

기술자료

Solid Waste Management of Nepalese Municipalities

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네팔 지방자치단체의 폐기물관리 정책

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Abstract

네팔 지방자치단체의 고형폐기물 관리 부서는 도시계획 및 개발국이나 환경위생 부서 또는 일반 복지 부서에서 담당한다. 네팔에는 폐기물관련법과 기준, 지침이 제정되어 있으며 지방자치단체법에 의해 지방자치단체 여건에 맞게 관련 법률 조항을 개정할 수 있다. 네팔에서 발생하는 가정폐기물의 65%는 유기성 폐기물이나, 폐기물 관리는 아직 체계화되지 않고 있다. 지방 NGOs와 일부 부락이 분리수거와 퇴비화를 실시하고 있으나 병원폐기물과 같은 유해폐기물의 경우 병원이 자체적으로 소각하고 있으며 지방자치단체의 의해 적절히 처리되지 않고 있다. 현재 네팔에서는 폐기물이 비위생 매립 방식에 의해 처리되고 있어서 지방자치단체에서 이를 금지하고 위생매립지를 확대 설치할 계획이다. 그럼에도 불구하고 기술 및 전문인력, 예산의 부족, 민간자본 및 시민들의 참여 부족으로 인해 지방자치단체가 설정한 폐기물관리 목표를 달성하지 못하고 있는 실정이다. 네팔 지방자치단체들이 당면한 시급한 과제는 지속가능한 폐기물관리 계획 및 전략의 수립이다. 네팔 지방자치단체의 폐기물관리 계획은 폐기물의 적정 처리를 위한 제도적 측면의 강화는 물론, 폐기물 분리 배출 및 수거에 시민들의 동참을 이끌어내고 이해관계자의 참여 확대, 폐기물 처리 비용, 폐기물 처리를 위한 적정기술의 개발과 같은 내용을 포괄할 수 있어야 한다.

주요어 : Solid Waste Management (SWM), Policy and Legislation, Nepalese Municipalities, Waste Minimization

I. Introduction

In 2011 Government of Nepal restructured 161 Village Development Committees (VDCs) into 41 municipalities. With addition of 41 municipalities, the number of municipalities across the country has now reached 99. The increased urbanization is putting immense pressure to municipal services. One of the problems of the urbanization, population growth and increasing consumerism is the increased generation of waste. The local municipality is responsible for managing solid waste generated from households, small industries, commercial and institutional establishments, street sweeping and yard [1]. However, these wastes are not being adequately managed and are thus, creating a serious environmental problems and health hazards.

The functional elements of an engineered solid waste management system should include the attributes such as waste generation, collection, transfer and transport, processing and recovery, and finally disposal [2, 3]. There are two basic reasons for the growing quantity of solid waste in the municipalities in Nepal. Firstly, increasing opportunities and activities resulting urbanization in non-agricultural sector has led to increased solid waste generation in the municipalities. Secondly, changing consumption patterns has also contributed to the increased generation rates. Increasing use of packaged food items, electronic products, plastics and other modern household appliances are some of the examples indicating the changing consumption pattern [4]. In addition to these, hazardous waste is another concern. Unmanaged disposal of medical wastes is also creating pollution and health hazards in the localities. In the absence of formalized waste segregation practices, recycling has emerged only as an

informal sector using outdated technology, which causes serious health problems to waste pickers [5]. The present study analyzes the current waste management practices in the municipality of Nepal. The public policies and legislation governing the management of every kind of municipal waste in Nepal has been described. Furthermore, various programs of the municipalities in overcoming with the problems and managerial aspect of the municipality in waste management have been discussed.

II. Policies, legislation and regulations

The main legislation under which a municipality functions is the Local Self-Governance Act, 1999 [1]. There are also other laws, standards or guidelines to govern municipal waste management which provides some provisions on the related aspects. According to the Local Self-Governance Act and its regulations, municipalities can, however, develop by-laws to suit their needs. Some municipalities have developed municipal by-laws and few municipalities have developed separate guidelines for waste management [6]. These waste management guidelines describe the municipal waste management strategy, clarify responsibilities and lists the amount of fine to be collected for various types of wrongful acts and addresses issues such as waste segregation and storage at the point of generation, recycling, composting, land filling and hazardous waste management. However, its contents are guided by national policy, scope, importance and the existing local practices in the community. Laws and acts and special authority to local government have provided an adequate mandate to take necessary action to manage waste of their

respective area. [6-8]:

1. Health care waste management guidelines

In 2003, the Nepal Health Research Council produced National Health Care Waste Management Guidelines in collaboration with the World Health Organization (WHO). The guidelines provide a minimum standard for safe and efficient waste management for health care institutions. It incorporates the WHO guidelines on emission standards for incinerators. The guidelines set out the key strategies of waste management in health care institutions, but not for other sources of medical waste. The guidelines lay the primary responsibility of health care institutions. The establishment of a waste management committee at each institution and the development of waste management plan are the means of implementing waste management. The guidelines also set out the concepts of waste segregation into several streams, labeling and containment, handling, storage and transport, treatment/disposal, occupational health and safety, training, and implementation aspects.

Soon after the publication of the National Health Care Waste Management Guidelines, the Ministry of Health completed a study on health care waste management. The weakness of the study is that it focuses on the public health system and ignores private health care facilities. The study comes down in favor of final disposal in municipal facilities and the guidelines considered the MLD to have a vital role in the national health care waste management strategy. Under the Local Self-Governance Act, municipalities have significant responsibilities for health care management, and are themselves generators of health care waste. The guidelines rightly point

out that locating incinerator within health facilities is impracticable and unacceptable on environmental grounds. The study also highlights two requirements for regulations:

- * Regulations on health care waste management.
- * Environmental standards for air emissions from incinerator plants for health care risk waste.

2. Waste management policies in the Republic of Korea

Government of the Republic of Korea has introduced the Volume-based Waste Fee (VBWF) system and packaging waste policy [14,15]. Use of disposable items and excessive packaging has been discouraged. Vinyl bags were charged more prices to reduce its use and to promote the use of reusable grocery basket. Under the VBWF system, households and commercial sectors are required to purchase designated VBWF bags to dispose their garbage, whilst recyclables are collected free of charge. Producers were encouraged to use re-usable and environmentally friendly packaging materials. The producers have a responsibility to collect specific refuse (e.g. glass, cans, packaging etc) from segregated household waste that are collected by municipalities. As a result, demand for refilling and recyclable materials was increased as both producers and consumers liked these items. After the implementation of these policies, the generation of municipal solid waste (MSW) has been dramatically declining.

During the period of 1994-2006, waste generated was decreased by 15.95 percent total. The quantity of recyclable waste generated was increased as much as 15,661 ton/day (175.4%) during the past 10 years. The pattern of waste generation, public awareness towards waste dis-

posal, as well as, the behavior of consumers and producers have been changed and there was an enhancement of the waste collection administration [14, 15]. Producer, generators and institutions all have responsibilities in recycling, reusing and reducing waste. Although the administrative cost for managing waste was increased, and policies created inconveniences to consumer and producers, Korea has achieved success in reducing wastes generated at source. Nepal can also formulate and effectively implement appropriate sustainable SWM policies and programs in order to effectively address the problems. However, it should be remembered that the overall cost of managing solid waste in developed countries like the Republic of Korea is very high as compared to that in most of the developing countries.

III. Waste processing

Introduction of proper solid waste management is a problem for any municipality. Studies conducted by various researchers show that the sustainable solid waste management is a complex process and thus requires a holistic management approaches. Troschinetz et al., found twelve factors influencing for the sustainable recycling of municipal solid waste [16]. Among these factors MSWM personal education, waste collection and segregation, finances, government policy and household economy were the biggest barriers whereas economic status was the smallest barriers. The waste handling becomes complicated and the processing cost will be higher if they are not segregated properly at the source. The situations become more complicated and, in certain cases, even impossible to process them if they are mixed with hazardous waste such as hospital or

pharmaceutical waste, pesticides, industrial chemicals and heavy metals. Solid waste management is now regarded as more social problems rather than technical and if managed properly can provide various benefits such as employment creation, increased economic benefit and minimize health and environmental hazards [16, 17].

1. Waste minimization: composting, recycling and reuse

In Nepal, organic fraction of solid waste is generally higher; composting is the best solution as far as practicable. It is found that rural areas (15% to 100% households) are practicing it but in urban areas (less than 10% households) where less land is available within household, it is generally not practiced. However, community or municipal composting exists to some extent and also in the planning phases in some municipalities. Open pile composting is in practice in many rural and semi-urban areas. Recyclable waste such as plastics, metals, glass, cartoons and e-waste has a good marketable value. However, due to lack of awareness, they are not recycled in a scientific way. Waste pickers are collecting recyclables at the transfer station, collection points and disposal sites. Furthermore, some itinerant collectors collect recyclables from the households. As, waste collection of newly formed municipalities and that in the semi-urban area is poor and irregular, the packaging wastes (plastics, papers and rubbers) are often burned which may lead to various environmental problems. Table 1 shows that most of the people think that the solid waste management is the major problem [18, 19]. However, the study shows that waste handling costs can be reduced and the amount of waste generated can be greatly reduced.

Table 1. Public opinion on environmental pollution in the urban area

Major environmental problem in urban area	^a Percent respondent (survey among 3980 urban residents)	Major environmental problem in Pokhara	^b Percent respondent (survey among 486 families)
Solid waste	59	Solid waste	37.04
Sewage	25	Water pollution	15.43
Water pollution	5	Air pollution	34.98
Air pollution	7	No response	12.55
Other	4		

Source: ^aCentral Bureau of Statistics (1997), ^bParajuli B.K. (2000).

Table 2. Composition of solid waste at Sisdole (Kathmandu valley), Pokhara and Karaute Danda landfill site

	Sisdole	Pokhara	Karaute Danda
Total waste disposal (T/day)	353.5	61.9	6.96
Per capita waste disposal to landfill (kg/person.day)	0.3	0.255	0.12
Organic (%)	61.86	49.12	65.81
Plastic (%)	12.0	12.71	8.42
Paper (%)	10.34	9.67	12.24
Glass (%)	3.31	5.6	3.06
Rubber and leather (%)	0.83	4.17	0.37
Textiles (%)	5.28	7.59	3.83
Construction and demolition (%)	3.98	4.5	4.59
Metals (%)	0.21	1.14	0.15
Others (%)	2.2	5.5	1.53

Source: Thapa Bijay and K. C. Ajay Kumar (2011) [20].

1) Recycling

The potential for recycling Nepal's municipal waste is high because much of it is recyclable [21]. Furthermore, there is a market for most recycled materials. The composition of MSW is shown in Fig. 1. On average, about 65% of household waste generated in Nepalese municipalities comprises organic matter, with about 22% being recyclable inorganic materials such as paper, plastic, glass and metals and only 9% comprises inert materials. As about two thirds of the waste is organic, recycling through composting, or the application of other appropriate technologies, can play an important role in waste management [19].

Some municipalities and NGOs have encouraged separation, collection and recycling of plas-

tic waste using suiro, metal hooks. Some municipalities encourage households to segregate waste so that itinerant traders can collect and sell them. Some NGOs have started reusing materials such as paper, cigarette packs and plastic in developing packaging materials and cards etc. Some smaller municipality is forming community user groups in conducting activities to raise awareness on waste minimization and promoting recycling and composting. These small efforts could be milestones in awareness creation and development of appropriate and low cost technologies and could enhance for further replications [3,21].

The processing of solid waste includes mechanical reduction by compaction, thermal reduction by incineration and manual separation, mainly at source. The compaction requires equip-

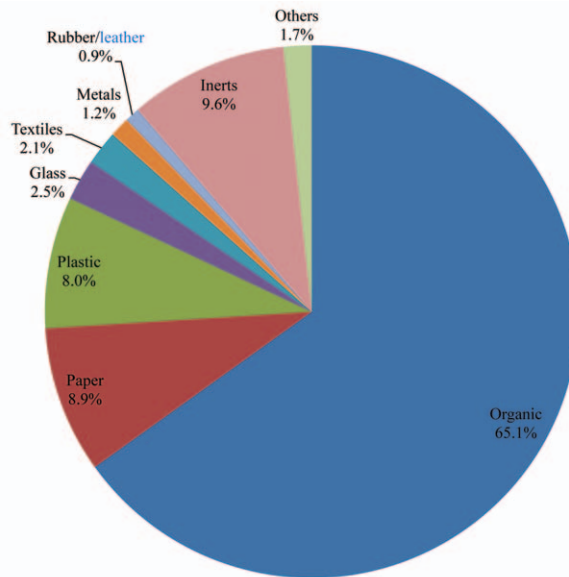


Fig 1. Composition of household waste in Nepalese Municipalities (SWMRMC (2008)).

ment, which are only available in the Kathmandu metropolitan city.

2) Composting

Organic waste is the largest component of the waste stream and is responsible for problems such as odors, disease vectors, headache, and methane. Composting can significantly reduce the cost and environmental impacts of waste management. There are examples of composting at the household, neighborhood, and municipal levels [7, 21].

There have been various attempts by NGOs and municipalities to encourage households to compost their organic waste. These attempts involved a combination of issuing composting bins at a subsidized price, promoting the concept to target households, and establishing a system for selling the compost. In particular, five municipalities in the Kathmandu valley have promoted household composting through the supply of subsidized home compost bins. However, only 1.6 percent of households are using the bins. It is

unlikely that waste composting by households on a large scale will ever be feasible. This is especially true when waste management is seen as the Government's responsibility; managing waste through household composting thus requires behavior and attitude modification.

There are examples of community programs collecting household waste and processing it by composting and recycling. In 1992, a few housewives in Lalitpur organized the Women's Environment Preservation Committee (WEPCO) to manage their solid waste [3]. Beginning in their neighborhood, where municipal waste collection was inadequate, they promoted environmental awareness and waste segregation among other housewives since, in Nepal, kitchens account for most organic waste. WEPCO then organized door-to-door collection of segregated household waste, which was then composted, recycled or dumped. After an initial period of free collection, WEPCO was able to charge a small monthly fee (up to US\$ 0.75/household,

though low-income households were exempted). The full-time waste collectors use tricycle carts to collect waste every other day from more than a thousand households. WEPCO collects about 1t of garbage per day, from which a manual pit and pile composting and screening operation produces 2t of compost each month. Compost is sold through local vendors at NRs10/kg, mostly to local residents or offices for use with indoor plants or small-scale landscaping. Although other neighborhoods in the Kathmandu valley have replicated the WEPCO model, it is not without constraints. Usually, not all the compost can be sold, and compost production must be subsidized by waste collection fees, paper recycling, and occasional donations.

Institutional composting: From 1984 to 1991, Kathmandu Metropolitan City (KMC) operated a composting plant at Teku, using outdoor windrow composting and mechanized screening with the intention of selling the compost. However, high broken glass content of the municipal waste input made the compost difficult to sell. Due to the lack of an established buffer zone, people moved into areas adjacent to the plant and then lodged odor complaints, forcing the plant's closure in 1991. In 2005, KMC established a new composting plant at Teku in cooperation with Pesticide Monitoring Nepal (PEMON) and Clean Energy Nepal under assistance from Clean Kathmandu Valley Study—a joint initiative of GoN and JICA. Waste from Kalimati market, Kathmandu's main wholesale vegetable and fruit market, is the raw material. Compost is produced in so called honeycomb boxes, in a chamber house, in bins, piles and in vermi-composting tanks. Initially, it was intended to degrade the raw material aerobically using

microorganisms as an activator for two to four weeks before feeding the partially decomposed material to worms. However, this scheme was not satisfactory. They switched to feeding vegetable waste directly to the worms. The capacity of the plant was about 6t/day, but output has never been more than about 2t/day.

The Bhaktapur Development Project established a composting plant in 1978 with the assistance of the Urban Development through Local Efforts (UDLE-UNDP) program. Bhaktapur municipality took over the plant in 1981. However, it did not have sufficient incentive to compost its waste and production gradually declined until ceasing in 1984. In 1988, the compost plant was rehabilitated and municipal staff trained to operate it with the assistance of the SWMRMC. Since then the municipality has continued to operate the plant with occasional technical assistance from SWMRMC. The plant is situated in a community mostly inhabited by the sweepers. The site was chosen because it is a bit away from the city center; while still close enough to the source of waste. There are a few houses nearby, but the residents are mostly sweepers who are used to working with waste, and there are no complaints. Analysis of the plant, however, indicates that, with some improvements in composting techniques and management, the plant can sustain itself and can be a model for other municipalities in Nepal [7].

Tribhuvannagar municipality operates a composting facility at its landfill site. Municipal laborers separate the biodegradable waste and tip it into the trenches for composting. Compost from the landfill site is sold for NRs300 per 10ft³ load and plastic and rubber are sold for NRs.13/kg (2008 prices) [3,21]. The communities of Hetauda,

Dhangadhi, Butawal and Biratnagar municipality are going to operate a composting plant under Public Private Partnership Modality. The lesson learned in the past clearly showed, institutional composting had problems due to the NIMBY feelings among waste generators and lack of accountability to the citizens.

3) Transfer site and landfilling

The transfer sites are not available in major municipalities except in Kathmandu, Lalitpur, Janakpur and Biratnagar. This may be due to fewer distances of the disposal sites from the urban center. If composting and other processing practices are introduced, then need of transfer site would be justified, so that sorting activities can be carried out at transfer sites.

Most of the municipalities do not have well defined disposal sites. The disposal sites are mainly riverbanks, depressed land, open pit or temporary open piles. This shows that awareness of proper way of waste management is still lacking. The public and community, where disposal is to be done, needs to be taken into confidence and they need to be made aware of the proper handling of wastes and compensation and the authorities need to adopt feasible measures of disposing wastes considering the social, economic and technical aspects. Till date the 26 municipalities have not planned for a landfill site, but other 32 municipalities have proposed, planned and made arrangements for landfilling. Seven municipalities have approved their IEE and some municipalities have submitted their EIA report for approval. The problems faced by the municipalities regarding construction of a landfill include waiting for approval and government decision for land acquisition, strong objections from affected families, lack of technical competencies of the

municipality, financial problems and lack of external support (technical and financial assistance from central government) etc. The political interferences have also been observed in many municipalities. For Kathmandu Valley waste disposal, Banchare dada landfill has been proposed, after closure of Sisdol landfill since 2000. KMC is going to construct a short term landfill site at Aletar in Nuwakot district. Awareness activities and program development, at present, show that there is necessary to have a sanitary landfill in most of the municipality. There are options in selection of landfill sites in many municipalities. But institutional, financial, management as well as technical competencies, public and political commitment, if could be streamlined, landfills could be developed in a few years time. The technical aspects of landfill need to be assessed properly and sustainable technologies need to be introduced as developing country like Nepal may not be able to run the system that has been developed for OECD countries.

IEE for a sanitary landfill project of Bhimeshwor, Putalibazar, Ilam, Tansen, Gulariya, Ramgram and Dhankuta municipality has been approved. Similarly, a sanitary landfill site for Kathmandu Valley's solid waste management is decided to dispose at Banchare Danda. The EIA report is under the approval committee at the Ministry of Environment, Science and Technology.

4) Hazardous and special waste management

The types of waste under special waste beside municipal wastes are mainly medical waste, dead animals, construction and industrial wastes. The main types of hazardous waste generated are medical waste, obsolete pesticides, batteries, and a few types of industrial wastes. Most of these wastes are often mixed with other garbage and is

either dumped or burned in ordinary kilns. Obsolete pesticides or pesticide containers are also a hazardous waste. Currently, about 43 cylinders of methyl bromide (each contains about 50kg methyl bromide) and 75tons of hazardous date expired pesticides are stored at different warehouses. The yearly consumption of insecticides and pesticides in the country is approximately 200tons of active ingredients. The environmental statistical data indicate that, although the amount of pesticides consumed in the country is relatively small, mismanagement of pesticide waste is a problem. Used batteries, e-waste and battery manufacturing industries are another source of hazardous waste because of the heavy metals they contain [19]. As e-waste and battery of electronic appliance (except dry cell) have certain scrap value, usually the households themselves sell them to the itinerant collector.

All used wet batteries from vehicles are sent to India for recycling, while dry cells are normally disposed of with other municipal waste. It is observed that for medical waste, incineration is done in the majority of municipalities by the hospitals themselves. The usual practice was to burn the infectious and hazardous wastes in the hospital compound within a chamber or open burning. Although most of the medical colleges, larger public hospitals and nursing homes are now provided with incineration plant, proper management of the waste in the incinerator has not been observed. Hetauda municipality has developed a simple and effective way to manage the health care waste generated in the city which can be a suitable model for other municipalities. The municipality has joined hands with a local NGO to provide a separate rickshaw for daily collection of the hazardous medical waste. All drug

stores, clinics and pathology labs in the city have to separate their waste into three categories: ordinary, hazardous and sharps. Hazardous waste is taken to a location away from residential areas and incinerated. The service fee (NRs50 to NRs200 per month) collected from the waste generators is sufficient to cover costs. However, the PADECO considers that in Nepal burial is much preferable to incineration on both environmental and cost grounds.

There are no proper slaughter house specifically designated in all the municipalities; however it is being planned in Kathmandu. The burying is done near riverbanks, jungle area and dumping sites. The responsibility of burying or dumping is taken care of by the municipalities themselves. The usual management practices of demolition waste include dumping, reuse or mix with other waste or dump in rivers. The owners themselves or municipality takes care of the management. In other countries, the demolition wastes are reused in pavements and small non-load bearing structures and also waste parks are developed, but no such practices exist in Nepal. Scrap dealers and house-demolishers in Kathmandu and some other big municipalities make reuse of certain building materials. If proper management is done, it could bring business to certain private groups and scrap dealers [3,6,21].

IV. Managerial aspects of solid waste management in municipalities

Good management practices, such as an effective organizational structure, adequate human and financial resources and systems to optimize the use of available resources, are essential for effective waste management systems [2,6].

Municipalities need systems to involve communities and the private sector.

1. Organizational structure

Waste management units are either part of the Planning and Urban Development Section or Environmental Health and Sanitation Unit or Community Welfare Section of the municipalities. Some of the smaller municipalities, however, do not have waste management units. In these municipalities, either the municipality is not providing any waste management services at all or the municipality has a few sweepers who work under the ward offices or one of the other units such as the administration unit.

Because of the importance of waste management services for the general public and the unique nature of operating waste management systems, it is essential for all municipalities to have a separate unit to deal with SWM related issues. In smaller municipalities, this can be a part of the Community Welfare Section or Urban Development Section. In large cities however, this should be a separate section in itself.

2. Resource allocation for waste management

Waste management is an important function of all municipalities and managing waste requires substantial human and financial resources. However, often due to financial constraints, municipalities are unable to provide adequate resources for waste management. Furthermore, due to technical and managerial inefficiencies, the available resources are not utilized effectively. The amount of financial and human resources dedicated to waste management varies significantly according to municipalities. Many small municipalities such as Khandbari have no solid waste

management staff but large cities like Kathmandu, Birgunj, Biratnagar and Butawal is allocating sufficient manpower. In addition, Kathmandu also uses the services of several private companies and NGOs in waste management.

The number of staff allocated for waste management generally depends on the characteristics of the municipality and their experience with dealing with waste management. Older municipalities, which tend to have large urban populations and have dealt with the problems of waste management for a long time tend to have a lot of staff to deal with the problem, while newer municipalities which generally have large rural populations have very few staff dedicated to waste management. There are no standards regarding the ideal number of people served by one SWM worker. Many municipalities do not have sufficient manpower to deal with waste management. It is highly unlikely that one worker will be able to provide effective waste management services to more than 1,000 people using labor intensive methods [6].

3. Private Sector Participation in waste management

The GoN's Local Infrastructure Development Policy (2004) strongly support private sector participation (PSP) in municipal services. PSP is especially important when waste management becomes more complex and specialized. In Nepal, however, PSP in waste management is a relatively new phenomenon and some municipalities have tried this approach. Even when municipalities have tried to involve the private sector, they have faced several difficulties. These include:

- * Lack of understanding of PSP process.
- * No clear policy and guideline for the involvement of local people.

- * Lack of capable private parties.
- * Poor coordination between private parties and municipalities.
- * Insufficient monitoring and evaluation by municipalities.

As a result, in general, municipalities have not been able to take advantage of PSP in waste management. Some municipalities including Kathmandu, Biratnagar, Hetauda, Bharatpur and Kirtipur have introduced PSP in solid waste management [8]. In most cases, the involvement of the private sector has been in the form of management contracts under which a private contractor collects waste from a certain area for a fixed fee. This is the simplest form of PSP whereby the responsibility for waste collection or transportation is given to a private party and it usually does not involve collection of service fee from waste generators. This arrangement may reduce the cost of waste management to a certain extent but it requires effective monitoring. In some municipalities, for example Hetauda and Kathmandu, a franchising or concessionaire system has been introduced, whereby a private company is given the responsibility to collect waste as well as a service fee from waste generators in a designated area such as a ward. This form of participation usually results in less cost to the municipality and the service provider will be more accountable to the people [22].

Since 1999, the KMC, through a bidding process, has allowed private companies to collect garbage from households. KMC has signed agreements with a dozen private companies to provide street sweeping, waste collection and transportation services. The metropolis have fixed garbage collection fee for households, schools, industries, hospitals and hotels on the basis of

the nature and quantity of waste collected. The private sector of KMC provides around 40% of street sweeping in the city and 69% of household collection and employs about 3000 workers. WEPCO which was established by the local women in the Kupundole area of Lalitpur in 1992 to address the problem of waste management in their neighborhood has come a long way since then. It is now collecting waste from several hundred households in Lalitpur and it is also involved in producing compost and recycled paper. WEPCO collects NRs.20 to NRs.200 from each household as monthly waste collection fees and it also generates some revenue by selling recycled paper and compost. WEPCO is also working on raising awareness on waste recycling and is assisting in establishing eco-clubs in schools. Biratanagar Municipal Corporation (BMC) and Silt Environment Services (SILTES) entered into an agreement in 1997 to start a pilot project on waste collection in the city by involving the private sector. In 1999, the contract was expanded to include road sweeping along a 14km stretch and now BMC-SILTES is responsible for waste management throughout the city. The company has taken over all SWM related municipal employees and equipment and added 78 additional staff of its own. Dharan Municipality had involved the private sector in waste management till earlier this year when the contract was cancelled due to opposition from municipal staff. The experience from municipalities clearly indicates that many realize the benefits of involving the private sector and are interested in doing so, but the municipalities are not clear as to how this can be achieved and they also face internal problems such as opposition from their staff. Hetauda attracted the attention

of the nation when it announced that it would ban the use of plastic bags in the city. It was a bold initiative. What was more impressive is that Hetauda Municipality, together with the local NGOs and Chamber of Commerce and Industry, went ahead and made a serious effort in implementing its plans.

V. Challenges and future prospect

1. Problems in management and implementation level

In the recent years, the management problems are becoming complicated and their magnitudes have been increased by many folds. The haphazard disposal of solid waste in densely populated areas, environmentally sensitive areas, riverbanks and heritage sites has adverse impacts on the public health and the environment of the surroundings which puts a negative externality in anticipated improvement on the quality of life of people. The problems existed at both management and implementation levels. Most common and frequently cited problems in the municipalities are listed below [2].

- * Lack of equipment and technical manpower, capacity building of manpower, no environmental specialist;
- * Lack of data, statistical records, research;
- * Lack of awareness and information, proper planning;
- * Insufficient budget;
- * No public private participation; and
- * Political issues

The study conducted by SWMRMC in fifty eight municipalities of Nepal show that more than 72% municipalities have been facing the problems of resources like equipment, technical

manpower, capacity building and environmental specialists. Similarly, a bit less than 50% municipalities are facing the problems of low budget for SWM. Only eight municipalities, including Kathmandu Metropolitan City, have been facing the problem of proper disposal site. Lack of information like data, statistical records, awareness and proper planning for SWM has been occurring in 34% of municipalities. The data indicate that about 62 percent of waste is organic, about 22 percent waste is reusable/recyclable and the remaining waste would have to be finally disposed of in sanitary landfills for a safe and environmentally sound disposal of waste, for which a sanitary landfill has to be properly selected, constructed and operationally managed.

2. External help to municipality

Projects like institutional strengthening, training awareness on SWM, training to staffs, shopping complex for resource enhancement, construction of dumping site, construction of waste water and sewerage treatment, eco-tourism project, compost plant, handling waste collection/recycling/dumping, community based sustainable waste management study program, regional solid waste management etc. are at an operational phase in different municipalities. Municipalities need some assistance and support from concerned departments and central level offices. These help includes both in the forms of hardware and software. Hardware supports include technical supports, physical equipment, financial support etc. Similarly, software which includes creating awareness, capacity building and manpower training and institutional assistance are also expected to achieve the objective of sustainable solid waste management.

VI. Conclusions

The policies and responses shown either from the Central Government or the local authorities are not adequate. Similarly, the capacity and the resources exercised by the NGOs are often limited. Paper, glass, metals and plastics should be recycled. Institutional composting needs to be promoted. As the communities are waste generator, segregation at source is expected to be an effective method for waste management and they can play a key role in waste collection, reduction, recycling and reusing. Hazardous waste including medical waste should be treated properly. Furthermore, because of the poor regulatory mandate to industries, industrial wastes are either burnt, dumped, drained in a river or mixed with municipal wastes and treated to a very less extent. There should be timely and effective monitoring of the SWM system of every industry and hospital.

Due to financial constraint, municipalities are unable to allocate adequate resources for managing waste. Furthermore, due to technical and managerial deficiencies, the available resources are often not utilized effectively. The number of human resources working in waste management is also showing extreme variations. The technical deficiencies, lack of human resources, poor response of citizens and insufficient budget are some major problems. There is clearly a need to provide technical and financial assistance to municipalities for developing an efficient waste management system. It should be ensured that the assistance is based on local needs and suitable for local conditions. Besides, for effective and sustainable waste management, local people should be fully aware with existing problems and have perfect information about the initiatives

of the local government and the consequences of poor waste management to health and the environment.

Despite the fact that several donor agencies are supporting in municipalities, these are not sufficient and municipalities are seeking some external support for to develop long term sustainable SWM plan and strategies. Effective rules and legislations, technical assistance, financial supports, awareness raising program at the community level, stakeholders active participation and institutional development program with the target of enhancing the skills and knowledges of the municipal staffs to waste management would definitely help in minimizing the problem associated with current solid waste management practices to a greater extent.

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