SOME GOOD EXAMPLES OF MUNICIPAL SOLID WASTE MANAGEMENT IN NEPAL AND AROUND THE WORLD

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Abbreviation

ADB	- Asian Development Bank
CBOs	- Community Based Organizations
GoN	- Government of Nepal
HH	- Household
INGOs	- International Non-Government Organizations
MSW	- Municipal Waste Management
NGOs	- Non-Government Organizations
NEPCEMAC	- Nepal Pollution Control and Environment Management Centre
SWM	- Solid Waste Management
SWMRMC	- Solid Waste Management and Resource Mobilization Center
TLOs	- Tole Lane Organizations
3R	- Reduce, reuse and recycle

ABSTRACT

Solid waste management (SWM) is one of the crosscutting environmental issues of many countries, including Nepal. The SWM affect livelihood, public health, sanitation, freshwater and terrestrial ecosystem, wildlife, natural resources directly or indirectly. Urban population growth and economic development lead to municipal solid waste.

The major objective of the study is to generate the data and information on adequate practices of solid waste management in Nepal and around world including the process of the technology of solid waste management and other vital information about the state of solid waste management in different part of Nepal and around World. Data obtained from the survey is expected to be a revolutionary for the future planning, monitoring and evaluation of the national development plans and programs related to solid waste management.

One of the cleanest city of country Dhankuta is an example showing that problems might be numerous if property managed the waste can be managed with the help of knowledge, training and awareness. Suiro Abhiyan in Hetauda is one the best example that's shows the recycle waste management in Nepal. Other like stakeholder/NGOs/INGOs/Entrepreneur has also played a vital role in Nepal waste management like NEPCEMAC and Khaalisisi.

Heath and waste in Indonesia, waste to heat in Sweden, waste to amusement park in Uganda, Semakau landfill to bio-diversity hotspot in Singapore and zero waste city in Japan is the best practices of waste management which can inspire others to invert and develop new and best practices of waste management.

1.0: INTRODUCTION

BACKGROUND

Solid waste management (SWM) is one of the crosscutting environmental issues of many countries, including Nepal. The SWM also impacts various areas of sustainable development. The SWM strategies, policies and approaches affect ecological, economic-social sustainability of every individual countries. The SWM affect livelihood, public health, sanitation, freshwater and terrestrial ecosystem, wildlife, natural resources directly or indirectly. Urban population growth and economic development lead to Municipal Solid Waste (MSW). In MSW, hazardous waste which is generated in urban area is another concern. Unmanaged disposal of hospitals and clinics waste or medical waste also contribute to pollution and public health hazards. Consequently, SWM has become a major concern in the world.

Every living being during their life, consumes water, food, and different materials. While consuming these things, living beings produce waste; "These wastes can be classified as solid waste, fluid waste, and vaporous waste". The term “solid waste” has been brought into use to separate between the current day broad idea including waste management and the past focus on garbage and other household waste that is because of the current waste is not taken only from the household but also include all the waste from the industrial commercial and agricultural activities. Solid waste is presently for the most part taken to incorporate all non-vaporous and non-liquid waste. Non-liquid waste coming because of the wide network of community, industrial, business, and agrarian activities is considered as waste.

Government of Nepal (GoN) has priorities SWM and endorsed the Solid Waste Management Act, 2011 which includes maintaining a clean and healthy environment by minimizing the adverse effects of solid waste on public health and the environment. The local bodies, such as municipalities is made responsible for the construction, operation, and management of infrastructure for collection, treatment and final disposal of MSW. The act mandates local bodies to take the obligatory steps to promote 3R principle that is reduce, reuse, and recycle (3R), including segregation of MSW at source. Also provides the private sector, community-based organizations (CBOs), and non-government organizations (NGOs) for the involvement in SWM through competitive bidding. It authorizes the local bodies to formulate rules, by-laws, and guidelines, with the approval of the municipal board.

SWM is the discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a proper manner that is in accord with the finest principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations. SWM includes all administrative, financial, legal, planning, and engineering functions involved in the whole spectrum of solutions to problems of solid wastes thrust upon the community by its inhabitants.

FUNCTIONAL ELEMENTS OF THE WASTE MANAGEMENT SYSTEM

There are six functional components of the waste management system as outlined below:

- Waste Generation
- Storage
- Waste Collection
- Waste Transfer and Transport
- Processing and Recovery techniques
- Disposal

The following flow chart shows the inter relationship between the functional elements in solid waste management.

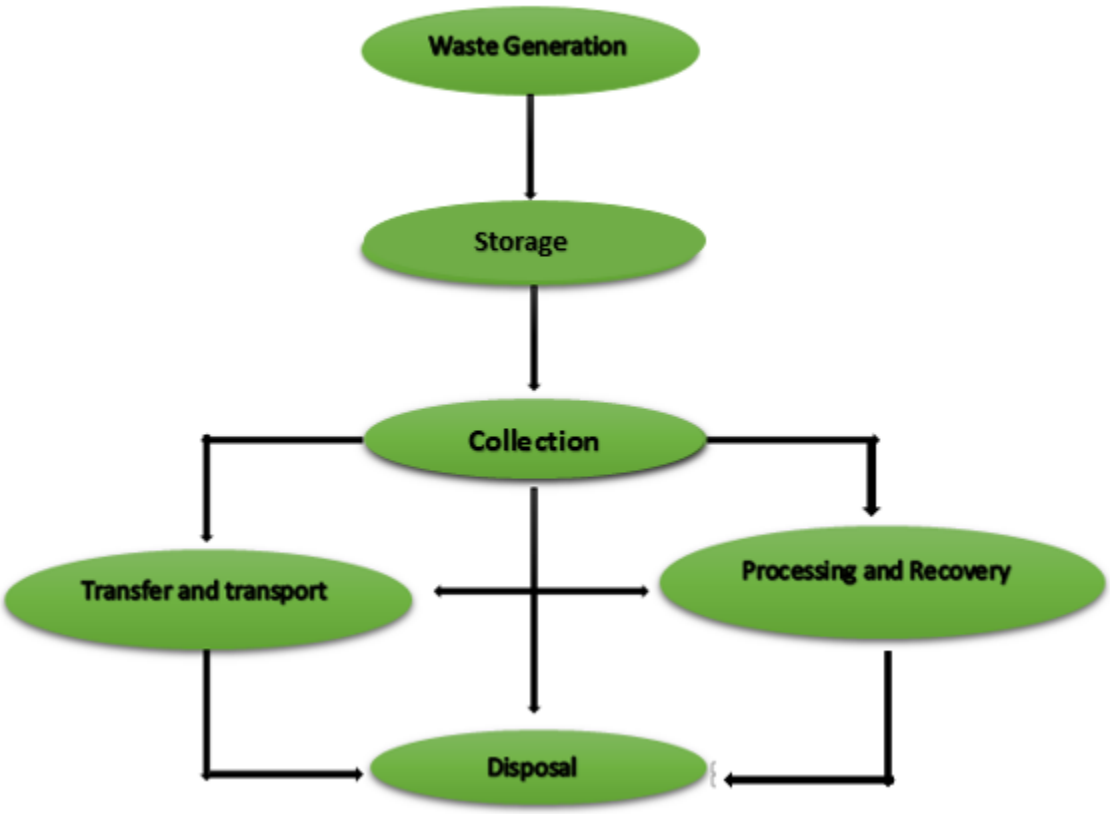

Figure 1 Functional element of solid waste management

WASTE MANAGEMENT METHODS

Different kinds of methods can be used to reduce the effect of waste on the general population and the environment. But the important thing that matters is not only the proper distribution of the waste but also the use to technology in management of the waste.

Incineration is mostly used in the developed nation because this process is very expensive to build and keep it running. During this process, waste is burnt down to reduce the amount of waste and the byproduct is heat. Further heat or the production of energy in the form of electricity can be used in industrials purpose. Although it reduce the waste to the landfill, this method very expensive due to the equipment needed. Also the end product ash which end up in landfill needed other equipment.

Anaerobic Digestion process can be very useful in developing or underdeveloped countries because high percentage of the waste is organic. The problem for the implementation of this process is segregation of the waste. This process is done with the help of microorganisms with very strict rules and methods, during the process of digestion no oxygen is used with a very low amount of water. The final product is fertilizer and it is used in agriculture like mentioned above it can only be done with organic material that needs to be sorted before the process is started.

Composting is the most commonly used method of reducing waste. This method is applied even at the household level to get manure. The simple process of kitchen waste to garden manure. This process is almost the same as digestion because it also uses the microorganism but with the aerobic condition. If appropriate method are made with good policy to promote this method it can be very beneficial in countries like Nepal.

Reuse and Recycle is one of the best methods to control and reduce the amount of waste. The method is popular in both developed and developing countries but the big difference is in developed countries it is done by creating a formal way on a big scale to extract high-value material and in developing countries is done on a small scale. The other thing that affects this process is segregation of the waste. Because if separation is done at the source it is less costly to scavenge the recyclable material in other words is it becomes cost-effective. Even though this process is promoted widely but recycling or reuse is only if there are potential markets. This suggests that there must easily access and availability of the companies from the place of segregation. Recycling depends on various factors like price, transport facility, and roads. Recycle is beneficial or applicable to any kind of economic. The problem with recycling in a developing country is it mostly done by the informal sector because it is taken as a work of low cast or poor people. So people doing this of work help to divert a large amount of waste from landfills to recycling industries. The scavengers are most likely to get different kinds of diseases because they are who visit the landfill and extract the valuable material in developing countries like Nepal. The informal sector or the scavenging is popular on the one hand because it is cheap on the other side it is not appreciated by the local people. After all, they think scavengers get the money from their waste. So in Nepal, the scavengers who visit the homes of people buy the recyclable material. This provides a win-win situation for both parties.

2.0: SCOPE OF STUDY

The present research mainly contain good practices of Solid Waste Management practices in Nepal and around world consisted of two parts. The first part includes research of good practices of SWM in Nepal including the technique and technology and the second part includes research of good practices of SWM around world.

3.0: OBJECTIVE

General Objective

The major objective of the study is to generate the data and information on adequate practices of solid waste management in Nepal and around world including the process of the technology of solid waste management and other vital information about the state of solid waste management in different part of Nepal and around World.

Specific Objectives

- Adequate practices of solid waste management in Nepal
- Adequate practices of solid waste management around World

4.0: LIMITATION OF STUDY

The research aim is to cover the good practices of SWM of Nepal and around world. However, the inadequate report, articles and research paper were only found. Also, due to the covid-19 the study was limited to online source. Thus, this might not cover global good practices.

5.0: LITERATURE REVIEW

Waste management is a complex task due to urbanization, industrialization and rapid economic growth around the globe. Waste production depends on the way of life of the people mainly the consumption habits of people. Urban establishment and migration to urban areas have increased the burden of the waste around the world. Increasing urban establishment, industrialization and the migration makes the process of waste management more difficult in future if the improved ways are not approached.

Underdeveloped or developing countries' nature of waste depends on the level of income. The higher level of income means people living in more urban areas and consumption resulting more waste and people from a rural area with low levels of income consume less resulting less waste also rural area people involve in indigenous waste management technique. Palnitkar (2000) has defined

Solid waste as a term especially used to describe non- liquid waste material that comes from the household, internal trade, commercial, agricultural, and manufacturing or industrial activities. In developing countries even with waste management, it only concentrates where there are high profile people, commercial areas, etc. Cointreau (1991) analyzed the effectiveness of waste collection in developing countries.

Landfill is the most popular and commonly used method of waste management in both the developed and developing worlds. Landfill can be seen in two ways first one is which are in developing countries where mostly open dumping is done which cause environmental problem leading to health hazards, the other one is controlled dumping found mainly in developed countries or where there is proper policy for waste management. Controlled dumping can be very beneficial in terms of the environment and economically. Controlled landfill sites are built in a way that it doesn't let the pollutants getaway which affects the environment not only this with this process or method there is the possibility of extracting one of the very potential gas called methane and it can be used in mostly in two ways, first is used as fuel for cooking and heating, the other one is for the generation of electricity.

6.0:SURVEY FINDING

Adequate Practices of Solid Waste Management

Solid waste management is defined as the discipline associated with control of generation, storage, collection, transport or transfer, processing and disposal of solid waste materials in a way that best addresses the range of public health, conservation, economic, aesthetic, engineering, and other

environmental considerations. Waste Management refers to the selection and use of appropriate management programs, technologies, and techniques to achieve particular waste management goals and objectives. (Leblang 2020)

Adequate Practices of SWM In Nepal

Kathmandu, Lalitpur, Pokhara, Ghorahi, Dhankuta, and Tansen have constructed sanitary landfill sites (ADB 2013) But, KMC and Lalitpur are facing the problems including frequent local protests, lack of proper management, and unavailability of necessary equipment, leading to unsanitary methods of disposal. While many municipalities have started to plan for a designated landfill site/dumping site, 14 municipalities still have no such plan.

Solid Waste Management in Dhankuta

In Nepal, most of the municipalities are struggling with the waste, Dhakuta was declared as the cleanest city in the country by the Government of Nepal in 2017 and was able to receive the prize money of 10 million Nepalese rupee. This was the second time when Dhankuta Municipality was listed as one the cleanest city. However, Dhankuta was also facing problems regarding waste management, it became possible when the World Bank mobilized the project of Output-Based Aid (OBA) in solid waste management (2013). 5 municipalities were selected by the OBA project Tansen Municipality, Dhankuta Municipality, Ghorahi sub-Metropolitan city, Pokhara Metropolitan City, and Lalitpur Metropolitan city. And target of the project was to benefit 800,000 people around these cities in solid waste management. After the selection, Dhankuta Municipality utilized the full potential of the project and gained a lot. The purpose of the OBA project in SWM was to reduce the gap between the cost of proper Solid Waste Management and income that the municipal office can collect from services provided and make the municipality independent in solid waste management (Bank 2013).

Every day about 10 tons of waste is generated amount which more than 50% waste is organic waste. After getting a proper training from OBA project people are able to utilized organic waste into manure and animal fodder. Other 50% which use to be dumped in landfill site are again segregated and reused and recycled by the local entrepreneurs. Dispute of these, municipality also conduct knowledge, training and awareness program are conducted in the local level. Daily or 2/3 times collection of waste from roadside, open pile and door to door are done. A technique of sanitary landfill site is also conducted in the municipality.

Solid waste management in Hetauda:

According to Hetauda municipality data and a field survey conducted in May 2008, the average HH waste generation rate in this municipality is 0.25kg/ person/day, which is same as the national average for urban areas and less than Kathmandu metropolitan city which is 0.39 kg/capita/day. The daily total generation in this municipality is 14 tons/day (SWMRMC 2008).

Suiro Abhiyan is a movement in Hetauda municipality concerned with the collection from HHs and recycling of plastic bags. It has turn out to be an exemplary practice in which members of each Tole Lane Organization are involved encouraging HHs to segregate plastics from other waste and

hook them onto a Suiro hook. Hetauda municipality is the first municipality to introduce this kind of program in Nepal.

Approaches from private organizations and TLOs has played significant role in developing at-source segregation of solid waste. The suiro program plays a major role in promoting the recovery of plastic waste. Ultimately, result in the reducing the amounts of plastic waste that are scattered and dumped, this program has also assisted in building a valuable relationship between women's groups and TLOs.

Involvement of stakeholder/NGOs/INGOs in Solid waste management

Nepal Pollution Control and Environment Management Centre (NEPCEMAC) established in 1997 is a non-profit independent organization, working in solid waste management with various communities of Nepal. NEPCEMAC is working in areas of Kathmandu metropolitan city, Lalitpur sub-metropolitan city, Biratnagar sub metropolitan city, Itahari municipality and Triyuga municipality.

NEPCEMAC has made an inspiring contribution to waste management in several urban areas of Nepal. Its awareness campaigns for household and schools are impressive. Similarly, waste collectors from NEPCEMAC are encouraged to recycle waste because they are officially allowed to keep any income they receive from the sale of recyclables. (Gotame 2012). NEPCEMAC has been conducting compost plan in Chovar producing compost by the waste collected form door to door and market.

Local entrepreneur and scavengers has played a vital role in the waste recycling process. Khaalisisi, organization collaborating with local waste entrepreneur who collects recyclable waste from local level resulting reduction of waste in the landfill site. Also, scavengers who segregate and collect waste either from roadside, open dumping site or landfill site has contributed in the reduction of waste.

Adequate Practices of SWM Around the World

Solid Waste Management in Indonesia; Health and waste

Malang, a city in Indonesia, generated more than 55,000 tons of waste every day resulting a huge pile of waste in landfill site. Also people health was directly or indirectly affected by waste and with majority people don’t having health insurance created more issue. Dr. Gamala Albinsaid, a healthcare entrepreneur and CEO of health company Indonesia Medika saw this as enormous social opportunity and created Garbage Clinical Insurance which let people trade garbage for medical services and medicines (Gering 2015).

The aims is to tackle both poverty and waste in Indonesia, a country where more than 10% live below the poverty line. This inspired low-income households to recycle their trash because by doing so they will be able to finance their health micro-insurance. The clinic takes in the trash

from people and sells it to recyclers for recycling. The money collected from recyclers is then spent on giving people basic health insurance.

Solid Waste Management in Sweden; Waste to heat

It sounds unbelievable, but yes Sweden has run out of trash and is asking other countries for their garbage so as it can keep its recycling plants running. About one percent of Sweden's household waste goes into the landfill dump and the rest is recycled in different ways. The 32 waste management plants in Sweden today produce heat for 810,000 Swedish households and electricity for about 250,000 private houses (W. Chan Kim and Mauborgne 2021). The country has adopted a recycling policy which funnels all the energy generated by burning waste into the national heating network. This provides an efficient way to heat homes in the freezing winter.

Solid Waste Management in Uganda; Waste to Amusement park

Ruganzu Bruno, artist and environmentalist has created an amusement park for the children living in the slums of Kampala in Uganda. However, not an ordinary amusement park, but one built entirely by waste. Bruno collected all the waste generated by the villagers and then, with their help, modified the waste to make swings and life-size board games. The goal of the artist is to make more than 100 such similar amusement parks in other parts of Uganda (Kermeliotis 2013).

Solid Waste Management in Singapore; Landfill to bio-diversity hotspot

The word 'landfill' immediately brings to mind an image of a mountain of rubbish, because that's what it is. Now, the landfill that is made out of rubbish is a bio-diversity hotspot that is home to flourishing mangroves, rich coral reefs and a capital of birds and marine life in Singapore (NEA 2021). The Semakau Landfill, is of the best example of how landfill site can be a beautiful nature.

Solid Waste Management in Japan; Zero Waste City

Kamikatsu in Japan, one of the role models for the world in waste management, as they announced themselves to be a 'zero-waste' region by 2020. Recycling being the core of most of their operations, the residents segregate their waste into 34 categories. 80% of the waste is recycled in the region, while only 20% goes to landfills (Tandon 2019). There are no garbage trucks, so each resident has to wash, sort, and bring their trash to the recycling center. A worker oversees the sorting process at the center, making sure trash goes into the right bins. Some used items are taken to businesses to be resold or repurposed into clothing, toys, and accessories.

7.0: CONCLUSION

Waste Management is an integral part of sustainable development of every country inducing Nepal. Starting for the scientific and effective waste categorization and collection from the primary source. Dispute waste management is done in many countries as well as Nepal, adequate practices of waste management is still fewer to be seen. Nevertheless different approaches and ideas are immersing like waste to cash, waste to heat or energy, waste to art and so on. This has

open the door and inspire and encourage every individual engage in waste management practices. Thus, creating a huge benefits, opportunities and concepts for future.

Nepal as a developing country it been very difficult to immerse in the sustainable development of waste management. However, we can see some of the good example of sanitary landfill site in Nepal. As more than 50% of the waste generated is organic waste, Nepal has introduced composting training and practices in HHs and in organization level.

Municipality like Dhankuta certified as one of the cleanest city of country by Government of Nepal in 2017 is one of the example showing that problems might be numerous if property managed the waste can be managed with the help of knowledge, training and awareness. Suiro Abhiyan in Hetauda is one the best example that's shows the recycle waste management in Nepal. Other like stakeholder/NGOs/INGOs/Entrepreneur has also played a vital role in Nepal waste management like NEPCEMAC and Khaalisisi.

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ANNEXES

Annexes 1:

Waste to Amusement Park, Uganda

Annexes 2:

Semakau Landfill, Singapore

Annex 3:

Local segregating waste in Kamikatsu in Japan

Annex 4:

Botanical garden constructed over the landfill site post closure of it in Dhankuta, Nepal.

Municipal Solid Waste at transfer station for segregation and compaction in Dhankuta, Nepal.