

SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACT OF LANDFILL SITE

(A Case Study of Sisdole Landfill Site, Nuwakot District)



**A Thesis Submitted to
Central Department of Rural Development
in a partial fulfillment of the requirements for the Degree of
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LETTER OF RECOMMENDATION

This thesis report entitled "**Socio-economic and Environmental Impact of Landfill Site: A Case Study of Sisdole Landfill Site, Nuwakot District**" has been prepared by **Miss Kopila Giri** under my guidance and supervision for the partial fulfillment of requirement for the Degree of Master of Arts in Rural Development. I here by recommend this work for its evaluation and approval.

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LETTER OF APPROVAL

This is to certify that the Thesis Report entitled “**Socio-economic and Environmental Impact of Landfill Site: A Case Study of Sisdole Landfill Site, Nuwakot District**” written and submitted by **Miss Kopila Giri** has been examined and approved by the Evaluation Committee. It has been declared to be successful work for fulfillment of the academic requirements towards the completion of Masters of Arts in Rural Development.

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ABSTRACT

The present study site “Sisdole Landfill Site” is situated in Okharpauwa VDC, one of the sixty-one of the Nuwakot District of Bagmati zone. Among the various villages of the VDC sisdole is located in ward 4. The study tries to show the socio-economic and environmental impact of the Sisdole landfill site in the local community of the sisdole. In order to retrieve a broad picture of the current waste management situation, the landfill site is investigated. JICA report 2005 reveals that 70% waste is organic waste and remaining are the inorganic which can be recycled with some extent.

The population growth rate of Kathmandu is more than 6% which is highest among the cities of Nepal. Due to the rapid increase in population and increase in the consumption of packed goods, the amount as well as the quantum of non-biodegradable waste is increasing over time. Among the total waste generated in Nepal, 80% is generated only from Kathmandu and only 30% of the total refuse is being collected in containers and transferred to the land fill site. A study carried out by CEDA (1986) revealed that 78% of the solid waste was biodegradable and 22% non biodegradable in Kathmandu. The Sisdole Landfill site was developed in 2005. Since then about 400-500 metric tons of wastes are disposed. It is situated in 475 Ropani of the land. The management system of this site is very weak. So that it has various harmful effects on the local people. Increasing pollution in Kolpu Khola not only destroy the water species but also effects in the irrigation system. This eventually effects on the agriculture production. Respiratory infections and diarrheal diseases can be spread due to unmanaged waste management system.

After the installation of the landfill site, the local people got the road, electricity, and health post near by the site. One health post is made by authority. The site has multiple effects on human beings, animals, plants, water species and various ecosystems. The main problem of the locals is water pollution, soil pollution and health problems due to this on human and animal. According to them the facility given by authority is not enough in comparison to its harms. The recurring conflict between local and authority is also taken as the improper management system of the government. If government made proper leachate system, proper soil capping system and processing of the waste the debate would not arise. The unmanaged waste system at the landfill site, no utilization of the waste, increasing amount of the waste,

increasing pollution and health problems at landfill site and ever rising conflict between government authority and the local people are the current problems related with this sector.

Although there are many problems related with the site, government authority had launched many policies such as Solid Waste management and Resource Mobilization Act-1987, National Solid Waste Management Policy-1996, Local Self Governance Act-1996. These acts and policies can be taken as the positive action towards the solid waste management.

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ABBREVIATION

| | | |
|--------|---|---|
| 3R | : | Reduce, Reuse, and Recycle |
| ALF | : | Alley Tar Landfill Site |
| ARTI | : | Appropriate Rural Technology Institute |
| BANANA | : | Build Absolutely Nothing Anywhere Near Anybody |
| BOD | : | Biological Oxigen Demand |
| CBO | : | Community Based Organization |
| CMU | : | Community Mobilization Unit |
| COD | : | Chemical Oxigen Demand |
| ED | : | Environment Department |
| JICA | : | Japan International Co-operation Agency |
| KMC | : | Kathmandu Metropolitan City |
| KVMP | : | Kathmandu Valley Mapping Programme |
| LFS | : | Landfill site |
| LULU | : | Locally Undesirable Land Use |
| MSWM | : | Municiple Solid Waste Management |
| NGO | : | Non-Governmental Oraganization |
| NIMBAY | : | Not In My Backyard |
| PSP | : | Private Sector Participation |
| PVT | : | Private |
| SLF | : | Sisdole Landfill Site |
| SWM | : | Solid Waste Management |
| SWMRMC | : | Solid Waste Management and Resource Recovery Mobilization Centre |
| SWMS | : | Solid Waste Management Section |
| VDC | : | Village Development Committee |

CHAPTER - ONE

INTRODUCTION

1.1 Background

Waste is generally known as unused things which are produced from used things. People use the resources to fulfilled their desires, aspiration and demand. After use those resources they generates enormous quantity of wastes as by products of production and consumption activities. Waste can be classified in three types namely: solid, liquid and gases. Solid waste can be defined as the organic and inorganic waste materials, produced by household, commercial, and industrial activities. Waste is issue is not only related with population on these days it is being the issue of environment as well. So, the concern about solid waste management is increasing day by day. Talking about environment, it has basically two types of problems, one is manmade problem; those arising from the activities of man (industrialization and urbanization) such as pollution and solid wastes. There are a number of types of solid waste which need to be dealt with. The first is recyclable waste, objects which are useful, but no longer wanted. Solid waste management includes the construction of facilities to recycle these goods, which include scrap metal, cans, glass, paper, plastics, wood, and other materials. Another category is Toxic waste: waste which could potentially contaminate the environment, meaning that it needs to be handled with care. This category includes electronic waste, a growing problem in many industrialized nations. Next is green waste such as compost and yard clippings. People with land can compost their own green waste, and many cities collect it separately from true garbage, the final category, so that the green waste can be composted and returned to the earth.

According to the United Nation's Statistic Division (UNSD): *Wastes are materials that are not prime products (that is products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into*

intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded. And there was not such problem of wastes as today. Almost everything was reused, recycled or assimilated into the soil. In towns, dumping of waste around houses results in an accumulation of health and environmental problem. The volume and composition of waste is steadily increasing, however very little space can be allocated for its disposal. The safe disposal of solid waste is now growing concern for both developed and developing countries.

The high rate of growth of population in Kathmandu is over last 50 years and unmanaged growth of settlements has intensified the problems in solid waste management. The generation rate of solid waste in developing countries is increasing due to the increase in urbanization. In 1970, developing countries generated about 160 million tons of municipal solid waste which doubled to 322 million tons by 1990. At present the daily generation of waste in Kathmandu municipality ranges from 300 to 350 tons which is on the range of rapid increase. According to the 2001 census, only about 15percent of Nepal's total population live in urban areas. However, because of the lack of employment opportunities in rural areas and the concentration of many facilities and services such as education and health care in urban centers, the rate of urbanization is very high. With rapid urbanization and changing consumption patterns, solid waste management has become a major challenge in most urban centers in Nepal, particularly the larger ones. According to CBS (1997), only 17 percent of urban households have their waste collected by waste collectors. Furthermore, in low-income households, indicated by houses having no toilets, only 2 percent of the households have their waste collected. Open waste piles are a common site and the work of municipalities is often limited to sweeping the streets and dumping the waste in the nearest river or vacant land. Modern waste management techniques, such as source separated door-to-door collection systems, material recovery and recycling facilities, sanitary land filling, and private sector participation have not yet been introduced in most municipalities (CKV JICA 2005)

According to the Local Self-Governance Act, 1999, municipalities are responsible for managing solid waste, but municipalities in Nepal generally do not have the necessary skills or resources to manage the waste in the proper manner. This act has empowered

municipalities to take every necessary action at local level. On average the 58 municipalities in the country are spending about 13 percent of their total budget on waste management related activities, but in most cases this amount is not being spent in an efficient manner (SWMRMC, 2005).

The population growth rate of Kathmandu is more than 6% which is highest among the cities of Nepal. Due to the rapid increase in population and increase in the consumption of packed goods, the amount as well as the quantum of non-biodegradable waste is increasing over time. Among the total waste generated in Nepal, 80% is generated only from Kathmandu and only 30% of the total refuse is being collected in containers and transferred to the land fill site (CKV JICA ,2005).

There is vast difference in waste management process among low, middle and high income countries. In high class countries there are organized education programmers to emphasize source reduction and reuse of waste materials and more than 90% of the generated waste is collected with highly mechanized vehicles. Whereas in low class countries, the collection costs represent 80-90% of the total waste management cost, but the collection of waste is sporadic and collection rate ranges from 50-70% and the service are limited in high visibility areas with wealthy and business families. This problem was considered from very early period in Nepal. In 1917 A.D the late Prime Minister Chandra Samsher created the “**Safai Adda**” which means clearing department, which later became the Kathmandu municipality. The safai adda was responsible for clearing the streets and later for managing public toilets. In 1980 A.D. a major project was launched with the assistance of the German government to reorganize and manage Kathmandu’s waste. The project which was implemented in four phases over the next thirteen years was quite successful in meeting its objectives till 1990 A.D. However towards the end of the project with the German involvement being phased out just as Nepal was under going major political changes.

In Nepal a waste management system was developed over a decade ago in the Kathmandu Valley. Implementation of organized solid waste management started in 1980 with the establishment of Solid Waste Management Resource Recovery Mobilization Centre (SWMRMC). A waste collection system for the urban areas of three municipalities with a population of about 0.5 million was built up with technical and financial assistance from GTZ. Compost production and resource recovery was

established at Teku in 1985, which was terminated in March 1991 due to local resident's opposition on environmental pollution ground. A sanitary land fill site for the final waste developed in 1986 at Gokarna, northern part of Kathmandu city, which was also closed down in January 1994 due to strong opposition from the people. After that Shova Bhagavati along the Bishnumati River was chosen as temporary dumping site for one and a half year which also ended in 1995.

After a great effort from Government and municipality, starting from 1996 another sanitary landfill site has been selected for waste disposal, at Okharpauwa, which is about 15 kms North-West of Kathmandu city. The Okharpauwa site has a landfill capacity of 4.2 million meter square with possible extension in Keraghari with addition 2.7 million Meter cube. Assuming the Kathmandu Valley's current rate of waste generation remains constant at 480 metric ton/day. it is estimated that the Okharpauwa site will have life of about 96 years which could be increased to about 27 years if 40% of solid waste are composted (CKV JICA, 2005)

. In July 1990, the GTZ assistance for SWMRMC ended and the solid waste management operation gradually slowed down as the central government could not provide sufficient fund to operate. Since 1994, the three municipalities and the SWMRMC share responsibility of cleaning collecting and dumping of solid Wastes.

1.1.1 Waste Characteristics and Generation

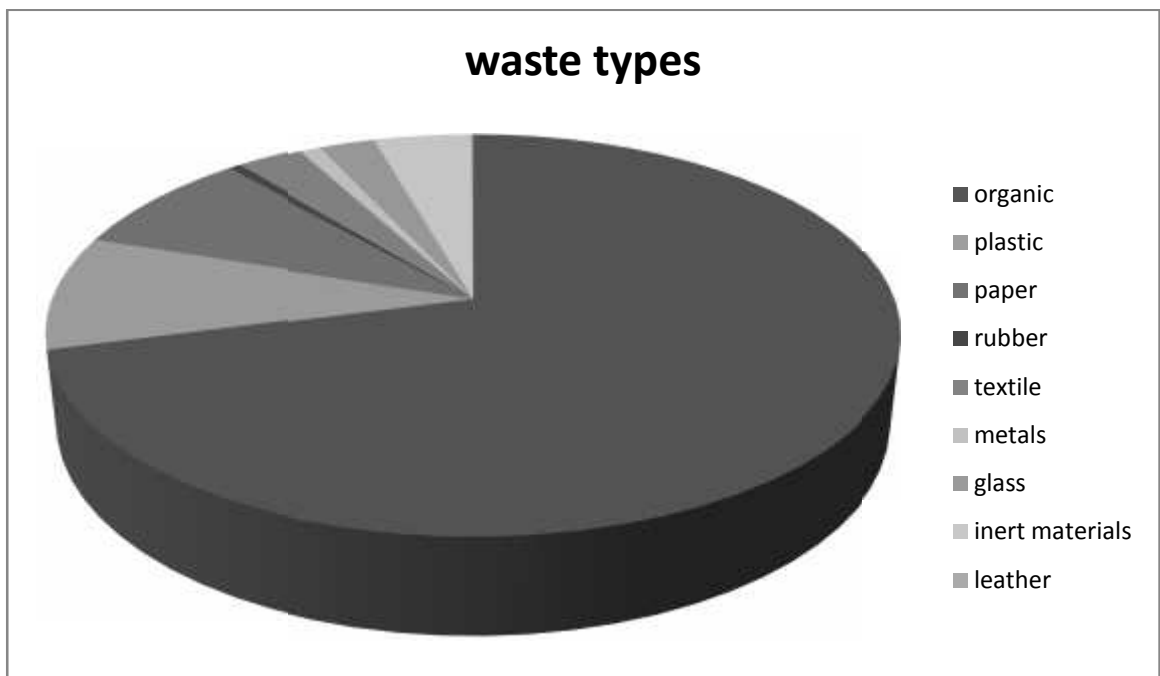
Different types of waste are generated in the city. This is mainly classified into two types that are organic and inorganic. As per the clean Kathmandu valley JICA 2005, the waste composition that has been generated is presented in the below table -1 and chart-1.

Table 1: Types of Waste Generated

| Types of waste | In percent |
|-----------------|------------|
| a) Organic | 70.87% |
| b) Inorganic | 29.12% |
| Plastic | 9.18 |
| Paper | 8.51 |
| Rubber | 0.54 |
| Textile | 3.02 |
| Metals | 0.92 |
| Glass | 2.50 |
| Inert materials | 4.33 |
| Leather | 0.12 |

Source: CKV JICA, 2005S

Chart 1: Waste types



Source:CKV JICA 2005

Based on the source of waste there are various types of the solid waste such as;

- i) House hold solid waste: the house hold solid waste is that type of the solid waste which is generated by the domestic activities.
- ii) Commercial and Industrial solid waste:

Balaju industrial sector, Patan industrial estate and Bhaktapur industrial sectors are the main source of industrial waste. These three places create 1, 03,910 kg of solid waste a month. There is no systematic approach to manage the solid waste generated by industries. Enterprises employ sweeper to clean up the premises. The waste is collected in sacks or drums and dumped in to pits or backwards or in open spaces or else it is burned within or outside the premises of the enterprises. The waste is also mixed with municipal waste. Not enough effort is being made to recycle the waste, apart from selling off scrap metal, although around 50% of the waste generated in the industrial state is recyclable.

Table 2: The status of the waste generation

| | |
|-----------------------------|--------------|
| Waste generation | 0.3 kg/p/day |
| Domestic waste generation | 269 ton/day |
| Commercial waste generation | 32 ton/day |
| Street waste generation | 32 ton/day |
| Waste from VDC | 32 ton/day |
| Total | 365 Ton /day |

Source: KMC, 2001

- iii) Medical waste:

Categories of medical waste: The National Health Research Council (NHRC) classifies waste generated in health care institutions into three types: General, Hazardous, and Sharp. A survey of six hospitals in Kathmandu showed that the proportion of general, hazardous, and sharp in the hospital waste are typically 77, 15 and 8%.

Quantity and rates : there are approximately 61 health care institutions in the Kathmandu valley with 3,905 beds (Nippon koie 2005).

Table 3: Amount and type of waste generated by selected hospitals (kg/day)

| Hospital | General (kg) | Hazardious (kg) | Sharp (kg) | Total kg/day |
|----------|---------------|------------------|-------------|--------------|
| Bir | 521 | 120 | 60 | 701 |
| Om | 221 | 31 | 16 | 267 |
| TUTH | 456 | 105 | 53 | 614 |
| Patan | 304 | 70 | 35 | 410 |
| Prasuti | 251 | 26 | 16 | 292 |
| Total | 1,752 | 352 | 179 | 2,282 |

Source: JICA 2005

1.1.2 Waste Composition and Utilization

Waste consists of inert materials , vegetable matter, metal , paper, cartoons, textiles, glass, plastics, rubber, leather wood, bones and batteries To get accurate information, a survey related to the waste generation and recycling conducted by SWMRMC in 1990 estimated that the waste generation in Kathmandu was around 480 - 500 ton per day. according to JICA (2005), the plastic waste is 9.18 %, scrap metal 7%, paper , 8.51 %, glass/ bottles 10%.

Total Waste Generation = 500 ton / day

Total recyclable materials = 500 ton x 30 %

= 150 ton / day or = 150 x 365 days

= 54750 ton / year

Then the scrap metal, plastic, paper and glass generation per year is-

Scrap metal = 54750 x 7 %

= 3832 ton / year

Plastic = 54750 x 9.18 %

= 5026.05ton / year

Paper = 54750 x 8.51%

= 4659.22 ton / year

Glass, Bottles = 54750 x 10%

= 5475 ton / year

From this it is clear that if we use the 3R concept of Reduce, Reuse and Recycle we can generate the income from it .so that developed countries always indicate waste as a source of energy and income. For example we produce paper waste 6% daily in 500 ton/day.

$$\begin{aligned} & 500 \times 8.51\% \\ & = 42.55 \text{ ton/day} \end{aligned}$$

This is the amount of paper which we produce as waste daily. We can generate income from it by selling it.

$$\begin{aligned} 1 \text{ ton} &= 1000 \text{ kg} \\ 42.55 \text{ ton} &= 1000 \times 42.55 \\ &= 42,550 \text{ kg} \end{aligned}$$

We can sell it atleast in 7 RS/kg.

$$\begin{aligned} & 42,550 \times 7 \\ & = 29,7850 \text{ RS/day} \end{aligned}$$

Simply, we can earn 29,7850 per day by selling only papers. This is how we are losing our income source and just we are adding waste on pile and making all over polluted.

1.1.3 Current Waste Management System

Municipality plays an important role in waste collection (including door to door collection), in promoting composting by households and the community as well as in running awareness campaigns. According to the informal estimates around 58 such organizations are active in the urban areas of Kathmandu valley. They charge about NRs 100 per month per house hold for door to door collection of waste. There are 64 primary vehicles collection to transfer station, 23 secondary vehicles (multi compactor and roll of truck) transfer station to land fill site for final disposal.

Table 4: Waste collection system

| | |
|-------------------------|-------------|
| Roadside collection | 192 ton/day |
| Door to door collection | 110 ton/day |
| Container collection | 21 ton/day |
| Total | 323 ton/day |

Source: KMC, 2001

Generally, the collection system of the Kathmandu can be listed as follows;

· **Street sweeping:**

Street sweeping is especially carried out by municipal or private sectors or NGO employees usually in the morning (5-7 AM). In some areas sweeping is also carried out later in the day. There are 919 street sweepers in total.

· **Collection and transport:**

The waste deposited on the road side or on the ground is picked up and transported by municipality vehicles (recently and to a limited extent by the private sector). The waste is either transported to the transfer station or directly to the final disposal point.

· **Door to door collection:**

NGOs and private sectors have recently started door to door collection services in limited areas. Tricycles and rickshaws are used and households are charged for the services.

· **Composting:**

Households composting is promoted by distribution of compost bins (100 litres bins). NGOs/CBOs manage community composting at different locations. Vermin composting is also being promoted. The composting facility at Teku (capacity of 15 tons/day) has been closed since 1990. The private sector has shown an interest in

setting up a compost plant: this however has not progressed because no site is available and low priority is given to this approach.

· **Reuse and recycling:**

Metal, glass/bottles, plastics, and paper are the main items reused/recycled. Independent collectors collect metal and plastic from houses and sell them to scrap shops. Informal estimates suggest that there are around 250 scrap dealers in Kathmandu valley. A total of about 116 tons of recyclable material is exported daily from the valley, excluding bottles, feathers, and waste oils from automobiles (Nippoan Koie, 2005).

· **Final disposal:**

Solid waste from Kathmandu and Lalitpur used to be disposed in the banks of Bishnumati and Bagmati rivers before this landfill site. Since June 2005, solid waste from greater Kathmandu is being transported to the Sisdole landfill site for the final disposal. This site also faces public opposition periodically. The long distance about 25 km, makes transportation to the site costly.

Currently, the waste management service in Kathmandu municipality covers about 20-25% of the total waste generation, the rest is left piled up around the corners of the town, settlements and open spaces. Percentage of unserved areas is increasingly high. The households which have access to road throw garbage into the road and who do not have access to road throw on any open space, causing hindrances for movement of pedestrians, vehicles, creating unpleasant settlement characters, water pollution and chances of disease spread.

1.2 Statement of the Problem

Solid waste management in these days faces great challenges not only in relation to management system but also in gaining public awareness and participation of the people. Due to rapid urbanization of Kathmandu Valley, Government is unable to cope with the increasing demand for solid waste management which resulted garbage and sanitation situation in a chaotic state. Uncollected waste can be found scattered

inside communities, footpaths and along the streets. Management of solid waste is extremely poor and the recycling of sewerage and industrial wastes is practically non-existent. Inadequate disposal of solid wastes poses a risk to public health. Growing income and growing reliance on industrially processed goods have led to changes in consumer patterns. Therefore the composition of wastes is also changing from biodegradable to non- biodegradable. The survey conducted during 1990 revealed that in three municipalities' areas and in 34 urbanized VDC areas of Kathmandu valley generate about 480-500 ton of solid wastes every day. Besides, there are hotels, industries, commercial establishments and hospitals producing a large quantity of solid wastes.

Improper planning coupled with rapid growth of population and urbanization serves to add congestion in streets, and as a result the waste collection vehicles cannot reach such places, thus allowing filth to build up over time. Lack of monetary resources, at times, results in improper or no transportation vehicles for waste disposal adding another dimension to the ever rising cycle of problems. Human and ecosystem health is also threatened due to improper handling of solid wastes. In addition to all the problems mentioned above, mountainous regions in developing countries face additional challenges in solid waste management, in terms of their highly fragile environment and difficult terrain. The problems associated with solid waste in the mountainous region have serious cascading effects on the lower valley. Often solid waste is the number one threat to the fragile ecology of the mountainous environment. Besides this, seasonal tourist inflow adds significantly to the demands on resource base and contributes considerably to the amount of wastes generated. Lack of proper regulations fails to encapsulate the waste generated by the tourists and fees to be paid there of.

In order to improve the current situation Government of Nepal and government of Japan have launched on a joint study titled the study on Solid Waste Management for the Kathmandu valley with the technical assistance of Japan International; Cooperation Agency(JICA). The study commenced in January 2004 and ran for a total of 20 months until August 2005. Due to rapid urbanization and population growth of Kathmandu valley, government garbage and sanitation in a chaotic state. Data shows that 335 metric ton waste is generated in the KMC alone and Kathmandu

metropolitan spends millions of rupees for its management. Uncollected waste can be found scattered inside communities, footpaths and along the streets. Management of solid waste is extremely poor and the recycling of sewerage and industrial wastes is almost non-existent. Inadequate disposal of solid waste poses a risk to public health and environment. Government is lacking proper planning and adequate laws in the waste management sector. Government has collected and dumped the wastes in various sites as well as in places having religious importance, thus, government has been criticized for its works by the concerned sector and the general public from time and again. Although, in today's time the city's wastes have been disposed at Okharpauwa, still there is conflict and it has been a matter of headache for both government and people. Even the Landfill site disposal scheme is not properly and successfully catered by government authority. The safe and appropriate management of the solid waste by the professional recycle, reuse and reproduction of the total solid waste of the Kathmandu Valley is still to go in the course of the time scale.

1.3 Objectives of the Study

The overall objective of the study is to identify the economic, social and environmental impact of the landfill site of Solid Waste Management undertaken by Kathmandu metropolitan city. Thus the main objectives of the study are as follows:

-) To study the social impacts of the landfill sites in the life of the people of Sisdole Landfill site.
-) To study the economic impacts on the people of Sisdole.
-) To study the environmental impacts of the landfill site in the life of the people living in Sisdole Landfill Site.

1.4 Rational of the Study

This study was focused on generalizing the value of solid waste management on human being and in environment. The proper management of the environment problems is challenging in today's world, especially in developing countries. High waste collection coverage is closely related to good governance since it demonstrates the commitment of the city authorities to keep the city clean and healthy. Waste management is being necessary for the all countries in the world because with the

rapid growth of population the amount of the waste is increasing. In Nepal, the issue of waste management has been burning issues these days. The lack of permanent dispose place is now the matter of concern for authority. The study focused on the impact of the Landfill Site on local peoples. Due to improper management of the site it is creating more adverse effects. People are getting health problems, decreasing soil fertility, pollution in Kolpu Khola are some of the effects of the landfill site. It has some positive aspects as well. Development of the road, electricity, and health post are some of the achievement of the Landfill Site.

The study analyzed the positive and negative aspects and effects of the Landfill Site on the local people. This study insisted on the possibilities of the solid waste and its current situation. According to KMC, 70% of the waste is organic and remaining 30% is inorganic which consists of recyclable, reusable materials. The utility of the waste is very high if we can use it as a productive source. We can use metal, glass and paper for secondary use and make it as a productive source. So this study tried to analyze those possibilities as well.

1.5 Limitation of the Study

The study is limited to only the area of landfill sites that is Sisdole itself which is in the ward number 4 of Nuwakot district, which is the area near the landfill site. The objectives of the study are also focused to the particular research area. So the finding of this study might not be highly useful to generalize the impact of overall waste management area everywhere. Therefore the conclusion drawn from this study might be more indicative rather than conclusive.

1.6 Organization of the Study

The study has been divided in to six chapters. Each chapter deals with different subject matters. The first chapter contains different topic and is further divided in to sub-topics as per the requirement. The first chapter consists of background which is further divided into sub topics like current waste management system and quality generated. Similarly, others topic included in the first chapter are statements of the problem, objective of the study, limitation of the study and organization of the study.

The second chapter deals with the literature review. It is basically done on the comparative study of the waste management in the developing country and developed countries. This chapter also studies the waste management, which shows the methods of data collection and analysis of the data. The third chapter describes about the research methodology.

The fourth chapter deals with the description of the sites. The site is described by dividing the topics in to the sub-topics like physical environment, biological environment and socio-cultural environment. On the basis of requirement the topic is further divided into the sub-topics. The fifth chapter studies the tabulation, analysis and the impacts, prospects and problems of solid waste management in the study area. The sixth chapter deals with the summary, conclusion and finally ends with some of the recommendation.

CHAPTER-TWO

LITERATURE REVIEW

This chapter studies the comparative study of the solid waste management between developed and developing countries. This also deals with the study of the past and present condition of the solid waste management of Kathmandu. There are several studies conducted to identify the composition of the waste. The solid waste management system has long history. In the beginning of the mid 1970s, there was drastic change in the area of solid waste management. Most of the cities in western Europe, North America, Australia, New Zealand, Japan and some in Korea have adopted municipally sponsored source separation and collection systems. In some cases, the separation of post consumer materials by waste generator has been made mandatory. In USA the volume of municipal solid waste generated were rising, many landfills were closing and sitting new landfills and incinerators were becoming harder to maintain due to local opposition. Combination of these factors, along with a surge of environmentalism among the public, led to an increase in recycling. Initially the people simply discarded the waste and the concept of NIMBAY (not in my backyard) was the motivating factor for the waste management. Later the concept of LULU (locally undesirable land use) emerged for the dumping of waste. Recently the concept of BANANA (Build absolutely nothing near anybody) is being developed for the management of waste (Shrestha, 1999). These concepts encouraged research work on the reduction in the quantity and volume at source as well as after the generation to achieve economic efficiency. Thus the studies in developed countries are made for the effective instruments to change household's behavior to reduce the volume and quantity of waste.

The result of a rapid urbanization, changing consumption patterns, and population growth contribute significantly to the increasing volumes of solid waste generated in urban centers. With increased urbanization, demand for solid waste management services will undoubtedly increase. Municipal tax and revenues, however, are not likely to rise as quickly as the population. This is due to the fact that among the people moving to the city, the majority are likely to be poor migrants from rural areas in search of employment, and therefore unable to contribute significantly to the revenues of the municipality. Although they may demand marginally less services due

to their lower level of consumption, they are likely (at least at first) to congregate in the poorer, more densely settled areas, exacerbating the health and sanitation problems posed by these often unplanned communities.

There are linkages between deficient infrastructure and health outcomes of urban residents. Respiratory infections and diarrheal diseases are the two biggest causes of death among the poorest 20 percent of the world's countries ranked by national GDP per capita (Gwatkin and Guillot, 1999). The rapid growth of urban centers coupled with the rate of solid waste generation have proved that traditional solid waste management practice, with emphasis on collection and disposal has proved inefficient and unsustainable. This is because the system has failed in addressing the problem of solid waste management of urban centers. This has resulted in uncontrolled dumping in any available open spaces and other unapproved places and spaces in urban centers. Consequently, specially developing nations adopt an integrated solid waste management model that ensures efficient and sustainable solid waste management in Urban centers. Many countries already adopted this model; this model is working in India and Nepal as well.

The Integrated Solid Waste Management model (ISWM) is a comprehensive urban solid Waste management model that combines the elements of waste prevention, recycling, Composting and disposal with active stakeholders' participation which ensures efficient and sustainable waste management. The model considers how to manage urban solid Waste in ways that protect human health and the environment which involves evaluating Local needs and conditions, and then selecting and combining the most appropriate waste Management activities for those conditions (USEPA, 2002). The model also lays emphasis on the 3R (recovery, reuse and recycle) approach to solid waste management. Resource recovery includes all activities of waste segregation, collection and processing which are carried out taking into consideration the economic viability of the material (Baud and Schenk, 1994).

Integrated Solid Waste Management System in India: In addition to the traditional practice where Municipal Authorities assume the responsibility of urban waste management, innovative urban waste management activities are being practiced, taking into consideration the ISWM model in India by both governmental (municipality) and non-governmental institutions (Adarsh, 1996). These local needs

and innovative practices are location-specific viable options in response to analyses of the local needs and are successful in ensuring efficient solid waste management in Indian urban centers particularly Bangalore and Madras. The innovations complement and supplement the efforts of the municipal authority.

Integrated Solid Waste Management Model in Nepal

According to the Local Self-Governance Act 2055 of Nepal (1999), municipalities were responsible for managing solid waste, but municipalities in Nepal generally do not have the necessary skills or resources to manage the waste efficiently. This act has empowered municipalities to take every necessary action at the local level. On average 58 municipalities in the country are spending about 13 percent of their total budget on waste management related activities (SWMRMC, 2004), but in most cases this amount is not being spent in an efficient manner. In view of the above, many municipalities in Nepal have adopted the ISWM model and are promoting waste reduction, reuse, and recycling among the communities. Municipalities have joined hands with local communities and the private sector to introduce innovative approaches for waste management that are cost effective and efficient. These include door-to-door collection system in some areas of Kathmandu and several other municipalities, plastic collection and recycling systems with community and private sector participation in Hetauda and Bharatpur, composting in Kathmandu and Bhaktapur, medical waste management in Hetauda and land filling in Tribhuwannagar(SWMRMC, 2004).

A study carried out by CEDA (1986) revealed that 78% of the solid waste was biodegradable and 22% non biodegradable in Kathmandu. SWMRMC (1990) stated that the waste of Kathmandu valley constituted 23.8% inert material while organic material constituted 76.2% in 1985. In 1988, the inorganic materials increased to 33.7% with 9.40% recycled materials. Similarly, according to Rai's report (1990) the recyclable material content was increased to 30% in Kathmandu. The recyclable materials were metal scrap (7%), plastic (7%), papers (6%) and glass (10%).

The population of KMC and LSMC is approximately 942 000 and 210 000 respectively. These figures are based on calculation with known population and growth rates (4.6% and 3.5% respectively) from 2001 (KMC, 2008; LSMC, 2007).

The current severe problems concerning Municipal Solid Waste generation and depositing in Nepal in general and in KMC in specific, started when the composition of the MSW altered from mostly organic to higher fractions of plastic, glass and metal. Earlier, the inhabitants of KMC could compost most of their waste and use it in the agricultural sector as fertilizers. But the change in waste composition, made it difficult for such an approach and people instead started to throw their solid waste in the rivers running through the city.

There are lots of differences in the management system between developed and developing countries. The difference is not only in the end of the management but its from the starting of collection of waste. In developed countries waste collection is the matter of the concern for every people due to the introduction of source separated collection of recyclables in North America and Organics in Europe. In developing countries, an influx of loans and grants for infrastructure development is just beginning to affect collection systems sometimes for the better and sometimes not. While collection is structurally similar in developing transitions and industrialized countries, there are important technical and institutional differences in implementation (KMC). In developing countries, collection often involves a face to face transaction between generator and collector. The level of service is low and the generators often have to bring their waste long distances and place them in containers that are sometimes difficult to use. In developing countries there is lack of services. Talking about developed, collection pattern is modern, technological and professional as well. Whereas in developing countries manpower is used to collect the waste so the chance of getting infection is higher. In industrialized country they use closed compacter, trucks so they don't impact on daily life of the people. Collection may or may not involve payment either direction. The term collection fee describes the situation where the individual disposing of the waste or organization representing community must pay the collector to have the materials collected or removed. In cases where the collected materials have intrinsic value, the collector often pays the generator for the materials either in cash or by barter as was the case in Japan there the paper collector would give out new rolls of the toilet paper in return for waste paper. In certain cases, such as the Zabbaleen in Cairo, the collectors or collector's organization must pay the city a concession fee for the right to collect and use materials (KMC, 2005).

Likewise, composting is also one stage of the waste management. Composting solid waste for use as a soil amendment, fertilizer or growth medium is important in many countries. Asian countries in particular have a long tradition of making and using compost. In Western Europe a range of modern technologies is used to produce compost. The composting system is failed in some developing countries due to high operation and management costs, high transportation costs, poor quality products, poor understanding of the composting process and competition from chemical fertilizers. In urban areas collection systems are too unreliable for urban authorities to consider running composition facilities efficiently (KMC 2005). There are different types of composting system in world some of them are known as following names;

1) Pit composting (Pune, India)

Biodegradable waste is placed in shallow pits and left to decompose for several months. This method is very simple, often practiced in public parks or domestic gardens. In rainy conditions it is susceptible to water logging.

2) Vermi composting (Bais city, Philippines)

It uses worms to digest the waste, rather than micro-organism. Raw materials are spread daily in thin layers and cannot be piled very high, so the technique requires much more space than other methods. Worms are also more vulnerable to extreme temperature and contamination than micro organisms. One of the advantages of vermi -composting is the high nutrient content of the product.

3) Compost chute (Kandy, Sri Lanka)

This chute composting plant is a long tube. Waste is fed in at top. As more waste is added, over a period of a few months, mature compost emerges at the bottom. Gravity drives this process, which involves minimal mechanization. Chimneys draw air up through the compost. This chute was developed by a partnership between University, NGO and municipality.

While talking about Nepal the impacts of solid waste management is increasing on both negative and positive sides. The environmental impact of solid waste is burning issue in these days, this is also discussed in newspaper as an articles such as;

Eight places in and around the Okharpauwa landfill site in Nuwakot district are environmentally at risk, according to a study report.

A study conducted in the site by the Nepal Academy of Science and Technology (NAST), environment of eight places including Okharpauwa, Jeetpur Aletar and Deurali is found affected mostly due to the garbage disposal. The NAST conducted a study on environmental impact in the area with the support of the Waste Management and Resources Mobilization Center. Some 56 places in and around the landfill site were selected for the study. Surface and ground water, soil and micro organic elements were tested in course of the study. An Alfactrometer, the device for measuring the foul smell, was also used for the study for the first time in the country. Improvement in the process of waste management and separation of disposable and non-disposable garbage before bringing the solid waste for disposal are among the recommendations included in the report.(RSS: June 17,2011)

Government Policies on SWM

-) Solid waste management and resource mobilization act- 1987
-) Municipality act -1990
-) National solid waste management policy-1996
-) Environment protection and regulation -1997
-) Local self governance act/rules-1996/97
-) New solid waste management act- under process
-) Private sector participation through high level commission.

The existing management of solid wastes relies on an overly centralized approach. With a rapidly growing urban population, current institutions are unable to provide an adequate level of service. The result is that piles of rubbish are left to rot in streets, presenting a particular health risk to children who often play close by

The traditional approach taken by the MHPP has resulted in people regarding solid waste disposal as the government's responsibility. With government nominally assuming responsibility, communities have little influence over trying to improve services. There is still a need of environmental regulations that protect people from undue risk of exposure to environmental threats, For example the need for regulations governing hazardous waste and toxic substances such as the storage and disposal of unused pesticides. Beside this there is a lack of laws to oblige households to separate

their wastes at source and sanctions for nonpayment of local fees and laws to prevent open defecation in open areas and rivers.

However, recently on June 21,1996, His Majesty's Government of Nepal (HMG/N) taken a major step towards improving the SWM situation and formulated new national policy on solid waste management in order to provide a long term solution of the garbage problems arising from unplanned urbanization. It has duly taken into consideration of mobilization of local authorities and involvement of private parties in the arrangement of solid waste. New policy states that national and foreign private agencies will be invited to undertake the work of SWM. As per the policy, a concept of cleanliness suitable to the local technology and social environment will be developed. Involvement of various NGOs in such campaigns will be encouraged. Solid waste will be used as resource to produce useful materials through recycling processes. It further intend to bring promising strategy to levy service charge to be paid by the public and it aims to introduce SWM as a subject in the school and to develop non-formal education curricula.. Besides this, it is determined to impose fines to those, who violate cleanliness regulations.

Different Institutions Involved in SWM in Kathmandu Valley

A number of governments, non government and donor agencies are directly or indirectly responsible for the improvement of the solid waste management services, environment, health and sanitation condition of Nepalese people.

National Level: the ministry of Housing and Physical planning (MHPP) is the prime responsible Government institution for physical planning of urban areas in the country and the department of Housing and Urban Development (DHUD) under this ministry implements them. The Ministry of Local Development is involved in planning and management of municipal and VDC area.

Municipality: Municipalities are local Government formed under the municipality act. The organizations although technically under the MHPP, function autonomously with little interference from the Government. Municipalities have the responsibility for sanitation in the towns. This is centered on the collection and disposal of solid

waste, management of public toilets, emptying of septic tanks, construction and maintenance of town's drainage system.

Ward office is also an important component of the local organizational structure. In almost all public work and development activities, ward committee are responsible for identifying ward communities need, discussing the needs with the community members. It plays a crucial role in facilitating community commitments to the project. Ward committee is a statute body. The Ward Chair is elected in a municipal election every five years. The Ward Chair in turn nominates four of aides from the community.

Sectoral Agencies- Solid Waste Management & Resource Mobilization Centre is an only responsible organization in Nepal for the improvement of sanitary living condition through proper waste management system in the urban areas of Kathmandu Valley. Though it is under a ministry of local development it works autonomously.

NGOs -There are more than 2700 registered NGOs in Nepal, with 150 at national level with district level networks. Another estimates puts the number at around 7000 registered NGOs both with the Social Welfare Council (SWC) and Chief District Office (CDO) in various districts .The number of NGOs involved in SWM are very few,. many of them are involved in income generating activities and are working in rural areas .NGOs that are solely involved in SWM is estimated at 5 or 6, including the involvement of international NGOs.

Donor Agencies - Donor agencies such as UNICEF, the World Bank, UNDP and the German Agency for Technical Cooperation (GTZ). all provide technical and financial support in this area to various sector institutions, municipalities and NGOs. Among them, GTZ has been directly involved in SWM in Nepal for a longer period of time. Much of the progress in SWM system in the Kathmandu valley is the product of GTZ assistance.

Private Sector -Private sector involvement in SWM has so far been very limited. Some households compost the refuse in their backyard later to be used as fertilizer in the fields or garden.

CHAPTER – THREE

RESEARCH METHODOLOGY

3.1 Research Design

The main objectives of the study are to analyze the socio economic and environmental impact of the solid waste management in the research area. For the study descriptive and exploratory research design is used. As a descriptive method it attempts to describe a situation problem, program, attitude towards an issue. And as an exploratory research design it tries to investigate the possibilities understanding to the solid waste management.

3.2 Sampling procedure

This research is done in Sisdole with the people of this area. So, the purposive sampling method has been adopted for the research. This research includes limited geographical area and limited households such as some key person like political leaders, social workers and local activists. The ward of the VDC is considered as the universe.

3.3 Nature of Data

This study is based on the qualitative and quantitative data collection and analysis. Both primary and secondary types of data are collected during the study.

- a. Primary data: Primary data is essential in providing the researcher with first hand in-depth information and understanding of the issue of solid waste management. These types of data are collected through the field survey, interviews, and observation.
- b. Secondary data: Substantial relevant secondary data on elements of solid waste management and the Integrated Solid Waste Management model have been gathered and reviewed thoroughly to understand what has already been done in the field of solid waste management. It is collected through both published and unpublished literature such as journals, articles, research reports and dissertations.

3.4 Data Collection Tools and Techniques

To collect the required information, the research area is visited and the selected households for household survey and filled up the questionnaires. To get further information interview with social worker of related area, political leaders and observation method is used.

3.5 Interview

An interview guide with a list of questionnaires to be covered was developed to collect solid waste management information from households. It also provided a clear set of instructions for interviewers and generated reliable, comparable qualitative data. In order to have reliable data and information an interview has been conducted among stakeholders such as community based organizations, local NGOs, activists, metropolitan staffs and other key person.

3.6 Household Survey

Nearly 20% of the household has been visited to collect the information. The scheduled questionnaires were filled up from the respondents.

3.7 Observation

This technique was used to gather information on solid waste management activities and infrastructure for managing urban solid waste in the study area. The variables observed included solid waste dump sites and solid waste management practice among solid waste management service providers. Accordingly, solid waste disposal sites were visited and photographs of events taken as they occur in the natural setting. The choice of this technique offered the researcher the opportunity to directly observe events occurring naturally in the study area and to analyze the direct and indirect impact on local people of the Sisdole village.

3.8 Analysis and Presentation of Data

The collected primary and secondary data and information during research period has been processed to different techniques. The study has adopted more qualitative techniques rather than quantities.

CHAPTER –FOUR

INTRODUCTION OF THE STUDY AREA

4.1 Study Site

This study site “Sisdole Landfill Site” is located in Okharpauwa VDC of Nuwakot District. It is situated in 475 Ropani land. It is situated in south western part of the district headquarter. It is 7.5 kosh far from the district headquarter. It has a landmass area of approximately 18.90 square kilometers of the total area of the district. The VDC situated between 27°46' north latitude and 85°13', east longitude. The population of the VDC is 7277 of which 3650 (50.15%) are male and 3627 (49.85%) are female. The total forest area including private, community and national forestry is 266.39 hectares. Among this only 91.39 hectares of the national forestry has been handed over to the community according to the Forest Act 2049 and Forest Regulation 2051 B.S. From this community forestry, 914 households from different caste group are being benefited.

4.2 Demographic and Socio-Cultural Status of the Site

Okharpauwa VDC has a total population of 7277 in the year 2001. The study area is located in ward no. 4 of the VDC. This ward has 200 total households with the total population of 1052. In the total population Male population is 533 and Female population is 519. Generally there are seven ethnic and caste group residing in this VDC. The distribution of different caste group is as follows;

Table 5: Distribution of the Population

| S.N | Caste/ethnic group | Population Male | Female population | Total | Percentage |
|-----|--------------------|--------------------|----------------------|-------|------------|
| 1 | Brahmin/hill | 733 | 760 | 1493 | 20.21 |
| 2 | Chhetri | 144 | 155 | 299 | 4.10 |
| 3 | Newar | 1235 | 1200 | 2435 | 33.46 |
| 4 | Tamang | 1302 | 1280 | 2582 | 35.48 |
| 5 | Kaami | 92 | 95 | 187 | 2.56 |
| 6 | Nurang | 65 | 60 | 125 | 1.71 |
| 7 | Others (Dalits) | 79 | 77 | 156 | 2.14 |
| | Total | 3650 | 3627 | 7277 | 100 |

Source: Village Profile, 2004

Table 6: Religion of the area

| Religion | Population |
|-----------|------------|
| Hindu | 4625 |
| Baudhha | 2641 |
| Islam | 5 |
| Christian | 2 |
| Others | 4 |

Source: Village profile, 2004

This VDC has 31.4 literacy rates In which male literacy rate is 40% and female literacy rate is 22.5%.

Table 7: Number of educational institutions

| School | Number of school |
|------------------|------------------|
| Pre primary | 0 |
| Primary | 5 |
| Lower secondary | 1 |
| Secondary | 2 |
| Higher secondary | 0 |
| Total | 8 |

Source: Village Profile, 2004

4.3 Topography

Among the various village of this VDC, Sisdole is in ward 4. It is situated in the small well protected valley with a very limited catchment. Geographically speaking, it forms the abandoned course of the Kolpu khola and is protected on all sides by elevated ridge spurs. The valley has two 50 to 75m wide opening one to the east and others to the south. The valley floor is gentle, flat land culminating to the ridge slopes exceeding 20m degrees in gradient in the south, north and west. The site is dominated by prime agriculture land. It has one sub watershed area known as Kolpu Khola.

4.4 Land Use Pattern

Topographically it is suitable for agriculture. As such the village is contributed by 60.30% agricultural land and 10.05% of land found to be non irrigated land. Likewise, forest land comprises of 18.65% and the rest of the land is other type of land including pasture land.

Table 8: Land use pattern in the village

| Land use pattern | Percentage |
|------------------------------------|------------|
| Forest land | 18.65 |
| Irrigated agriculture land | 60.30 |
| Non irrigated agriculture land | 10.05 |
| Other (pasture land, wet land etc) | 11.00 |
| Total | 100 |

Source: Village Profile 2006

4.5 Climate

The site has warm subtropical climate, the climate is characterized by heavy monsoon rainfall which occurs between June to September and delivers a total annual average rainfall of 2990 mm (1990). This figure is based on Kakani rainfall station, which may vary with rainfall at the bottom of the hill, at Kolpu khola basin. It has a small watershed area and the outlet to the river passes through a flat terrain. The annual average temperature at the top of the hill Kakani varies from 8 degree to 19.7 degree centigrade.

4.6 Health Status

The people have easy access to the health post. According to the health officials only minor cases are seen most of the time like fever, common cold etc. the complicated one is advised to go Kathmandu. The society is more conservative still. They are not conscious for health treatment.

4.7 Biological Environment

Some of the major types of the vegetation are Uttis (Alunus Nepaletis), Chilaune (Schima wallichii), Dhaero (Woodfordia fruticosa), Mothe(Cyperus), Banmaara (Eupatorium), Aiselu (Rubus ellipticuss), Sisnu (Urtica dioica), Titepaati (Artemisia vulgaris). A total of 31 plant species are recorded during the survey period in and around the SLF. Out of 31 plant species tree, shrubs and herbs are recorded to be 10. The total of 29 bird species is recorded in the study area (Vilalge Profile, 2005).

4.8 Socio-Economic Status

The society is dominated by the Brahmin community. The people live in joint family. Often the family comprises of there or four generation members. The illiteracy rate is high; nearly 60% people are illiterate. The main source of their income is found to be agriculture.

Table 9: Source of income

| SN | Sources of income | Percentage |
|----|-------------------|------------|
| 1 | Agriculture | 85 |
| 2 | Jobs | 5 |
| 3 | Idle | 5 |
| 4 | Other | 5 |
| | Total | 100 |

Source: Field Survey 2011

From this table, we can assume that the main source of income of the people is agriculture. And very few percentages of the people are engaged in jobs like government and non government. And five percent of the people are idle.

From the cultural point of view, there are 3 goddess temples and two Shiva temples in Okharpauwa VDC. The goddess temples are located in ward 1, 7 and 9 while Shiva temples are located in ward 1 and 4 of the VDC.

4.9 The General Introduction of Sisdole Landfill Site and its Existing Operation

Sisdole landfill site has been developed by SWMRMC by dividing in to two valleys; valley 1 was developed as a semi-aerobic landfill first with necessary improvement works under the pilot project of the study. SWMRMC was responsible for such works as waste dam heightening, fencing, preparation of power supply, office building and administrative utilities. Using these facilities, the valley 1 started its operation on June 5, 2005.

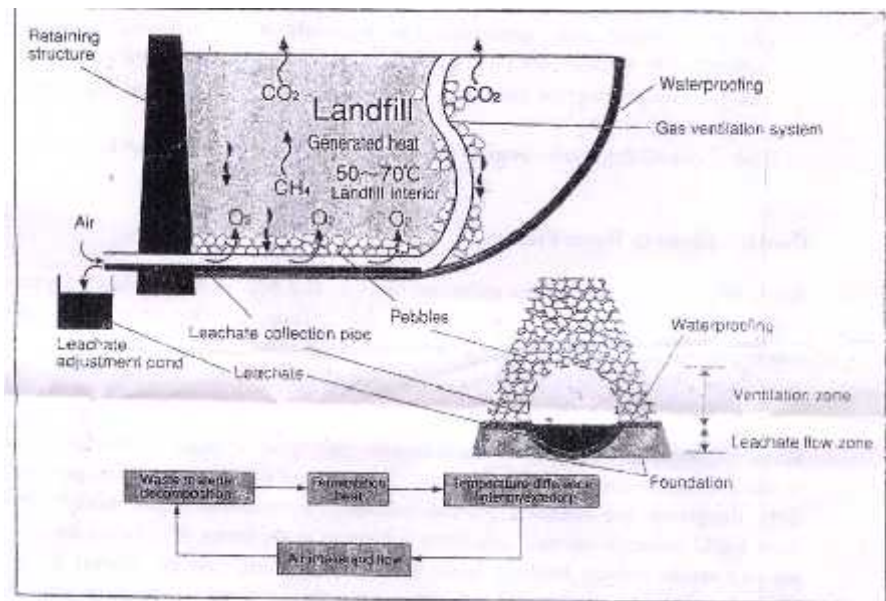
At present the basic concepts of an umbrella concept of solid waste management has been proposed to clarify the administrative responsibilities of municipalities and to show a basic direction for effective solid waste management. As part of umbrella concept, four basic concepts; i.e. improvement of collection, transportation and final disposal system, collection and transportation facilities, promotion of waste minimization and public participation and behavior change have been proposed. While talking about the published matters of the study “the study on the solid waste management for Kathmandu valley”-September 2005 landfill system is being further discussed in terms of semi-aerobic landfill type and landfill level and it is said that present landfill site is constructed and concept under which the site was developed is a semi-aerobic type of sanitary landfill system which is more clear than past solid waste management.

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

4.9.1 Semi-aerobic Landfill Type

Anaerobic decomposition of organic matter produces methane and water and the decomposition is slow and leachate content is large. On the other hand under aerobic decomposition, organic matter decomposes into carbon dioxide and water and the decomposition is rapid. Aerobic decomposition requires a supply of oxygen to be pumped into the landfill, but this is a costly system. to cope with these problems, a particular type of semi aerobic landfill known as “Fukuwa method” was developed as

a joint project of Fukuwa city and Fukuwa university. The Semi-aerobic system is schematically presented in figure below:



Source: The Fukuwa Method, Fukuwa City Environmental Bureau

The landfill sites can be classified based on these microbial environments existing in the landfill layers. As discussed above a semi aerobic system has advantage in leachate improvement, reduction of methane gas generation and rapid stabilization of the site. In addition, the technology it cost effective and simple to construct and operate, and allows a high degree of freedom in the selection materials for pipes and accessories. It is therefore suggested to develop the landfills as semi aerobic systems. Sisdole landfill site has been designed under this concept and started operation in 2005. The results of this pilot project should be carefully monitored to determine the suitability of the semi-aerobic landfill system to waste of the vehicles.(CKV JICA, 2005)

Table 10: Semi-aerobic and anaerobic landfill system

| Items | Semi-aerobic landfill | Anaerobic landfill |
|---------------------------|---|--|
| Objectives | Stabilization of waste by natural ventilation. Reduction of leachate toxicity. | Maintain the common situation at the landfill. |
| Condition of waste layers | Large parts of the layers are anaerobic. Layers surrounding the leachate collection pipes and gas removal pipes are semi-aerobic. | Anaerobic condition through the waste layers. |
| Leachate collection pipes | Open to air at the pipe outlet connected with gas vents. Large pipe diameters. | Pipe outlet immersed |
| Gases produced | Roughly divided into CH ₄ And carbon dioxide | Mainly methane with carbon dioxide |
| Leachate quality | Lower BOD and COD value. Rapid decrease in generated volume. | Higher BOD and COD values. Slower decrease in generated value. |

Source: JICA study team

While discussing about the landfill level in the case of Sisdole LFS, it is expected to be operated for only 3-4 years and therefore application of natural liner and leachate re circulation with natural attenuation treatment was recommended as mentioned in the report.

4.9.2 Site Management

The road constructed in and around the site facilities both for the local resident and for the mobilization of heavy container trucks and dozers. The road is however closed

from 9 to 10 in the morning for the movement of the container trucks by the local residents so as to facilitate movement of school children. The site roads are water sprayed in dry seasons to prevent blowing of dust particles. The container trucks unload the waste, which is scavenged and heavy dozers level the leftovers. The waste dump is then covered by a layer of soil and debris in a certain time period. The soil and debris is excavated from smaller hillocks in and around the site. Such work has obviously maintained the site. The construction of leachate into the seasonal stream flowing southeast of the site. It also controls percolation of leachate in to ground water. The authority also checks water samples from time to time in order to keep the area safe.

4.9.3 Waste Handling

Generally the main solid waste sources are the domestic waste, Commercial waste, industrial waste, agricultural waste, institutional waste and natural waste. The unloaded piles of waste are thoroughly scavenged by about 60 workers. The wastes are sort out and the recovered are sold to a group of collectors. They in turn are reselling to local scrap dealers and some other dealers. The local inhabitants collect fresh vegetables leftover for stall feeding of cattle. They also collect some other materials that might come in use in some of the domestic purposes. The waste handling is totally left for the scavengers. There are no interventions or guidelines of authority in terms of safe method of collection and precautions to the waste workers.

CHAPTER – FIVE

DATA ANALYSIS AND PRESENTATION

5.1 Social Status and Impact of the Landfill Site

This landfill site has positive social impact along with negative impacts on local people. In social aspect this study is focused on like caste/ ethnic group, education etc.

Table 11: Population Distribution of Study Site

| Population | No. of persons | Percentage |
|------------|----------------|------------|
| Male | 533 | 50.66 |
| Female | 519 | 49.33 |
| Total | 1052 | 100 |

Source: Village Profile, 2004

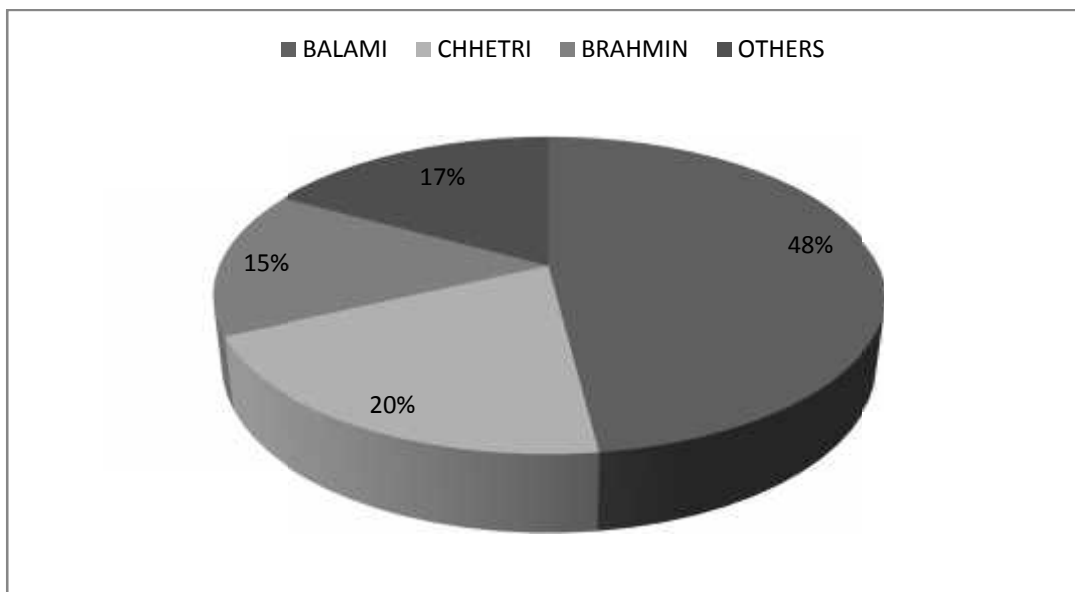
From the data above, we can say that the population of the male is higher than the population of the female.

Table 12: Ethnicity and Caste of the Study Area

| S.n | Caste/ethnic group | Household | Percentage |
|-------|--------------------|-----------|------------|
| 1 | Balami | 19 | 48 |
| 2 | Chhetri | 8 | 20 |
| 3 | Brahmin | 6 | 15 |
| 4 | Others | 7 | 17 |
| Total | | 40 | 100 |

Source: Field Survey 2011

Chart 2: Caste and ethnic Status of the Study area



Source: Field Survey 2011

From the data above it is clear that the study area has maximum number of Balami. 48% is balami, 20% is chhetri, 15% Brahmins and rest of the people 17% are others likea Newar, and other castes.

Table 13: Family Types of the Study Area

| Family type | No of households | Percentage |
|-------------|------------------|------------|
| Nuclear | 8 | 20 |
| Joint | 32 | 80 |
| Total | 40 | 100 |

Source: Field survey 2011

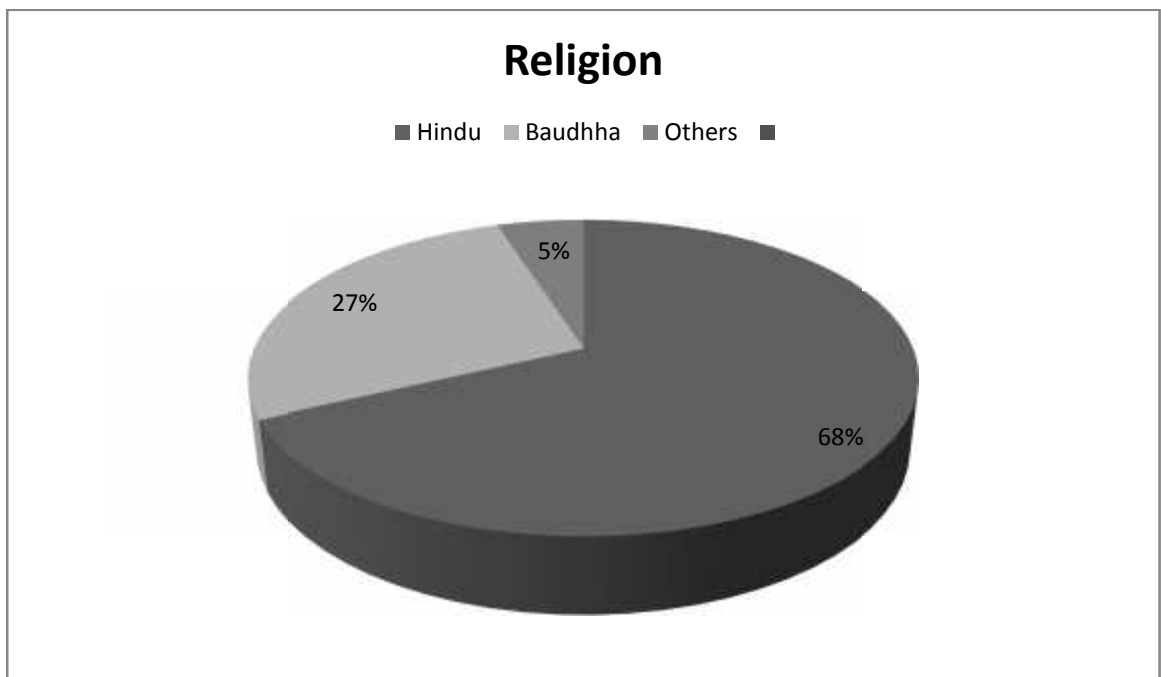
In the study area, 20% of the peoples have nuclear family, like wise 80% of them have joint family.

Table 14: Religion of the Study Area

| S.n | Religion | Households | Percentage |
|-------|----------|------------|------------|
| 1 | Hindu | 27 | 68 |
| 2 | Baudhha | 11 | 27 |
| 3 | Others | 2 | 5 |
| Total | | 40 | 100 |

Source: Field Survey 2011

Chart 3: Religion of the Study Area



Source: Field Survey 2011

Above data shows that there are 68% people who are in Hindu religion, after that Baudhha religion can be seen and rest of the religions are others like Christian..

Table 15: Perception about Landfill Site

| | |
|-------|-------|
| Good | 1.2% |
| Bad | 98.8% |
| Total | 100% |

Source: Field Survey 2011

From this, it can be said that most of the people think that the land fill site is not good to be there. And only few peoples like to be the land fill site there with proper management system.

Table 16: Reasons for Conflict

| Reason | No. of households | Percentage |
|-------------------------------|-------------------|------------|
| Accident risk | 23 | 57.5 |
| Government's carelessness | 10 | 25 |
| Improper management of wastes | 7 | 17.5 |
| Total | 40 | 100 |

Source: Field Survey 2011

The reason for the conflict is generally due to livestock accident. Increase in the construction and operation related vehicular traffic has increased the chances of accident in the area. Similarly, government authority's ignorance about the demand of local peoples is also creating the conflict between them. Due to the improper management of the landfill site, the effects of wastes are increasing such as in the health of animals and in the health of local peoples. So the conflict is emerging day by day.

Table 17: Educational Status of the Study Area

| S.N | Educational status | Male | Female | Total | No. of households | Percentage |
|-----|--------------------|------|--------|-------|-------------------|------------|
| 1 | I.A or above | 10 | 5 | 15 | 20 | 7.17 |
| 2 | S.L.C | 12 | 7 | 19 | 23 | 9.09 |
| 3 | 6-10 | 20 | 15 | 35 | 22 | 16.74 |
| 4 | 1-5 | 30 | 24 | 54 | 25 | 25.83 |
| 5 | Literate | 30 | 36 | 66 | 25 | 31.57 |
| 6 | Illiterate | 7 | 13 | 20 | 20 | 9.56 |
| | Total | | | 209 | | 100 |

Source: Field Survey 2011

The above data analysis shows the clear data about the educational status of the study area. The data shows that male is more educated than female in higher education. Comparatively women are high in literacy level, due to various literacy program they joined, so that in the study area female are literate than male.

5.2 Economic Analysis of the Study Areas

Table 18: Occupation of the Study Area

| S.N | Occupation | Household | Percentage |
|-----|-------------|-----------|------------|
| 1 | Agriculture | 31 | 78 |
| 2 | Business | 4 | 10 |
| 3 | Service | 2 | 5 |
| 4 | Labor wage | 3 | 7 |
| | Total | 40 | 100 |

Source: Field Survey 2011

Chart 4: Occupation of the People



Source: Field survey 2011

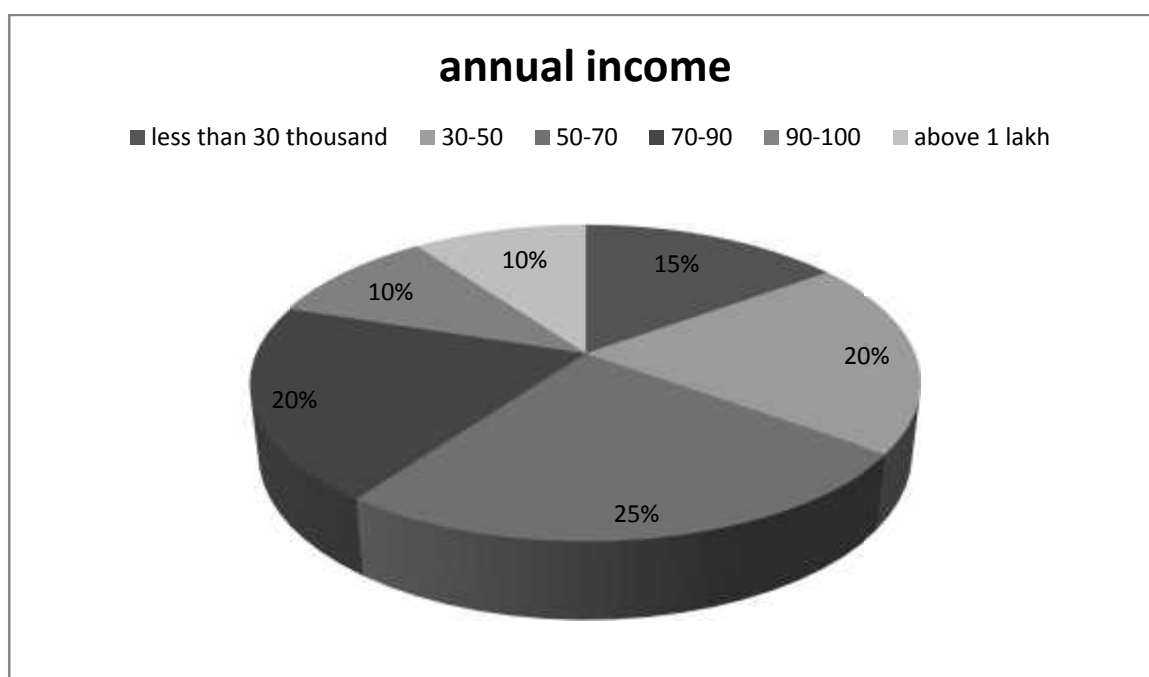
Nepal is known as the country of agriculture where most of the people are engaging in agriculture. Talking about rural area, agriculture is the main source of income. in this study site 78% people are engaged in agriculture, likewise 10% on business, 5% in service and 7% are in labor. More precisely, the main occupation of the people is agriculture. They produced maize, rice etc and nowadays they are conscious about the commercial farming system.

Table 19: Total Annual Income of the Households in Study Area

| S.N | Annual income | No. of households | Percentage |
|-----|-----------------------|-------------------|------------|
| 1 | Less than 30 thousand | 6 | 15 |
| 2 | 30-50 “ | 8 | 20 |
| 3 | 50-70 “ | 10 | 25 |
| 4 | 70-90 “ | 8 | 20 |
| 5 | 90-100 “ | 4 | 10 |
| 6 | Above 1 lakh | 4 | 10 |
| | Total | 40 | 100 |

Source: Field Survey 2011

Chart 5: Annual Income of the Households



Source: Field Survey 2011

From this data, it can be said that most of the people have 50-70 thousand annual income. This is very hard to get income in rural area where there is hard to solve the hand to mouth problem.

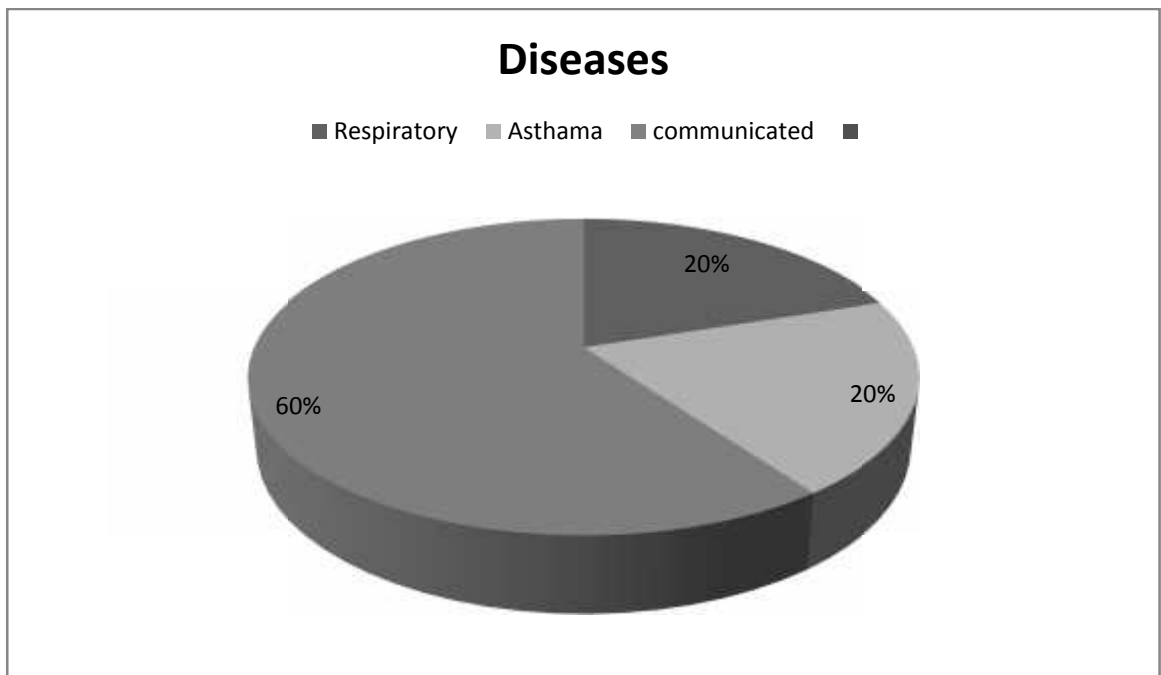
5.3 Health Impact

Table20: Health Problems of the Study Area

| S.N | Problems | No. of respondents | Percentage |
|-----|-----------------------|--------------------|------------|
| 1 | Respiratory | 10 | 20 |
| 2 | Communicable diseases | 30 | 60 |
| 3 | Asthma | 10 | 20 |
| | Total | 50 | 100 |

Source: Field Survey 2011

Chart 6: Diseases Created by Wastes



Source: Field survey 2011

Among the household surveyed, majorities were found to have an opinion that the disposal of the solid waste along the sites is not an environmentally sound method, which has further deteriorated the environment of the area. Although there was any

direct health impacts visible due to dumping these people seemed to believe that such activities in future might bring adverse health effects. Garbage of course harms the health whether it is animal, human being or plants. Solid waste especially creates communicable diseases.

5.4 Environmental Impacts

Table 21: Physical Environmental Issues and Impacts

| Issues | Impacts | Direct/indirect |
|----------------------|---|--|
| Land resources | Loss of agricultural land due to development of infrastructure and site | · D |
| Climate and weather | More on land fill area | · D |
| Water quality | <ul style="list-style-type: none"> · Water pollution due to solid waste dumping activities · Water pollution due to leachate generation and movement. | <ul style="list-style-type: none"> · D · D |
| Air quality | <ul style="list-style-type: none"> · Air pollution due to vehicular emission · Air pollution due to waste dumping activities. | <ul style="list-style-type: none"> · D and I · D and I |
| Noise and vibration | Noise pollution due to the movement of vehicle and equipment operation along road access and at the landfill site. | · D |
| Visual and Aesthetic | Visual and aesthetic impact | · D |

Source: Field Survey 2011

Note: D = Direct, I = Indirect

Table 22: Biological Environmental Impacts

| Issues | Impacts | Direct/indirect |
|-------------------------------|---|-----------------|
| Forest/ Vegetation | · Loss of vegetation for the development process, | · D |
| Terrestrial fauna and habitat | · Loss of terrestrial Fauna and habitat due to the project activities. | · D |
| Aquatic ecosystem and life | · Loss of aquatic life and habitat due to waste and leachate discharge in to the river. | · D |

Source: Field Survey 2011

Note: D= Direct, I= Indirect

5.5 Developmental Impact

Table 23: The Expenses Table for the Infrastructure Development

| ACTIVITIES | EXPENSES IN NRS |
|---|-----------------|
| Expenditure on entrance road construction | 21,28,05,000 |
| Infrastructure development of SLF | 3,84,97,000 |
| Infrastructure development of ALF | 1,30,00,000 |
| Total | 26,43,02,000 |

Source: Ministry of Local Development, 2006

Transportation is one of the major means of economic development of any place. It does not only connect two areas but also helps to take the agricultural products to the market and to improve the economic condition of the local people. Being more peculiar and talking about the study site there were no access of motor able road. People used to walk a long way through foot trails to move to urban centre mainly Kathmandu valley which use to take long time.

During the time of the study it came to know that till date around NRS. 26, 43, 02,000 has been used for development of infrastructure.

CHAPTER –SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter deals with the summary of the study, draw conclusion about the socio-economic and environmental impacts of the landfill sites of Okharpauwa VDC of Nuwakot district. Summary mainly insists on the objectives, methods and findings of the study. Conclusions mainly focus on the result of the study. Like wise recommendation part focuses on the suggestion or recommendation to all who are directly or indirectly affected by this site.

6.1 Summary

Living in clean and healthy environment is desire of human being. Due to rapid population and unmanaged settlement in urban area the problem is going to be severe these days. Many control mechanism are made for this. Instead of this mechanism its effect is multiplying day by day. So it is known as current challenge for every society in Kathmandu and other cities as well. KMC has responded with introducing a new waste management strategy simply by initiating a few new programmes such as community mobilization, private sector participation and increasing the budget for waste management. At the same time it is trying to make its programme more successful through the activities like PSP (private sector participation), capacity building works, medical waste management, door to door collection, community and children mobilization works and consultation to private sector. However in spite of this effort, there is still an urgent need to improve the overall performance of waste management services. We can't ignore the issue that is raising conflict between local people and government authorities. At such condition it becomes difficult to handle the problem that is rising due to such conflict. It's very important to know that solid waste management has direct and indirect impact on human life and all living creatures as well. KMC has given top priority to improve the waste management system of Kathmandu Valley Mapping Programmed (KVMP) is assisting in this process.

The study is focused to analyze social impacts of landfill site to its surrounding community, economic opportunities and threat to the environment that has been

emerged through the development of the landfill site. The major findings of the study site are listed as follows:

-) In the study area there are different types of ethnic and caste groups, such as Balami, Chhetri, Brahmins, and others. This area has maximum number of Balami followed by Chhetri and Brahmins.
-) In the sector of education, only literate people are more in that female are more literate than Male , the number of literate women in 30 households is 40 and men is 30.
-) The primary occupation of the people is agriculture with 79% share. Most of the people are engaged in agriculture and they produce vegetables to sell.
-) The economic status of the people is not so high because most of the people are based on traditional agriculture system. About 25% of the people have income of 50-70 thousand per year.
-) Talking about health impact, 60% of the communicable diseases are created by landfill site wastes.
-) From the study, we can say that waste has negative effect on environment. It has direct effect on water, land pollution, bio-diversity loss etc.
-) The landfill site not only harms the people and environment, it also has some positive aspects, such as developmental activities in the village, development of health post, awareness programmes, development of road etc which connect people with Kathmandu.

6.2 Conclusion

The present study site Sisdoile landfill site is situated in Okharpauwa VDC, one out of the 61 VDCs of the Nuwakot district. It is situated in the south western part of the district headquarter. The VDC occupies 18.90 sq.,km of the total area of the district. The altitude of the VDC ranges from 1164m to 3147m, above the sea level. The VDC is situated between 27°46' north latitude and 85°13' east longitudes.

It is well-known fact today that Okharpauwa is not the permanent solution of solid waste management of Kathmandu. It is technically and environmentally not suitable and it is very expensive. The environmental geology project of department of mines

and geology conducted a geological evaluation of the site and concluded that it was not suitable site for landfill. Similarly, a study done by Kathmandu Valley Mapping Programme indicated that cost for operating a landfill site at Okarpauwa, which is 28 km from Teku Transfer Station, is more than four times higher than locating the landfill at Chovar. Despite of its saying Okharpauwa was developed as the landfill site due to many political involvement. But saying this we can't ignore the positive impacts. It has positive impacts on many developmental activities such as road, electricity, education, health post etc. these can be the achievements for locals.

The burning issue in this area is never ending conflict between locals and authority for minor matters. We can see the conflict for small reason such as for accidently killing a chicken of a villager, the road is closed, so that the full amount of waste remain piled up on the side of road at Kathmandu. We can easily assume the harm of waste in Kathmandu, if the local of Okharpauwa closed road then about 450 metric tons of the waste remains on the side of open area or Chowk in Kathmandu. This is really severe matter in Kathmandu nowadays. This site creating problem day by day, there are some problems which has emerged there are as follows:

i) By locals:

- J Low level of awareness on locals: obviously the people of Okharpauwa are not aware about the process. They don't care about the development which they got after the landfill site. Such as road, health post. They are ignoring what authority makes for them for example they are making kulo between the roads. This really damages the road and creates problem for driving.
- J Conflict is major issues these days, we can see more and more conflict between locals with authority and other related persons. Loss itself is not good but making issue for a small reason is also not good at all. For the accidently killing of a chicken, local peoples are closing the ways with higher demand. This creates the conflict situation.

ii) By authority:

The disagreement can't be created by one side only. The carelessness of the government authority creates this issue severe day by day. The government is not responsible for the landfill sites and its management. Though local people are having benefits through physical development

such as road access, health post but no one is concerned about the future utility of this land and the environment. It is proved that this site is not environmentally suitable, it has lots of harm on the local people. There is no proper management and planning of government for solid waste management. Such as some amount of leachate is mixing in the kolpu khola, no processing of waste like in degradable and non degradable, no any planning for the use of this land. It's not out of political game. So without any assessment and proper planning it's being conducted.

While dealing more precisely, after the establishment of landfill sites the government started to assist for the establishment of the schools. Though the efforts were very limited in amount and seem like the snails race. At the same time, private investment in boarding school has increased mainly due to road accessibilities that can be noted as the positive result of the landfill site. The government has established health posts to deliver health service to local people. To ensure health services, people of Sisdole demanded health services from the very beginning of the establishment of landfill site. As response to the demand, the authority has assisted to establish health post and provided some medicine with health service. But it is also well said that the facilities provided are minimal and are not according to the prevalent required diseases care.

The construction of road, establishment of the educational institution and health posts are directly connected with the fulfillment of the basic needs as there are the three required efforts to uplift the living standards. Access of the road service connected them with cities and being more economical. In fact, road service make them more economic and people are able to sale their products. The co-ordination committee elected by mass meeting of the local peoples receives 10 million rupees per annum. The mobilization of this fund should be in the favor of local people. This is also affected by politics so that the people especially low income get very minimum amount. So they think that these activities don't have impact on their life except pollution.

Our government actually has no any clear policy, strategy and planning related to solid waste management. There are few policy made for solid waste management but they are not implemented properly. Talking about other countries like USA there is certain policy and clear strategy about the waste. They are not serious about only how

to dump but also in three R concepts; reduce, reuse, recycle. They first of all try to reduce the waste, and then they try to reuse the waste. If the waste can be recycling they use the waste as productive source. Likewise, they have proper management system and construction in the dumping site. They have planning for the use of land after the dumping waste. This is in fact not a hard task for our country as well. This is due to us conscious people are careless and the illiterate people can't do any thing for this. The land is useless for any productive activities for coming years. So government should be conscious about this because if it is not managed then it will have effect long last. Which is really bad for the local people? So this is the part of analysis. The leachate generated during the decomposition of waste which is collected in small pond is over flown. The leachate goes to nearby river, stream polluting the river source. People use the water of this stream for many purposes like cleaning, washing, irrigation, drinking water for animal and so on. The polluted water generated by landfill site created a number of problems in health, land productivity, agricultural system and biodiversity within the water. The polluted river used for irrigation also polluted the soil. At the same time, people are facing a number of problems to save their health.

The bad smell of the site is so harmful for health of the people. It has created itching and skin related problem to local people. Vultures are attracted by the open disposal system of the waste. These are the problems which we can see there and is going severe day by day. SWM has positive role though. At least, it is trying to reduce the pollution. The fact is that our solid waste management some how reduce the amount of pollution of Kathmandu and Lalitpur. It seems that it only transfer the amount of waste from one place to next. So it is clear that with the amount of waste it transfer harm as well, unless and until it is properly well cared and managed.

6.3 Recommendation

Solid waste management is a major challenge in urban areas throughout the world. Without an effective and efficient solid waste management programme, the waste generated from various human activities, both industrial and domestic can results in health hazards and has a negative impact on the environment. Understanding the waste generated, the availability of resources, and the environmental conditions of a

particular society are important to developing an appropriate waste management system. Solid waste has been a problem since mankind decided to live in the community. Waste is not worthless stuff, if we know it has lots of value within it. It is “Gold for known, Coal for unknown”. We can turn it from waste to income and other business sources. In the context of Nepal it will be a good option to reduce the pollution and increase the income. The main problem of this spreading pollution is that we people just think about us not about others so that we like to throw the bundle of wastes on the road but not to home. Being cleaned at home is not the solution of the waste management, so behavior of the people should be changed first of all.

i) Management of inorganic wastes for use :

The waste which is currently disposed in dumps, landfills, presents the greatest potential for recycling, processing, or reuse. In many countries, inorganic waste such as paper, metals, and plastics are readily recycled, as the world demand for this waste is growing. What is needed is a proper management system for recycling so that this waste can be sold based on world price. With a proper management system at the institutional level most inorganic wastes can be taken out of the disposal system.

ii) Make the organic matter useful:

Selected organic wastes can either be reduced or transformed into organically beneficial products through the application of new and innovative approaches and technology for the reuse of the resources for energy, organic fertilizer, and animal feed.

It can be utilized as follows:

• Bio- briquetting for the domestic use and for thermal power plant.

- Feed for animals,
- Aerobic composting
- Feedstock for anaerobic digestions i.e. (biogas plants)

iii) Implementation of strategies and possible implementation plan:

Organic waste should not be seen as a source of environmental pollution that has to be gotten rid of by putting it in a landfill site but this could cause other pollution problems.

There are number of possible plan for converting organic waste in to valuable products. While talking about this study, this study analyzes many individuals and institutional weakness.

6.3.1 The recommendation to the Local People

1. The local people should be responsible on the management and care of the developed infrastructure.
2. The local people should be actively participated in every work with own feelings.
3. Local people should understand the effect of minor reasoned conflicts, and behave properly to move ahead collectively.
4. Private investment should be promoted with effective operation mechanism and appropriate feasibility study.

6.3.2 Recommendation to the Government Authority

1. The waste produced by urban households contains significant amount of reusable and recyclable materials such as plastics, papers, glass and scrap metals. If sorting of these wastes at house holds level and sell to scrap dealer it will reduce the quantity of the waste on one hand and increase income on other hand. Therefore government should provide the 3 R concepts to the people for professional application.
2. Awareness programmes should be organize in proper and effective manner so that people can understand about how to handle the waste and mange it effectively.
3. The hawkers should be encouraged to collect reusable and recyclable materials from the households and promote 3R professionally.
4. Government should invest in the proper construction of the site such as leachate pond and be concerned seriously about possible harms to the local people.
5. Government should make proper waste management policy and analyze the effects of the implemented programs.
6. Management of regular supervision of the landfill site operation

7. Government should think seriously about the long-term effect of the site and manage the site.
8. Government should be concerned about the post utilization of the soil of the landfill site.
9. Management of proper processing system either in origination or destination.
10. Government should develop the infrastructure for the local people with the involvement of local people.
11. Government should be responsible for the regular management and should visit regularly to the site to assess the need of the site and demand of the local people.
12. Government should have clear task to mitigate conflict between the authority and the local people.
13. Establishment of compost plant rather than making stress on the landfill site for dumping purpose. Setting up a compost plant instead of a landfill is a better option from an environmental as well as economic point of view. Further it will be easier to dump the waste.
14. Government should establish the processing work on landfill site, if it is installed then, the local people will be involved in sorting of the waste and they can increase income through this activity.

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ANNEX -1
QUESTIONNAIRES

Some guiding semi-structured questionnaires

Group-A

- 1) a) Name of the head of the household.....
DistrictVDC.....Ward No.....Village.....
b) Sex..... c) Education.....
d) Occupation.....

- 2) Name of the respondent.....

- 3) Relation of the respondent with the head of the household.....

- 4) Information of the respondent
a) ageb)sex.....c) casted) qualification.....
e) occupation.....

- 5) Age group
a) Below 14 b) 15-59 c) Above 60

- 6) Family types
a) Nuclear b) Joint

- 7) types of house (wall)
a) Pakki ??(made up of brick and cement)
b) Made up of stone and mud with thatched roof
c) Kachhi (made up of hay and sticks)
d) Wooden (made up of wood)

e) Others.....

7) Social information of family members

| S.N | Name | Age | Sex | Educationa status |
|-----|------|-----|-----|----------------------|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |

Group B

· **Social:**

1) How many schools were there before and after the landfill site?

a) Before andafter

2) Is there any conflict after LFS?

a) Yes b) No

3) If yes, what are the causes of conflict?

a)

b)

c)

4) What do you think about LFS? Is this good to be here?

a) Yes b) No

5) If no, what are the reasons of your dissatisfaction?

a)

b)

c)

6) Was there this road before the LFS?

a) Yes b) No

7) Does this road effect on your daily life ?

a) Yes b) No

8) If yes, what can you do by connecting with road services?

a)

b)

c)

9) What you want from authority to be here?

a) Employment

b) Skill development program

c) Infrastructure development

· **Economic**

1) Source of income

a) Agriculture b) Job c) Wage labor d) Others

2) Annual income of the respondent

a) Less than 30 thousand b) 30-50 thousand c) 50-70 thousand d) 70-90 thousand
e) 90-100 thousand f) above 1 lakh

3) Major cropping pattern

a) Maize and paddy

b) Millet

- c) Vegetables
- 4) Is there any job created by the authority?
 - a) Yes b) No
- 5) If yes, what kind of job you get?
 - a) Labor b) collector c) administrations d) others
- 6) What type of infrastructure is developed by authority?
 - a) Electricity b) school c) health post d) road
- 7) Are the waste used for economic generation?
 - a) Yes b) No
- 8) If yes, how does it work?
 - a) Production of the fertilizer
 - b) Bio-gas
 - c) Production of fuel

· **Environment and health impact**

- 1) What type of the pollution can be seen there?
 - a) Air pollution
 - b) Noise pollution
 - c) Vision effects
 - d) Soil pollution
 - e) Water pollution
 - f) All of the above
- 2) Are the water resources contaminated?
 - a) Yes b) No
- 3) Does leachate cause ground water pollution?
 - a) Yes b) No
- 4) Can the water of Kolpu Khola be used?
 - a) Yes b) No
- 5) Is the waste carried from Kathmandu processed?
 - a) Yes b) No
- 6) Do you think the loss of biodiversity due to LFS?
 - a) Yes b) No
- 7) If yes what are those rare biodiversity, which were there before?

a) b)

b) d)

8) Any kind of bird hazards?

a) Yes b) No

9) What are the effects of the landfill sites in the animal rearing especially in the health of animal?

a) b) c)

d)

10) What kind of diseases can be seen?

a) Communicated

b) Respiratory

c) Asthma

11) Did you feel these diseases before?

a) Yes b) No

12) How many health posts are made by authority?

a) b) c)

d)