SWM Act, section 9(1) has provided the responsibility to KMC for transportation. The KMC and private organizations involved in SWM activities have been transporting waste collected by them. According to Rule 7 of the SWM Rules the vehicles using for transportation of solid waste should have following arrangements:

- Solid waste should not be visible, should not fall out and no seepage of liquid materials should be made,
- No leach and odor coming out of the solid waste,
- Solid waste can be easily loaded and unloaded,
- Conducive to road capacity and condition.

As per information received from the KMC in the month of Kartik, 2071 (Oct.18 to Nov.16, 2014) total 3 thousand 364 trips of wastes were transported to landfill which is 27 to 194 trips on a normal day. The range of daily transportation in that month could be presented as *table 9*. It shows that the variance in daily amount of waste transportation. On an average 111 vehicles/trips (21 from the KMC, 85 from private sector waste collector and 5 from Lalitpur Sub-Metropolitan City) of wastes have been transported from kathmandu to Sisdol landfill. As per received information from the KMC, 76.5% of vehicles are run by the private sector waste collectors. The most of them hired vehicles for that purpose which may not be complied with the above criteria. Section 9 (2) of the

SWM Act has provisioned that vehicle to be used for transportation of solid waste should be prescribed considering weight, age, ways or process, capacity of the road and the impact on the environment while transporting the solid waste. The KMC could not prescribe the type of vehicles for the transportation. Therefore, there exits risk of damage to the environment and local health during the transportation.

Table 9: *Transportation of solid waste to landfill.*

Number of trips per day	Days
No transportation	4
1 - 50 trips	1
51 - 100 trips	6
101 - 150 trips	14
More than 150 trips	6
Total	**31**

Source: *The KMC.*

While interviewing with drivers of the KMC it is revealed that 6 to 18 ton waste has been carried by per trip of transportation. As per information provided by the KMC it has been collecting 516 tons waste per day showing on an average 5.86 tons of waste had to be carried out by per trip (except Lalitpur Sub-Metropolitan City). This shows no reliable and compatible data between daily transportation and collection.

According to the KMC it has 21 vehicles (16 Ashok Leyland container truck, 4 Icher Tipper and 1 Tata container) for transportation of waste to landfill and it used to hire necessary vehicles as and when required basis. Most of those vehicles are old and having no facilities or arrangement as stated above. The problems of waste falling out, seepage of leachate and odour along the way are common due to overload, lack of proper covering and proper maintenance of the vehicles and gravelled road having potholes.

13. **Reduction, reuse and recycle:** Section 5 of the SWM Act, 2011states that any individual, organization or body shall as far as possible, reduce the production of solid waste by making arrangement for disposal on owns area or reuse of solid waste. Similarly, the Section 10 of the Act has mentioned that the Local Body (here the KMC) may, take necessary steps to encourage the reduction, reuse and recycling use of solid waste, by issuing necessary directives by coordinating with the concerned industry for its effective implementation. As per available data the KMC has collected 516 ton waste per day. The *table 10* depicts the types of daily collecting waste.

Table 10: *The quantity and types of daily waste collection in the KMC*

Types of waste	Quantity in ton
Organic waste	326.22
Plastic	55.72
Paper	46.54
Glass	27.96
Construction and demolition waste	23.22
Textile	11.87
Rubber	6.19
Metals	2.17
Others	16.07
Daily waste collection	**516**

Source: *The KMC.*

The above data shows that the major portion of the waste is organic which can be reduced by segregating and composting at household level, in collection centre and transfer station. At the same time, the large proportion of plastic, paper, glass and other materials provides a great opportunity of reuse and recycling. But the KMC neither issuing directives nor operate compost plant for reducing organic waste. Similarly, the KMC has

not system of recycling plastic, paper, glass etc. There was a compost plant at Teku Transfer Station but it was closed in 1990s. After closure, the KMC could not run the plant again which led more waste in landfill site.

As provisioned under the Act, 3Rs should be promoted to significantly reduce the amount of waste to be disposed of at landfill sites, thereby saving costs for final disposal and reducing public health and environmental risks. The public awareness on segregation of waste at sources, operation of composting and recycling plants in municipal and community level have been introduced and should be scaled up. Accordingly, steps for segregating waste at the transfer site should also be considered.

14. **Landfill site**: Land filling is the most common solution for handling either all the waste or the residuals that cannot be treated as a part of other waste processing methods, such as composting, incineration, etc. There is a wide range of landfills that vary from open dumps that create adverse environmental problems to soil, water and air to sanitary landfills that are a fully acceptable environmental solution. Landfills are usually divided into three different categories:[2]

- Sanitary landfill
- Controlled dump
- Open uncontrolled dump

A landfill can have a number of environmental impacts. Contaminated water called leachate can contaminate soil as well as ground water and surface water. Emission of landfill gas normally consists of approx. 50% methane, which has a green house gas effect 21 times stronger than CO2. Uncontrolled fires and toxic emissions are quite common if the landfill is poorly managed and are a major source of pollution. Furthermore, landfills often cause littering problems, poor aesthetics, odour, rodents, insects, traffic and noise.[3] According to law's provision landfill site shall operate in such manner that the adverse effect on environment should be managed effectively. Final disposal of waste is usually the last step in SWM. The KMC has been dumping the waste collected in municipal area in Sisdol landfill site. The following are the main audit observations on it:

Figure 6: *Sisdol landfill site.*

Source: *Captured during the field visit.*

14.1. As per section 12 of the SWM Act, the local body (here the KMC) shall, under the prevailing law relating to environment prescribe a sanitory landfill site for the management and permanent disposal of the solid waste collected within its area. Prevailing law provides the responsibility for prescribing and operating landfill site to KMC. The waste generated in the KMC has been disposed at *Sisdol* landfill site of Okharpauwa Village Development Committee (VDC) in adjoining district, Nuwakot. The site is about 26 km far from Teku Transfer Centre. Location of the site has been selected by Solid Waste Management Technical Support Centre (SWMTSC) and has come in operation since 2005. In the beginning, the site was proposed for lasting 3 years. Now it has revised the estimation time to 10 year by doing some expansion work.

[2] INTOSAI Working Group on Environmental Auditing: Towards Auditing Waste Management, appendix 1.

[3] INTOSAI Working Group on Environmental Auditing: Towards Auditing Waste Management, appendix 1.

The SWMTSC has been expended of Rs.31.43 million for 1st and 2nd phase of expansion of Sisdol landfill site from FY 2011/12 to 2013/14. The Sisdol was selected to dispose waste for short term period until the construction of Bancharedanda landfill, about 2km ahead from the Sisdol, is completed. Before the completion of new landfill the KMC has no option to Sisdol landfill, whereas the Sisdol landfill has seen almost filled up because it has been used since 7 years which of 4 years more than initial time estimation.

14.2. According to section 12 of the SWM Act, the KMC (local body) has the responsibility to operate sanitary landfill for disposing the waste generated in municipality area. The SWMTSC specially involved in land acquisition, distribution of compensation and physical construction, whereas KMC has involved in day to day operation of the landfill site. The involvement of two institutions for managing the same site could overlapping or avoiding activities essential for environmental protection and mitigation measures. Conversion of initially sanitary landfill into controlled dump has been caused by joint responsibility. The *figure 6* gives the view of Sisdol landfill.

14.3. During the audit both institutions have been solicited for their responsibilities and area duplication/ dispute/ misunderstanding between them regarding operation and management of the Sisdol landfill. Unfortunately, both of them remain silence about this issue. Because of joint responsibility and their silence it is difficult to point out which institution is responsible for what. Although as it is the responsibility of the SWMTSC to plan for a new landfill site, the KMC has little or no incentives to run the landfill site efficiently. For the remedy of this problem and making accountable to all situations, the overall responsibility should be transferred to KMC as provisioned in law.

15. **Operation of landfill site** is critical to environmental perspective. Therfore, the Environmental Protection Act, 1997 requires the approval of Environment Impact Assessment (EIA) before operating landfill site. This provision has been complied with regards to Sisdol landfill site. The mitigation provisions and present situation of the site is found as follows:

Figure 7: *Leachate treatment pond in Sisdol*

Source: *Captured during the field visit.*

15.1. As per SWM Technical Guideline leachate generated in landfill site is the main source of water, land and air pollution around the land fill site. So, there should be a provision of leachate collection and treatment. The process includes, mainly, construction of leachate liner, estimation of quantity and quality of leachate, collection and treatment system. The EIA report of Sisdol landfill site has fully acknowledged this process for mitigating water and air pollution. It categorically mentions for minimizing water and air pollution by,

- Constructing leachate liner in landfill site,
- Constructing leachate treatment unit (pond) and operating it effectively,
- Constructing separate drainage for rain water management in order to minimize leachate generation,
- Construction of separate underground drainage to prevent spring water pollution around landfill area,

- Prohibiting on discharge of untreated leachate to Kolphu Khola (Kolphu river),
- Restricting of littering of wastes around the landfill site.

During an field trip to Sisdol on 21 August, 2014, the landfill leachate management system was observed in poor condition. The leachate liner was found in almost collapsed, flowing leachate here and there on the road and other open spaces. The responsible authorities have not made estimate of quantity and quality of leachate production. Even though, there are two leachate treatment pond, the leachate is flowing directly into Kolpho Khola. The generator used for leachate treatment had already stolen and other machine left in the dry pound waiting for maintainace. The *figure 7* depicts the real scenario of the site.

Figure 8: *Scavengers are segregating waste at Landfil.*

Source: *Captured during the field visit.*

15.2. In the process of decomposition of waste, gases are generated in a landfill. Such gas should be managed properly. Therefore, the EIA report has specifically mentioned that gas venting facilities have been designed in such a way that the generated gas is released from gas venting facilities and burned. Landfill gas collection systems are designed as to minimize hazardous conditions that may result from the uncontrolled accumulation and dispersal of highly inflammable methane gas in a landfill. During an field visit it was observed that there were no gas venting facilities in the landfill. The SWMTSC has responded that feasibility study needs to be carried out to design gas venting facilities.

15.3. According to KMC's official about 300 scavengers are currently segregating, *figure 8,* the waste at landfill. This activity is in no part official, as the scavengers are putting their health at risk while also hampering the operation at the landfill. In July 2014 a female scavenger died as she was hit by a vehicle that was operating at the site. Locals are also letting animals feed at the landfill site, causing risk to themselves as well as the animals and obstructing operations. That the scavengers are making a small livelihood from selling the segregated waste is also proof that the management of waste is inefficient. No other segregation of waste was observed by the audit team.

As per above observations the SWMTSC and KMC have been found less sensitive to environmental mitigation measures mentioned in EIA report. The result is that Sisdole landfill site is not run according to the environmental provisions of the EIA, with leachate run off into the environment and a hazardous environment for the people at the landfill.

16. **Development of landfill:** As per Solid Waste Management Technical Guideline for Municipalities of Nepal prepared by the SWMTSC with the support of UN-HABITAT, various points need to be considered while developing a landfill. Some of them are all weather access road up to the site, leachate treatment system, landfill gas management and buffer zone. During the site visits of existing landfill and the new under construction landfill, the following facts was observed regarding the development of landfill site.

16.1. According to the SWM technical guideline the landfill should have all weather access road up to the site. The road from Kathmandu to Sisol landfill site is long and narrow with many curves and also prone to landslides. The access road from Teenpiple to Sisol is gravelled and especially during the rainy season it is difficult for heavy transportation. In

FY 2070/71 the KIM has authorized by the Government of Rs.120 million for the improvement of that road. But the KMC could not spend the disbursed budget for that purpose, and condition of road likely to remain as it is for upcoming year. Similarly, the condition of road within the site has also found poor. During the visit of the audit team at site in the month of August, 2014 some waste carrying vehicle was found stuck in the mud as shown in *figure 9*, halting operations.

16.2. Finally according to the SWM guideline, there should be a plan for a new landfill site after phasing out existing ones. The sisdol landfill site has been operationed since 2005 is now reaching to its capacity. The SWMTSC with the help of Government has choosen another site Bancharedada for landfills, about 2 km further from Sisdol. After completing EIA and other formalities, the centre has started construction of access road, diversion, bridge since FY 2013/14. In that year three contracts have been awarded for that purpose amounting Rs.85.28 million and made payment of Rs.24.87 million only. During the field visit it was observed that only the access road has been completed and diversion and bridge construction works have been proceeding in a slow pace. Other development works of landfill, e.g. ground bed, waste cell, liners, gas ventilating system, leachate collection and treatment system etc are yet to be started. So it is difficult to predict when the new landfill will complete. Since existing landfill has already crossed its time bound and almost exceeded its capacity, the construction of the new one should be kept in priority. For that the SWMTSC should prepare a timetable for the construction of work allocating adequate resources and establishing system to monitor the construction work.

Figure 9: *Waste truck struck in mud at Sisdol*

17. **Institutional and Managerial Aspects:** As per SWM Technical Guide institutional and managerial arrangement should be made for efficient management of solid waste. Clear role and responsibilities, updated policies, strategies and directives on SWM, adequate and efficient management tools as well as monitoring and follow-up mechanism are necessary for management of solid waste.

17.1. As per SWM Technical Guide, the KMC should prepare a plan comprising of all elements of waste stream. The plan incorporates basically, strategic plan and operational plan. The strategic plan provides an overall framework and direction for SWM, whereas operational plan provides detail activities with resources for the achievement of strategic objectives. On examination it is revealed that the KMC has not prepared a strategic plan nor operational plans for managing solid waste in an integrated manner. In the absence of these plans, the KMC has no clear cut vision, mission, goals and objectives for SWM. The KMC has been conducting SWM in an unplanned and adhoc manner. Unplanned management of solid waste has resulted adverse impacts on environment and public health.

17.2. Policy, plan, strategy, standard, guidelines, manual, directives should be developed and implemented for managing solid waste efficiently and effectively. There is no updated national policy of SWM. The SWMTSC has informed it has formulated a new national policy of SWM and submitted to Urban Development Ministry in order to get approval from the cabinet. But the SWMTSC could not provide details about when it would submit the draft for approval and why approval process is being delayed. The SWMTSC

has developed "SWM Technical Guideline for municipalities of Nepal" with the support of UN-HABITAT. This guideline covers step by step procedure to manage each stream of solid waste i.e. prevention, generation, collection, transport and disposal. The KMC who has the overall responsibility of SWM activities within its area have not developed any kind of policy, operational manual and directives for guiding waste management activities.

In order to increase the efficiency, effectiveness and sustainability of solid waste management in KMC, strategic and operational plans for SWM should be prepared, implemented and monitored by the KMC.

17.3. According to section 3(1) of the Solid Waste Management Act, the the KMC is responsible for the management of solid waste by construction and operation of infrastructure like transfer station, landfill site, processing plant, compost plant, biogas plant and also collection of waste, final disposal and processing. It is revealed that the KMC is involved in collection, transportation and final disposal of waste, as well as in operating the transfer station in Teku. The KMC has not constructed any processing plant, compost plant or bio-gas plant. While interviewing officials of KMC it is briefed that it could not construct and operate processing plants due to lack of proper land, technology, infrastructure and coordination, thereby not fulfilling its tasks according to the law.

Regarding the landfill site, it was briefed that the KMC has been disposing waste only at Sisdol landfill site. Construction part of the landfill is undertaken by SWMTSC and the KMC is only involved in the operational part. It could be not verified what sort of efforts was made to end during past few years.

As pointed out above paragraphs, all kinds of wastes are being disposed at Sisdol landfill site because of lack of establishment of processing plants and composting plants. The heavy portion of organic waste, bad odour and large quantity of leachate in landfill site have severely affected environment around the landfill site and risk to local people's health.

The KMC has to fulfill its role and responsibility by constructing and operating composting and processing plants and by adopting modern technology.

17.4. SWM requires adequate and sufficient human and financial resources. The human resources should be competent and skilful to handle the solid waste. The KMC has established separate department for managing solid waste activities. As shown in *table 11*, the human resources deputed in the department is 1111 in number.

Table 11: *Human Resource involved in SWM in 2014.*

Post	Number
Department Chief	1
Division Chief	2
Engineer	5
Section Officer	3
Administrative Personnel	36
Junior Engineer	3
Municipal Police	19
Driver	135
Sweeper	828
Other	79
Total	**1,111**

Source: The KMC

According to the KMC the human resources are inadequate for managing solid waste. However, the KMC could not mention what types of resources are inadequate and what activities will do with more human resources. The KMC has provided data as shown in *table 12* about the utilization of manpower.

Table 12: *Manpower allocation in the field in Kathmandu.*

Particular	Number	Total area/Length	Number of Manpower
Durbar square	1 (Hanuman Dhoka)	Data not available	10
Temple Area	10 (Main)	Data not available	No manpower deputation
Park	5 (The big one)	Data not available	48
Road	The road from where wastes are collected by vehicle	Data not available	828
Other	River banks (Bagmatee, Bishnumatee, Dhubi Khola)	Data not available	No manpower deputation

Source: *The KMC*

Table 12 shows that the KMC has limited or no information about the area and length of road served by above manpower as well as the workload assessment of each manpower. Due to lack of workload assessment it is not possible to determine whether manpower are sufficient for assigned work or not, or to assess the effectiveness of the work. The KMC has not deputed separate manpower in cleaning up the river banks which are the main area of illegal dumping.

The personnel involved in SWM activities should have competency in managing all stream of SWM e.g. prevention to final disposal. The capacity development program should be framed to build competency. As per information provided by the KMC only four personnel have got short term training on SWM and selection of landfill site from India and Nepal.

Due to insufficiency of existing manpower, the KMC could not mobilize available manpower SWM and has also affected the efficiency in SWM. Thus, the KMC should determine required manpower to handle the increased volume of wastes through organization and management survey or other similar survey. It should establish clear cut policy and procedures to mobilize the available manpower efficiently and make necessary arrangement for enhancing the competency of the existing personnel.

17.5. Financial resources are vital for every activity; the same is true in SWM. The KMC should allocate sufficient budget for SWM purpose. The *table 13* depicts the annual allocation on SWM as compared to total budget for previous three fiscal years.

Table 13: *Amount of budget allocated to SWM as compared to annual budget in KMC from 2011/12 - 2013/14*

Fiscal Year	Annual budget	Budget allocated to SWM	Percent
2011/12	1,900,000	462,600	23.36
2012/13	2,215,700	482,960	20.24
2013/14	2,630,894	621,700	23.32

Source: *The KMC.*

The table 13 shows that the KMC has allocated between 20.24 and 23.32 percent of its total budget to SWM from 2011/12 - 2013/14. However, the allocated budget could not be fully utilized. The *table 14* shows that there has been under utilization of allocated budget in SWM in the period from 2011/12 - 2013/14.

Figure 14: *Allocation Vs expense in SWM*

(Rs.'000)

Category of expenses	2013/14		2012/13		2011/12	
	Budget	Expenses	Budget	Expenses	Budget	Expenses
Salary and other facilities of sanitation personnel	290000	279463	254100	253408	252000	244571
Landfill/Transfer station management	138100	6143	30150	8836	20000	7370
Fuel	90600	79398	84000	82935	70000	74022
Maintenance	26900	10951	35000	24441	30000	25301
Community mobilization	14350	1623	20725	2034	19000	4480
Other	61750	25445	58985	26888	71600	44246
Total	**621700**	**403023**	**482960**	**398542**	**462600**	**399990**

Source: *The KMC*

Due to low expenditure on 'Landfill/Transfer station management,' 'Community mobilization' and 'Other' heads the KMC could use 64.83 to 86.47 percent of its budget allocated to SWM as per *table 15*. The major portion, e.g., 61.14 to 69.34 percent, of expenditure was incurred in salary and other facilities for sanitation staff. It is followed by expenditures for fuel and maintenance of vehicles which has occupied 22.42 to 26.94 percent of total expenditure. These two categories have occupied 85.98 to 91.76 percent of the total expenditure. This expenditure pattern makes clear that the KMC has given focus on collection and transportation of waste. The landfill/transfer station management and community mobilization get least priority.

Table 15: *Category wise expenditure in SWM activities.*

(Rs.'000)

Category of expenses	2011/12		2012/13		2013/14	
	Expenses	Percent	Expenses	Percent	Expenses	Percent
Salary and other facilities of sanitation personnel	279463	69.34	253408	63.58	244571	61.14
Landfill/Transfer station management	6143	1.52	8836	2.22	7370	1.84
Fuel	79398	19.70	82935	20.81	74022	18.51
Maintenance	10951	2.72	24441	6.13	25301	6.33
Community mobilization	1623	0.40	2034	0.51	4480	1.12
Other	25445	6.31	26888	6.75	44246	11.06
Total	**403023**	**100**	**398542**	**100**	**399990**	**100**

Source: *The KMC.*

In fiscal year 2013/14 the KMC has received Rs.130 million for the improvement of access road to Sisdol landfill but due to delay in contract management it could not spend about Rs.80 million which was freezed at the year end. The KMC has selected contractor and provided mobilization advance but could not complete the work as per work schedule of contract.

17.6. The solid waste management activities should be monitored and follow up activities should be done adequately. The solid waste management Rules, 2013 has made provisions related to the monitoring. It has commissioned a six member central level committee to monitor relating to the segregation, processing, discharge and disposal of the solid waste. The committee consists of members from the Ministry of Local

Development and Federal Affairs, the Ministry of Environment, Science and Technology, the Ministry of Urban Development, the Ministry of Health and Population and SWMTSC. An analysis of minutes from the meetings held by the committee shows that it has not monitored the solid waste activities of the KMC since its establishment.

Similarly, according to the section 25(4) of SWM Rules, 2013 the KMC has to make follow ups on the following matters:

- Whether the measures and technology for the reduction of solid waste at its source is followed or not,
- Whether the process prescribed for the reduction of solid waste by the local body related to reuse, and recycling use of solid waste has been followed or not,
- Whether the solid waste has been segregated at its source and that the segregated waste is discharged according to the prescribed place, time and manner or not,
- Whether the matters prescribed by the KMC related to the management of waste has been obeyed or not.

According to the KMC, it has monitored SWM activities and the follow up is being carried out regularly and reports have been received from the wards. However, our examination shows that the KMC has not prepared schedules and procedures for follow up activity and it could not furnish information about how many times it has monitored and undertaken follow up activities during the past three fiscal years. So, the claimed follow up is sporadic in nature.

Inadequate and unsystematic monitoring and follow up could have effects on stream of solid waste management. So, the central level committee, itself should monitor and follow up solid waste management of KMC and other municipalities in Nepal as envisioned by the Rules. The KMC should also ensure a more systematic monitoring and follow-up as a basis to improve the solid waste management by the municipality.

17.7. As per EIA report of Sisdol landfill, three types of monitoring are required in each phases of project implementation. They are impact monitoring, compliance monitoring as per EIA recommendations, and compliance monitoring as per the national environmental standards. Monitoring indicators for physical, biological and socio-economic environments have been identified with specified methods of monitoring and frequency of monitoring. At the same time, the report has provisioned that the Ministry of Population and Environment shall prepare a post environmental audit report after two years of the completion of construction as per the Environment Protection Rules, 1997. According to the KMC and SWMTSC such types of monitoring and audit have not been carried out.

Noncompliance of above provisions shows that the concerned authorities are not committed to landfill operation in environment-friendly manner leading the condition of landfill worse.

17.8. As mentioned in EIA report of Sisdol landfill, the Ministry of Science, Technology and Environment, the Ministry of Federal Affairs and Local Development and the Ministry of Industry and Commerce and Supplies have some kind of direct institutional set up and responsibilities for the waste management. It further states that all the institutions need to be brought into the framework of waste management. A clear demarcation of roles and responsibilities between the MOUD, MOFALD, KMC and SWMTSC need to be defined and applied.

17.9. Chapter 4 of the SWM Act, 2011 has provisioned about involvement of private and community sector in the management of solid waste. For that purpose, the interested parties should obtain licence from the KMC. According to the KMC, there are 18 private organizations involved in waste collection and disposal activities without a licence. As mentioned in Para 10.2, those private organizations have provided their services in 23 wards in collaborating with the KMC. Though it is contrary to the Act's provision, the KMC has remained not taken action as per provision of the Act.

Similarly, as per SWM Act, the KMC has not forged a partnership with private sector, community and non-governmental organizations for SWM work like promotion of public awareness for reduction of solid waste, collection of solid waste, management after the closure of landfill site, construction of the garden and beautification.

The Act has another provision about awarding contract of solid waste management by making competition. The KMC has not yet followed this provision. The KMC has informed that the Investment Board has sent a letter to it for not awarding any kind of contract for the purpose of SWM. It seems that the KMC could not encourage private participation in SWM. Therefore, the KMC should involve the private sector in SWM in a coordinated manner.

Conclusion

Solid wastes have been increasing gradually with the urbanization in Kathmandu. The KMC has the main responsibility to manage municipal waste. The Government of Nepal, other concerned Ministries and the SWMTSC also have direct and indirect responsibilities regarding solid waste management in Kathmandu. Huge amount of uncollected waste and open burning of waste are found due to practice of mixing waste, lack of reduction, reuse and recycle system, disparity in service to the citizens, inefficient collection and transportation system, multiple handing of wastes, poor condition of access road to landfill, lack of environment-friendlily management of transfer centre and landfill, local people's pressure to close down the existing landfill and delay in construction process of new landfill, lack of awareness and inadequate capacity development program, informal involvement of private waste collectors.

Audit evaluation shows that the KMC has weaknesses in its management regarding follow-up and monitoring, lack of capacity/plans/strategies to recycle and exploit the recycle possibilities at Teku and thereby reducing the total amount of waste, and exploiting waste as a resource. The KMC has not been able to run Sisdole according to rules and regulations with (possible) severe consequences for the environment and the surrounding areas. Further, the KMC has failed to determine an alternative site to Sisdol in due time. This process is overdue now and it will pose a major challenge to the kathmandu city and its inhabitants if Sisdol is close down before finalization the new site.

Strategic and operational plan formulation, waste separation measures and 3Rs of waste need to be implemented to dispose of only the non recyclable waste in landfill for management of solid waste efficiently and environment-friendly manner.

List of abbreviations

SWM	**:** Solid Waste Management.
KMC	: Kathmandu Metropolitan City.
MOUD	: Ministry of Urban Development.
MOFALD	: Ministry of Federal Affairs and Local Development.
SWMTSC	: Solid Waste Management Technical Support Centre.
PSOs	: Public Sector Organisations.
FGD	: Focus Group Discussion.
MOPS	: Matter of Potential Significance.
ADB	: Asian Development Bank.
EIA	: Environmental Impact Assessment.
IEA	: Initial Environmental Assessment.