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IMPROVING A MUNICIPAL WASTE MANAGEMENT STRATEGY

Case: Sunwal Municipality, Nepal

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<p>With the increasing number of wastes all over Nepal, Municipalities face big problems and challenges on waste management from local bodies, budget, skill staffs and government policies. The study gives an overall picture of waste management situation of Sunwal municipality. The purpose of the thesis was to find out waste generation, waste composition, the current waste management system, gap and the shortcomings of Sunwal municipality waste management system and develop a strategy plan to improve the current waste management system in the long run.</p> <p>Electronic questionnaires were done to municipality environmental officer and the college students. A visit to the landfill area was done and interview to municipal waste collectors, households, restaurants and hotels owners and local recyclers were conducted. The study also includes PESTEL and SWOT analysis to help to find out a better strategy.</p> <p>A strategic plan is presented which intend to improve current waste management system towards integrated waste management system. It discusses important concepts such as segregation at source, 3R practices, strengthening capacity, public participation and safe disposal in the context of Sunwal municipality.</p>		
Key words Integrated Waste Management System, Municipal Waste, Waste management Strategy		

CONCEPT DEFINITIONS

ADB	Asian Development Bank
Doko Recycler	Waste recycling company in Kathmandu
Hilly	middle hill region
IGES	Institute for Global Environmental Strategie
ISWM	Integrated Solid Waste Management
IWM	Integrated Waste Management
IWMS	Integrated Waste Management System
Kabadiwala	local waste recycler
Khalisisi	Waste recycling company in Kathmandu
KPI	Key Performance Indicator
MSW	Municipal Solid Waste
NGO	Non-Government Organization
NRs.	Nepali Currency
PPP	Public Private Partnership
SWM	Solid Waste Management
Terai	Plain Land region
3R	Reduce, Reuse and Recycle

ABSTRACT
CONCEPT DEFINITIONS
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1 INTRODUCTION

1.1 Background

City, country and world is growing fast with introduction of new technology and innovation. Population has increased rapidly resulting increase in households, industries, factories, hotels and restaurants, and other facilities. Uncontrolled and rapid urbanisation, poor municipality management, unsanitary waste disposal and management and the lack of public awareness has led to an increase in solid wastes and has a negative impact on environment. Waste has been one of the increasing problems for the world. People, households and business sectors generate a large amount of solid waste daily. The world is struggling to manage waste which is produced by 7.7 billion of populations (Worldometer 2019). Only the developed countries are able to impose an effective solid waste management system. Over a half of the world countries do not have waste collection facilities. Countries which do have a waste management system face several challenges with the increase in population (Gamaralalage & Macdonald 2018).

For the developing countries such as Nepal, solid waste management has been a major health and environmental issues. Solid waste is increasing rapidly with the increase in service industries. Waste is thrown on the street, in front of the houses, hotels, shops. The main sources of wastes in Nepal are households, institutions, streets, markets, commercial areas, public areas and industries. According to Asian development bank 2013, Waste generation in Nepal is 317 gm/capita per day (524000 tons per year). There is no systematic waste management system in Nepal. The waste management system mostly includes collecting, transporting and landfill. It is basically collection and disposal. The main target is to collect waste as much as possible to keep villages and towns clean. People do not know where their waste goes after collection and have no idea that waste is actually a valuable resource which generates money, provides job and contributes to the economy of the country. (Acharya 2017.)

Nepal 60% waste is biodegradable which can be composted. The problem is the lack of segregation and failure to recycle and most importantly increase in plastic waste. All the waste is mixed which causes a major problem. There is no systematic waste management system which can go beyond collecting and dumping. Nepal also lacks an alternative plan for landfill. They mainly focus on one landfill site and when it went on its full capacity only, they plan for other. The main problem is not following the basic

3Rs practices of waste management and the lack of responsibility and coordination between municipality, government and locality. (ADB 2013.)

1.2 Objective

The main objective was to find out strategy that can improve the current waste management practices in Sunwal Municipality, Nepal. For that it is necessary to find out waste generation, waste composition, current waste management practices, the shortcomings of current waste management.

The objective of the study is

- To Find out municipal waste generation
- To Find out municipal waste composition
- To Find out current municipality waste management practices
- To Find out waste management gap and shortcoming
- To develop a waste management strategy

1.3 Scope and Limitation

The survey consists of visit, direct questionnaires and social media questionnaires. Questionnaires were done to households, restaurants, hotels, municipality office and individuals about wastes produced and waste management. Municipality waste generation and composition data was taken from Asian Development Bank and Sunwal municipality. Multiple visits to local kabadiwala, municipal waste collecting staffs and drivers, dumping sites were done. Other required information was taken from official website of Sunwal municipality. Questionnaires' were done to municipality staff also by email. Visiting of 13 wards, dumping sites, landfill was done to find out the current state of solid waste management in Sunwal municipality. All the materials and required information was gathered from ward of municipality which has 13 wards.

During the study, only household, institutional and commercial waste were taken as municipal waste. Wastes from street, open areas, parks were also not considered. The survey was done for short period of

time with limited resources. The longer survey with enough sources could result in more accurate information. There was not up-to-date data for municipal waste record.

1.4 Government Policy on Solid Waste Management

Government introduced Solid Waste Management Rule, 2070 (2013). The objectives of solid waste management Rules 2070 are as follows: (Nepal Law Commission 2013.)

- The local body shall be responsible for segregating organic and non-organic solid waste at its source.
- It should determine time, place and manner of solid waste discharge. It should also consider transportation, processing and final discharge of solid waste.
- It shall be responsible for discharge and management of chemical and harmful solid waste.
- It shall conduct public awareness programs.
- It shall be responsible for management and segregation of solid waste.
- It shall utilize vehicles for the transportation of solid waste.
- It shall operate the sanitary landfill site. It shall also manage after its closure.
- It may mobilise non-governmental organisation in the solid waste management works.
- Private sector obtaining license should follow the standard maintained by local body. The licence may be revoked in case of violating it, violating environmental law and not following its standard.
- The local body shall impose service charge for solid waste management. The service charge may be discounted fully or partially to underprivileged group.

2 WASTE GENERATION AND COMPOSITION

According to Sunwal municipality, currently waste is collected by tractor on ward no 4, 1 and market area on daily basis. However, on the rest of the ward, waste is collected once in a week. The municipality has addressed not to mix organic waste with inorganic waste. After collecting inorganic wastes by vehicles, it is then taken to hilly area of ward 4 where the waste is dumped in a pit. There is a total of 5 municipality employees for waste management. (APPENDIX 2.)

Although municipal waste includes industrial waste, agricultural, bio-medical, hazardous and other street and market waste, only household waste, institutional and commercial waste are described as Municipal waste here. From the data given by Sunwal municipality, Municipality generates 3000 kg of waste per day (APPENDIX 1/1). The waste generated depends on the economic status, geographical region and climatic condition. The waste produced in the rural ward(terai) is higher in amount than in the urban ward(hilly). Organic waste and plastic waste are the highest among wastes produced in municipality. With increase in plastic product and its uses, it has been growing concern and problem for the municipality. Since there is no systematic waste separation from source, most of the waste generated by municipality is mixed and wet. (APPENDIX 2.)

From the data given form Sunwal municipality, 75 % waste generated are organic waste (55% related to agriculture, 12% paper and paper products, 5 % clothes, 3 % leathers) and 25% are inorganic waste (20% plastics, 1% rubber, 1 % glass and 3% others. (APPENDIX 3/3.)

3 EXISTING SOLID WASTE MANAGEMENT SYSTEM

According to Asian Development Bank 2013, Nepal spends 60-70% of municipality waste management budget on collecting wastes. About 20-30% goes on transport and the remaining small amount goes for disposal. There is no systematic waste management system in the municipality. It has not any project and plan regarding solid waste management (Sunwal Municipality 2075/2076). The system only focuses on collection and disposal of waste. This system is applied from earlier time and there is no sign of adopting new system. Municipal waste collector and Kabadiwala is playing a key role in managing waste of Sunwal. A Municipal waste collector goes door to door to each ward depending on the specific day. The municipality currently disposes large amount of waste on landfill. The disposed waste is then sorted by local recycler where little amounts of waste are reused, recycled and recovered. There is no effort from municipality of preventing the waste. The main issue is that municipal waste is not treated before disposal or seen as a resource which generates income. (ADB 2013.)

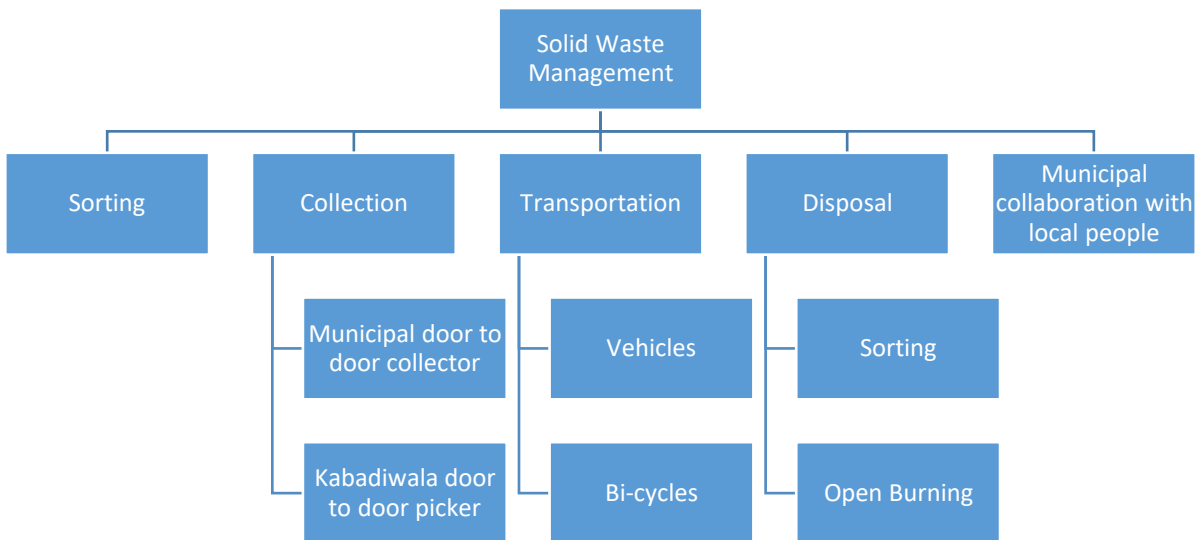


FIGURE 1. Current waste management practice in Sunwal Municipality

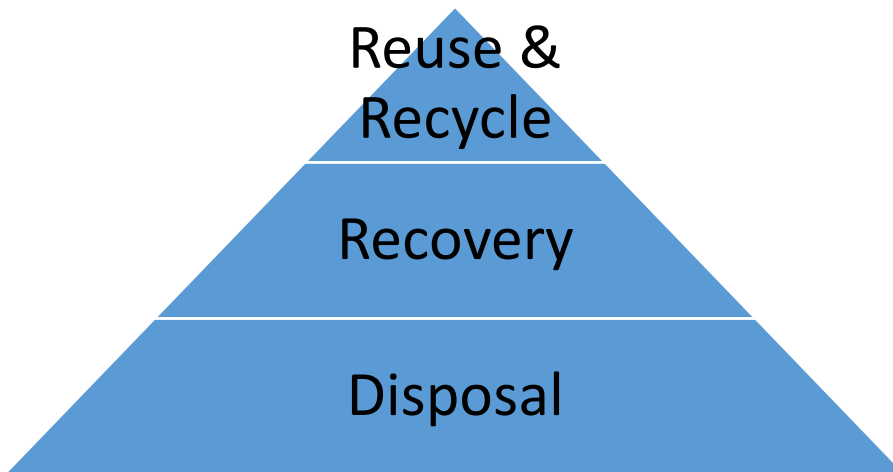


FIGURE 2. Current waste management hierarchy of Sunwal municipality (Whatplastic 2018).

3.1 Segregation and Collection

Only 30% of household waste is segregated at source, the rest 70% is collected by municipality and is disposed in the form of mixed waste (ADB 2013). Kitchen waste is segregated for its own uses such as domestic feeding. Other waste such as paper, bottle, iron, steel is segregated and sold to Kabadiwala. The mixed waste is collected by a municipal vehicle with one driver and two helpers. The collection is done in each ward according to municipal schedule. For example: waste is collected in ward no.3 on Sunday morning every week. Door to door collection and contact basis is applied mostly in this municipality for collecting waste. They will take the recyclable and reusable waste. There are 5 employees and 3 vehicles for collecting of waste. Other waste such as street waste, road waste is neglected. Some households segregate kitchen waste and use it for cattle feeding and composting. (APPENDIX 2 & 3/3.)

Kabadiwala do door to door visits to people's houses for collecting waste which can be reused and recycled. They also go to industries and factories on a phone call basis. They pay per kilo rate to the items which can be reused and recycled depending on the items.



PICTURE 1. Municipality vehicle collecting mix waste from resident (ward-03)

3.2 Transport and Disposal

At the beginning, one vehicle was used to transport municipal waste. Recently 3 vehicles were added for transporting collected waste in Sunwal municipality. It is then transported to final disposal sites. The final disposal sites are 3 km north from the centre of the Sunwal city area which is in ward 4(hilly side). The final waste is disposed without treatment. The disposal is done carelessly. The waste disposal is not planned beforehand. It is the driver who decides where to do the disposal not the municipality office. The disposal is done 3 km away north from the municipal area. If a villager complains about disposal area, only then disposal sites is postponed to different sites.



PICTURE 2. Current municipal waste dumping site

3.3 Sorting

Kabadiwala plays an important role in the sorting of disposed waste. In Sunwal municipality, there are 5-6 small recycler companies. The company employees either go door to door to houses, restaurants, shops for collecting recyclable waste or they make contract with municipality for sorting out disposed wastes. Recently, municipality has contracted disposal site for 50 thousand Nrs. (€450) with one of the local recyclers for one year (APPENDIX 3/3). Kabadiwala then goes to landfill and sorts out the useful items which can be reused and recycled. Then the recycled iron, metal, plastic is sold as resource to the respective company.



PICTURE 3. Recyclable waste collected by kabadiwala

3.4 Open Burning

After sorting the waste source in landfill, recyclable and reusable waste are taken away by kabadiwala. After that the remaining mixed waste which contains glass, papers, plastics, organic food, metals, steel and many more are burned openly by the Kabadiwala neglecting its impact. This causes smelly, hot temperature around the dumping sites. It creates serious health risks and environmental problems not only for the nearby village area which is 3 km away but also for whole Sunwal municipality.



PICTURE 4. Open Burning at the municipality disposal area after sorting



PICTURE 5. Open burning under the bridge of Mahendra Highway



PICTURE 6. Open burning in front of a shop

3.5 Municipal collaboration with local people

Municipality has less effort on bringing waste management education and awareness program. There is no special event to promote waste management system in the municipal area. Only cleaning is done during a special event or festival. For example: if there is some festival coming near then every ward will clean their ward. One person from each house comes in the event with different tools for cleaning. The main target of the event is to collect and burn the mixed waste which is hazardous to the environment and local community.



PICTURE 7. Local People participating a cleaning event(ward-03)



PICTURE 8. Mayor visit during ward-03 cleaning event

4 THE SURVEY RESULTS

The main target of the survey was to gain idea about the current waste management practices and local people knowhow on their waste generation to the final dispose. For this, A survey was carried out among local people, restaurant and hotel owners, college students and municipality employee. The survey was done during my stay (January-March 2019) in the Sunwal municipality. During this period, information was gathered from households, restaurants and hotels, local recyclers, college students and municipality employee. several visits were done to local recycler storage area, municipality waste disposal site for gaining clear picture. About 100 college students were involved for social media questionnaires.

4.1 Survey carried out among local people and recycler

The survey was done to local people from neighbour households, restaurants, hotels, shops regarding waste management. Most of the restaurant, households and hotel owners do not know about waste management. They throw all the wastes in one garbage bin which is collected by municipality. Wastes such as plastics, rubbers are burnt in front of shops. Few households and restaurant sort out organic food, iron, metal, plastics. Food is given to domestic animals. Metals, irons, plastics bottles are sold to kabadiwala. Other mix waste is burnt.

A survey is also done with local recyclers. Since it is a private own business, the local recycler was not happy with municipality due to the lack of support. There is a lack of respect in the community and the recycling job is considered as low-level profession. They face many challenges during their profession. One of the recyclers mentioned that while buying recyclable waste from people it can be theft item and can cause bigger problems for them. So, they were hoping for government support and encouragement.

4.2 Questionnaire to College Students

A questionnaire was done by social media to local students. About 100 students from different ward numbers were asked about waste management on Facebook by creating group. Out of 100 students, only 30 students responded. Most of the wastes consists of organic mainly from kitchen. Students were

unaware of 3R of waste management. Students does not have any idea where the final collected municipal waste goes. Few students have heard about the dumping area but have never seen it. The rest have no idea. They do not know what municipality does to the wastes after collection. Participants do not remember municipality waste management awareness program or campaign, but they do know sometimes there is a cleaning event on each ward during a festive or a special occasion which includes sweeping and burning. On suggestion, they want the municipality to collect waste more than once a week. (APPENDIX 2.)

4.3 Questionnaire to Municipal Staff

A questionnaire was sent to environmental officer of Sunwal Municipality by email address. According to him, waste collection service is free of cost. The disposal place which the municipality has chosen for the municipality waste is far from the residential area and does not hamper to the life of municipal people. During disposal organic waste is buried in to the ground. During sorting, only some waste is recycled. The municipality organises regular projects for awareness programs for solid waste management. In future, the municipality has a plan for sanitary landfill site and public partnership system. (APPENDIX 1.)

5 FACTORS INFLUENCING WASTE MANAGEMENT

PESTEL analysis was carried out in order to understand the macro environment of Sunwal municipality. Any change on the macro environment factors can have an impact on waste management as well as other waste management key players. SWOT Analysis was done in order to understand strength, weakness, opportunities, and threats for waste management system.

5.1 PESTEL Analysis

PESTEL analysis provides detail about challenges which can come during operation of waste management. (De Bruin 2018.)

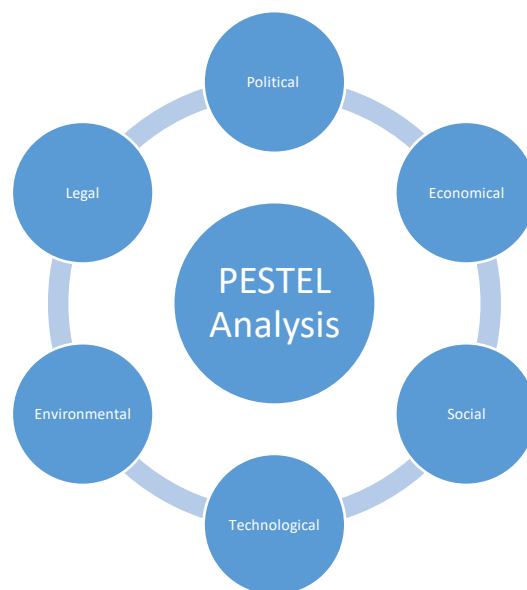


FIGURE 3. PESTEL Analysis.

5.1.1 Political

Nepal has waste management Act 2068, which imposes a service fee on solid waste management, provide technical supports to local body, has clear guidance for municipality for operation and management of wastes. It promises to keep clean and healthy environment by minimising adverse effect of solid waste on health and environment. It has stated that municipalities will take charge of collection, transport, treatment and final disposal of waste. But waste management 2068 Act is more on paper than in action. Moreover, Nepal has political instability. Nepal government and management has bureaucracy system. It also has high level of corruption.

5.1.2 Economic

Currently Sunwal depends only on collecting and disposal of waste. The current waste management is done by the government. There is no direct fee for the service. Introducing a waste management strategy will need funds from sorting to landfill. It will need investment from government, private sectors. Most of the wastes in the area is found to be mixed and wet, hence, required more funds and time for sorting. It will require more resources to operate and salary for human resource. It also needs sorting, storage department and landfill which will require funds. Carrying out waste management strategy will need budget allocation. Therefore, during the beginning phase, waste management strategy requires more funds. However, once the system gets established, it starts generating income and gives employment to local people.

5.1.3 Social

Sunwal people do not have a waste management culture. They mix all types of waste and throw them together in a sack. Therefore, changing the culture and introducing a waste management culture and system will take longer time and investment. It will need much effort, education, awareness program and time to establish a sustainable waste management system. Local people of Sunwal also need to be willing to pay for the waste management. Gradually, local people will get used to it and will be attracted to waste management system. There should be social conditions for waste workers. The sanitary disposal should be far from the residential area and has to be treated regularly.

5.1.4 Technological

Municipality do not have latest technology for supporting waste management system. It lacks skilled manpower, latest tools and technology for recording data. Therefore, it is hard to get accurate waste generated or related data. Municipality has limited vehicles and staffs for collecting and transporting waste. The municipality would need different coloured bins for sorting out different waste. It would require segregation, waste sorting, waste weighing and waste treatment facilities before going to disposal area. All the waste generated, collected, sorted, composted and disposed data should be maintained and updated regularly.

5.1.5 Environmental

Waste can be seen on the street, road, river side, market area, and near households. Sunwal municipality also has a hot climate. The waste has a negative impact on the environment of Sunwal. It has created bad smell, polluted air and water, and has several health impacts on human beings and animals. Open burning has produced carbon emissions in the air. Therefore, a systematic waste management is important for the municipality. It helps to keep the city and the surroundings clean and lower the environmental impacts.

5.1.6 Legal

Municipality lacks laws and regulation in action for waste management. The laws and regulation for waste management is based only on paper. The responsible staff for waste management is not taking responsibility and commitment towards waste management. They are happy to repeat the same old system of collection and disposal. The municipality should introduce segregation, 3R practice and composting rules. Municipality should introduce a reliable service which local community can trust, and collection of waste should do frequently in each ward. It also should have health and safety law for workers.

5.2 SWOT Analysis

It helps to get information related to each sector. The municipality would be able to use the information and compare the positive and negative side. Finally, it would help to take decision based on the information and implement the strategy accordingly. (Schooley 2019.)

TABLE 1. SWOT Analysis of Waste Management System in Sunwal Municipality.

Strength	Weakness
<ul style="list-style-type: none"> • Large amount of sources • Large manpower • Lower cost manpower • Political support • Suitable location • Sustainable strategy 	<ul style="list-style-type: none"> • Mixed and wet source • Lack of waste management culture • Weather conditions • Lack of education and awareness • Waste management costs • New to people
Opportunity	Threats
<ul style="list-style-type: none"> • Job opportunity • Economic upliftment • Lower health and environmental impact • Cleaner city • Happy and satisfied people • Business opportunities 	<ul style="list-style-type: none"> • People can be misguided • People will not accept waste management system • not enough funds • lack of results may lead misunderstanding • bad odour and smells due to weather conditions • political instability and lack of political support

5.2.1 Strength

Sunwal municipality produces a large amount of waste resources which are mainly collected and disposed. Therefore, it has enough sources to operate the organisation. Large number of people of Sunwal municipality are jobless. It is easier to find the manpower and with lower cost. Sunwal geographical location is in terai region. So, it is easy for transporting the wastes. Current waste management system is operated by government and it will have government and political support as well. the strategy introduced has great benefit in long run and is sustainable.

5.2.2 Weakness

The waste produced in Sunwal Municipality is mixed with different waste categories. The main problem is that the inorganic waste is mixed with organic waste. The resultant mix and wet waste make difficult and time consuming for sorting out. Sunwal municipality people do not have a culture of waste management system. Municipality lacks education and awareness on waste management system. During summer, because of high temperature it will be hard since it will create bad smell from wastes. During rainy season, rain will make transportation and storage difficult. The strategic waste management system will be new to people and takes time to understand by people and will be costly in the initial phase.

5.2.3 Opportunity

Waste management will create more job opportunities to local people and will introduce different business opportunities. This will help to uplift the economic status of the municipality. With the introduction of the better waste management, it will help to keep city clean and lower environmental impact. It will lower the health impact to the local people and eventually make people happy and satisfied.

5.2.4 Threats

Introducing a waste management culture to the local community, it will create confusion among the residents. Initially people will not accept the system and it will take more time and money for education

and awareness. There can be lack of enough funds for carrying out the program which can lead to a complete damage of the system. People always look to the positive results. It can be a threat not to achieve positive results on a given time. Moreover, Nepal has political instability. If there is different party on the power, then there will be a chance of lack of political support and funding.

6 WASTE MANAGEMENT STRATEGY

Sunwal municipality waste management is limited to waste collection and disposal. The current waste management system is practiced from long time ago. The municipality does not follow segregation, 3R practices and sanitary. The effort made by municipality is just to keep street and neighbourhoods clean. The current system is only for solving day to day problems but lacks long-term vision. Because of this, the amount of waste generated keep on increasing but municipality does not have better plan and capacity to deal with growing waste. In the future, it will create big problem for the municipality. On the other hand, this is an opportunity for the city. Therefore, a waste management strategy is proposed which target to improve current waste management system.

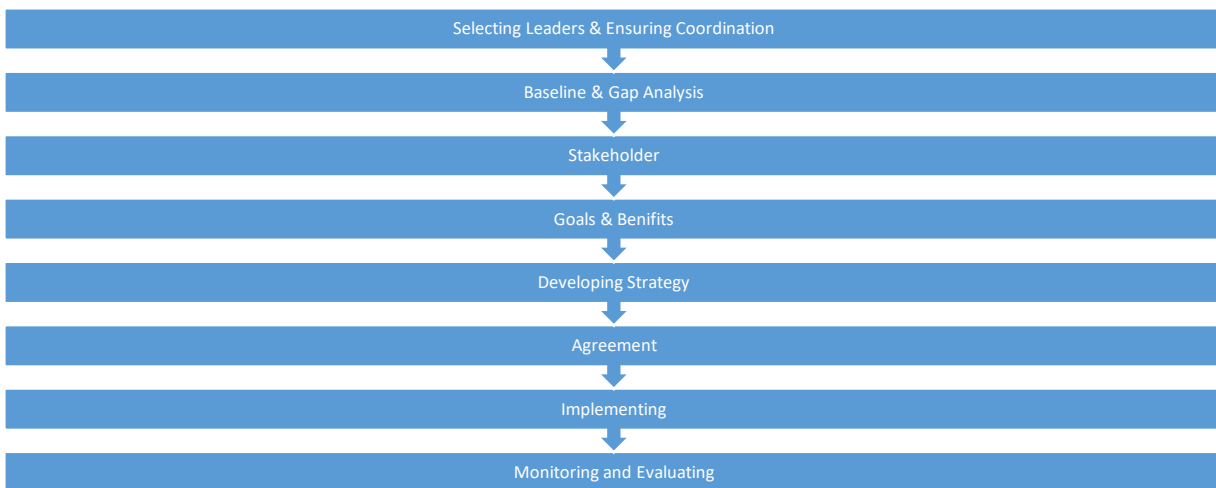


FIGURE 4. Proposed Waste Management Strategy. (Gamaralalage & Macdonald 2018.)

6.1 Selecting Leaders and Ensuring Coordination

Municipality should select leaders who has political power and resources. The leaders should be in charge of waste management and have full responsibility for driving waste management strategy. The selected leaders should provide unity of purpose and political commitment to the community. The leaders should drive the waste management system to the success with common purpose and goal. the leaders should make coordination among different governmental and non-governmental agencies such

as environment, labour, health, safety. It should also ensure all agencies are actively participating having common goal for the development of the strategy.

6.2 Baseline and Gap Analysis

For developing the effective waste management strategy, it is important to know current waste management situation and identify the gap. Data related to waste generation, waste classification, collection, transportation and disposal should be collected. The municipality should address technology, employees, infrastructure, budget used for the current system. It also has to identify capacity, infrastructure, skill employees, technology required for the city for developing new strategy. Sunwal municipality needs to address those identified gaps.

The following things are the shortcoming and gap of current Sunwal Municipality waste management system:

- System has to be adopted according with time and situation but Sunwal municipality is adopting the same waste management system from a long time.
- The system basically is collection and disposal or open burning.
- It focuses on less collection of waste but higher number of disposals.
- Open burning on street and landfill.
- This has a serious impact on health and environment.
- The current waste management system focuses on day to day collection. It collects whatever it gets and dispose it without caring its impact.
- The municipality does not have a sustainable goal.
- The municipality does not have a closed landfill and treatment process on the landfill.
- People of Sunwal municipality is unaware of waste management system. All the waste generated are mixed and wet.
- Lack of public awareness and education regarding waste management.
- Lack of sorting and 3R practice of waste management (ADB 2013).

6.3 Stakeholders

All the stakeholders must be identified wisely. The government plays a key role in creating waste management strategy. Other government agencies such as environment or health play major roles. Organisations and groups also play important roles in activities of waste management. In waste management, stakeholders can be waste generators, service providers or supporting body. They can be private sector, NGOs, communities or academic institutions. Roles must be identified for each stakeholder. A committee must be formed where representatives from different stakeholder groups meet for the discussion.

For example, kabadiwala plays a vital role in segregation and recycling of wastes. They have been in the business for many years. Involving them with other stakeholders would be a great idea.

6.4 Goals & Benefits

The municipality should focus on reduction of generation of waste and sorting out of different wastes, rather than managing day to day wastes generated. At the initial stage, municipality should give priorities to some categories of waste, but other waste should be managed later.

The municipal strategy should have specific targets to achieve goals.

- Priorities for sorting wastes
- Adopting 3R activities
- Accelerating waste collection
- Stopping open disposal and burning
- Capacity building
- Awareness raising
- Regular monitoring

The strategy should also provide benefits such as waste reduction, lower operating costs, economic opportunities, resource efficiency, improve health, lower environment impacts.

6.5 Developing Strategy

The municipality should focus on building upon existing waste management system rather than developing a new one. It should consider previously identified issues and should consider the following:

- Identifying actions
- Identifying targets
- Action plan
- Policy into action

6.5.1 Identifying Actions

The management of each waste category or issue should be analysed properly. It should focus on the use of limited resources available rather than managing waste better. The waste should be treated as resource for generating income. Current waste system should be lean towards integrated waste management system. The resource should be recovered, recycled and reused. It should focus on strengthening capacity, attract public private partnership and public participation. It should impose cost recovery scheme and set waste management priorities. It should manage all the waste management data and update it regularly.

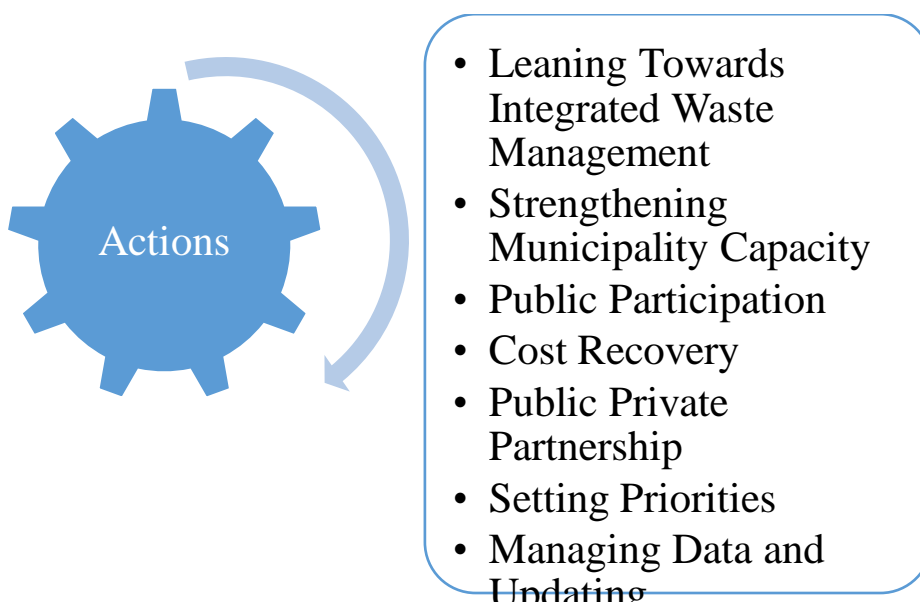


FIGURE 5. Action for improving the Current waste management. (ADB 2013.)

a) Leaning towards Integrated waste management

The municipality should apply Integrated Waste Management approach to current waste management system. Following things should be implemented. (The Open University 2016.)

i) Sorting at Source

It is vital to separate different types of waste at households, restaurant, offices or other sources. This will help in recycling, reuse and final disposal of the waste. wet and dry waste should be separated. Wet waste means organic which is generated from kitchen and is disposable. Dry waste is other waste such as plastic, paper, bottles and others. Sunwal municipality has around 75% organic waste and 25% inorganic waste. Therefore, it is very important to do sorting at source. The municipality should provide different bins types and containers for organic and inorganic waste for households and restaurant, hotels.

ii) 3R Practice

Local residents should avoid unnecessary use of resources by buying in bulk, using reusable bag, using less plastic and using reusable items. This will lead to lesser waste to be managed. Reusing can be done by local people at household level. This will lead to lesser waste produced and lesser waste for landfill. it also saves money to buy new product. People should donate unwanted materials or clothes to second-hand shop or people. Plastics, boxes, jar should be used for storage, container and habit of reusing product should be encouraged. It avoids completely neglecting old products. Products such as plastic, paper, cardboard, glass, aluminium, tin can be recycled. Organic waste can be recycled to compost. Municipality should provide facility and funding for composting of organic waste and encourage entrepreneur for recycling business.

iii) Resource recovery facilities

Sorted waste should be collected at resource recovery facilities and should be turned into valuable products or used or recycled. It helps to create valuable products and reduce landfill space. Plastic, glass,

aluminium, paper, cardboard are a few examples of those products. It is not only management of wastes but also help in generating income. It helps in minimizing the extraction of natural resources and amount of waste produced. The facility centre should have fence and roofs. Waste should be removed frequently to prevent unhygienic condition and environmental impacts.

iv) Improved collection and transportation

The municipality should do twice a week collection on each ward. It should increase the number of vehicles for collection of waste. Vehicles should have several waste containers with a large capacity according to waste types. A Careful plan of the routes for collecting waste should be done for an efficient and productive result

v) Sanitary Landfill

The landfill site should be far away from the residential area and nearby water sources. The sanitary site should avoid any leach leakage. This will prevent any contamination with ground water and the surrounding soil. The site should be engineered with a disposal and restoration plan. The site should have a trained staff for regular operation, maintenance and supervising of the sites. The waste should be spread in layers and should be compacted. The whole sanitary area should be fenced to restrict entry.

b) Strengthening Capacity

Although Sunwal municipality take charge of collecting, transporting and disposal of municipal solid waste, it has shortage of technical, managerial, financial and human resources. The government should introduce training, investment, stakeholder involvement, awareness program to strengthen capacity. For this municipality should introduce development program on human resources, organisational and legal sector. The municipality should make training program for employees regarding waste management. This will broaden employees waste knowledge and skills and become able to perform effectively. Municipality should separate greater budget and introduce required infrastructure, tools and technology required for the smooth operation of the waste system.

c) Public Participation

The participation of local people in the success of waste management is crucial. The municipality alone cannot carry out the smooth operation. Local participation should be encouraged by education, and campaigns. The municipality should arrange awareness program regarding segregation, 3R practices, composting, waste recovery and sanitary disposal. Municipal waste system, waste collection, waste generation, disposal site should be visible to the local people. It should accept any feedbacks from locality.

d) Cost Recovery

Currently municipality waste management system does not cost money. However, municipality lacks resources, technology, manpower for smooth operation. Therefore, municipality should introduce fee for municipality waste management. The introduced fee will help to recover cost for day to day operation and maintenance. The municipality should introduce cheap cost for waste management at the beginning. With the time and with the improvement of waste management system, it can increase service charge. The municipality should regularly monitor and review waste management practices and introduce cost saving measures.

e) Public Private Partnership

The municipality should encourage the involvement of private sector in this area. It should introduce competitive bidding for the private sectors. This will bring qualified and experience private partners in collection, sorting, transportation and landfill. Hence, it will improve the waste management system of the municipality. It will also help to carryout collection and transport at a large scale. Hence, uplifting organisation capacity and improvement in operational service.

f) Setting Priorities

The municipality should set priorities to deal with different kinds of waste. In the beginning, it may be required to address some kind of waste urgently. The waste which need urgent attention has to be

processed first and other types of waste need to handle later. The municipality generates high volume of bio-degradable waste. Therefore, giving priority to this waste play crucial role in municipal waste management. Composting should be carried out by municipality. It will bring down waste volume to lower quantity. Waste education and awareness program and segregation at source should be priorities at first.

g) Managing Data & Updating

The municipality should record data regarding waste generation, waste composition, segregation, collection, disposal and others. It should update data time to time to track changes and implement progress. The municipality should apply key performance indicator (KPI) for waste management. Periodic update of KPI is crucial for monitoring progress. The updated data needs to be provided to stakeholders and local people for better visibility and feedbacks.

6.5.2 Identifying Targets

The target should be specific, measurable, achievable, relevant and time bound. It helps to create and implement action plans and encourage stakeholder's involvement creating common purpose. It should address the municipality current challenges and issues.

- Reduction of waste
- Segregation of waste
- Increase waste collection and transportation
- Implanting bins in households and in streets
- Increase recycling and reusing
- Processing facility
- Public awareness program
- Composting program
- Safe disposal

6.5.3 Action Plan

After actions have been identified, an action plan should be made for waste and issues. The action plan should include everyone on the team. It should prioritise the task and set the deadline for the task. It should setup alerts to help team to become more effective. The municipality should identify easily implemented action at the beginning so that others can start work together and achieve early results. The action plan should provide task status and later discuss any pending task. (Bridges 2017.)

TABLE 2. Measures and Activities of Action Plan for the Municipality

S.N.	Measures	Main Activities	Sub Activities	Due Date	Status	Remarks
1	Immediate measures	1. Windrow Composting		1st June 2020		
		2. Setting priorities		1st June 2020		
		3. Information, Education & Awareness		3rd July 2020		
		4. Segregation (implanting bins)		10th August 2020		
2	Short term measures	1. Decentralised composting		2nd Jan 2021		

		2. Material recovery facility		10 th April 2021		
		3. 70% Collection & transportation	1. Arrangement of segregated waste collection and transport from household	31 st June 2021		
			2. Arrangement of staffs and vehicles	10 th July 2021		
		4. Imposing fee for waste facilities		1 st August 2021		
		5. 3R Practice		31 st May 2021		
3	Long term measures	1. Bio-gas Plant	1. Finding land	1 st Dec 2022		

			2. Construction of facility	31st Dec 2023		
		2. 100% Collection & transportation		31st 2023		
		3. Centralised Processing facility	1. Finding land	1st Dec 2023		
			2. Construction of facility	31st Dec 2023		
		4. Sanitary landfill		31st April 2022		

6.5.4 Policy into Action

Although Nepal has solid waste management Act 2013 for improving solid waste management practices, it has not been applied into actions. The government should introduce a plan which gives clear guidelines and instructions for implementing waste management to local bodies. It also should introduce specific time bound for implementing different task. It should also introduce regular training facilities for interested local people and should provide tools and technology for monitoring and updating waste system. The municipality, government and locality should have clear understanding and coordination

for achieving common goal. Recently, Doko Recycler, Khalisisi are emerging entrepreneurs who have brought new ideas for waste management in Nepal. Both the company currently recycle waste and run waste education and awareness program. The government should encourage entrepreneurs and new ideas creating better environment for waste management.

6.6 Agreement

After making the strategy, it is important that the proposed strategy need to be accepted and agreed by all the parties including local bodies, stakeholders, non-governmental organisation and local residents. All the parties should present on the meeting and have common agreement. Finally, the agreed report should be presented on the municipality for the official approval.

6.7 Implementing

The strategic waste management plan is executed to achieve short-term and long-term goals. The documented plan is made into action by local bodies after it is agreed and approved by official. It is time taking process which put formulated plans into action to achieve desired results. The municipality should secure sufficient budget and resources for the waste management system. It should supply required infrastructure and information system. It should employ skilled and experience staff and introduce training program. The waste management policy should consider existing municipal waste management, public health and environment. It should wisely select leaders and ensure all stakeholders and bodies are participating actively. It should carry out task according to the prioritize list. It should first focus on immediate measure for action plan and build plan for short-term and long-term measures. It should do publicity of waste segregation according to waste types via newspaper, television, and the internet. Different promotional campaigns should be carried out during occasions such as sports, cultural program. School education about municipality solid waste to the students must be done. There should be penalties and charges for not sorting but mixing waste. External support in the form of volunteers or funds should be welcomed. All participants and stakeholders should feel the sense of ownership on the waste management system. The periodic review of strategy and adjustments must be done regularly. (Business Jargons 2018.)

6.8 Monitoring and Evaluating

Monitoring and evaluating provides information regarding performance of waste management system. It collects large data and converts it into useful information with the help of tools. The key performance indicator should be used for monitoring and evaluating upon agreement with stakeholders and local people. This tool will help to monitor and evaluate action plan over period of time. Monitoring should be done for waste generation, waste recycled, waste composted, and waste disposed using information for improvement of the service. It should monitor service performance of the system, how well the system is carried out. It also should monitor sampling of specific size of household in order to have general picture of targeted area. It should monitor awareness, local people satisfaction for real issues faced. The result will help stakeholders know how system is performing and for doing corrections where needed. It should monitor and evaluate over time and should report to show any progress. Based on the result, adjustments should be made regularly for smooth operation of the strategy and achieving the goals.

7 CONCLUSION

With the increase of population and household in Sunwal municipality each year, the amount of waste generated has also increased accordingly. The waste management system practiced in the city only focuses on few recycling and reusing but high volume of disposing. The waste generated depends on the economic status, geographical region and climatic condition. The waste produced in the rural area is higher amount than in the urban. Organic waste and plastic waste are the highest generated in the city. Organic waste can be found more in urban area. Whereas, more plastics are found in rural areas. Sunwal municipality produces 3000 kg of waste per day with an average of 75 % organic waste and 25% inorganic waste. (APPENDIX 1/1.) & (APPENDIX 3/3.)

Municipality waste management system include few sorting at home but large amount of collection, transportation and disposal. Local residents sort recyclable and reusable waste and sell it to local recyclers. Bio-degradable waste are used for composting and animal feeding. Municipal waste collector collects mix waste from households. Other remaining mix waste are burnt in front of house. Kabadiwala plays a key role in managing waste of Sunwal. Municipal waste collector goes door to door to each ward on schedule basis. The disposed waste is not treated, and the disposal site is not and engineered. only a small amount of waste is reused and recycled.

Current waste management system is old and only focus on collection and disposal of waste. It lacks segregation and 3R practice of waste management. Municipality lack capacity and infrastructure and has no sustainable goal. it does not have sanitary disposal area. Waste is burnt openly on streets and the disposal area which has a serious health and environmental impact. There is a lack of public awareness and education regarding waste management.

Therefore, a strategic waste management plan was made in order to improve the current waste management system. Purposed strategy focuses on integrated waste management system, capacity building. It encourages on building capacity of municipality by developing human resource, technology, organisation, and infrastructure. It forwards plan to establish composting facility and waste recovery facilities. Municipality should encourage public participation and attract public private partnership. It should impose a cost recovery scheme by charging a little amount in return of providing waste

management facilities. It also focuses on giving priorities to some waste at initial stage and deal with other later.

8 RECOMMENDATION

Based on the study, improvement on current waste management system need to be made for the long run. The current waste management should lean towards an integrated waste management system. With a high percentage of organic waste, municipality should encourage on commercial composting. The municipality should prioritize high volume of sorting and 3R practices but less disposal. Finally, the disposal area should be engineered properly. Imposing a certain charge for waste management to local residents will help to maintain smooth operation of the system. Strong willingness of municipality, local bodies, organisations and local residents as well as availability of sufficient infrastructure and technology will improve Sunwal municipality waste management system.

For the future study, survey must be done including more people and should spend more time. The study should cover other waste type such as street waste, hazardous waste, industrial waste, agricultural waste and bio-medical waste.

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Questionnaire for municipality authority regarding municipal waste management

Date: 2075/12/4

Name of

Contacted person: Khem Raj Awasthi

Position Environmental Officer

Phone Number: +9779849064135

Email Address: awasthibt@gmail.com

Address: Sunwal Municipality

What is the number of wards, household in Sunwal municipality?

Number of Wards : 13, Number of HH : 12000

Does municipality keep record of municipal waste produced?

Yes

If yes. What are the sources for the solid waste in Sunwal municipality?

Household waste form the houses of people, industrial waste and business (from markets, small industries)

If yes. How much municipal solid waste is generated each day?

Around 3000 kg

If yes. What is the composition of municipal wastes produced? percentage of each composition per day?

Organic waste : 75 %

Inorganic Waste : 25 %

What is the current waste management system applied?

Door to door collection system with conservational disposition method for the disposal of generated waste.

Does municipality do collection, segregation, transportation of solid waste? How?

Yes, Sunwal municipality has three vehicles for door to door collection of waste and after collection the waste is taken to waste segregation centre, which is 3 km away for residential area.

- Is there any recycling, reusing and composting of municipal waste?

In the segregation area, only some waste is taken for recycling purpose (ie. Metal, Bottles, cans etc)

- How is municipal waste disposed? Is it environmentally friendly or non-hazardous to human health?

Firstly the disposed place is far from main residential area so, it does not hamper to the general life of municipal people.

And the organic waste is buried in the ground so, it could not effect during the period of decay.

- Is there any organization or managerial body for municipal solid waste management?

There is Department of Environment, Forest, Waste and Disaster Management.

- What policy and regulation are implemented for municipal solid waste?

Solid waste management act 2068

- Lumbini sugar mill has become major problem for environment of Sunwal municipality. How municipality is going to tackle this problem?

Municipality has been legally and administratively working for the solution of problem created by Lumbini Sugar Mill.

- Does municipality separate budget for municipal solid waste management?

Yes, Municipality collects waste free of cost.

- Does municipality provide any awareness program or campaign for solid waste management?

Yes, Municipality has regular projects for awareness programs.

- Is there any planning for sustainable municipal waste management?

Municipality has planned for sanitary landfill site and also passed a bill for public private partnership system.

municipality waste management Questionnaire

Date: _____
Name of Contact: _____
Phone Number: _____
Email Address: _____
Address: _____

- How many family members do you have in household?

- What are the sources for the solid waste in your household?

- What is the composition of solid waste?

- How well you are familiar with segregation, composting, recycling, reuse?

- Where does your wastes go?

- Does municipality collect wastes? How often does it collect? Are you satisfied?

- Are you aware what municipality do to your solid wastes? Is it recycled, reused or disposed?

- How well you are aware of adverse effect on health and environment because of solid wastes?

- Is Lumbini sugar mill a problem for Sunwal municipality in terms of wastes produced?

- Do you think municipality authorize body are active and doing their best for solid waste management? Why?

- What do you think about youth, people participation and program regarding solid waste management?

- Does municipality separate budget for municipal solid waste management?

- Does municipality provide any awareness program or campaign for solid waste management?

- Any suggestion regarding municipal solid waste management?

नेपाल सरकार
जनसंख्या तथा वातावरण मन्त्रालय
वातावरण विभाग
कुपण्डोल, ललितपुर

वातावरण विभागबाट स्थानीय निकायहरू (जिल्ला विकास समिति तथा नगरपालिका) ले
वातावरण संरक्षण तथा प्रवर्द्धन सम्बन्धी गरेका कार्यहरूको अनुगमन फाराम

मिति: २०७३/६/१४

१. अनुगमन गरिएको जिल्ला: नवलपरासी
जिल्ला विकास समिति/म.न.पा/उप.म.न.पा/नगरपालिकाको नाम र ठेगाना: सुनवल नगरपालिका
सुनवल, नवलपरासी
२. स्थापना मिति: २०७१/१/२५
३. जि.वि.स.को हकमा गा.वि.स. र न.पा.को हकमा वडा संख्या: १०
४. कुल जनसंख्या: ४६६३८
५. घरधुरी संख्या: ८,६००
६. कुल जनशक्ति: २८ जना (वडा कुल ५५९०० जना स्वीपर संख्या: २ जना)
७. शहरी गा.वि.स. संख्या: — ग्रामीण गा.वि.स. संख्या: —
८. शहरी वडा संख्या: वडा नं. १, २, ४, ९ (२ वटा) ग्रामीण वडा संख्या: २ वटा
९. शहरी गा.वि.स./शहरी वडामा फोहोर संकलनको प्रक्रिया: वडा नं. ४ र ९ मा नगरपालिकाबाट
ट्याक्टरबाट फोहोर संकलन गर्ने गरिएको । बाग क्षेत्रमा दिन दिनमा
र अन्य क्षेत्रमा हलामा एउटा दिन फोहोर संकलन गर्ने गरिएको ।
घरहरूमा सेप्टी ट्यांक वा ढलको व्यवस्था के छ? घरहरूमा सेप्टी ट्यांक नभएको । केतिपय घरमा
पारत हुनु भन्दा फुडाडि बनाइएका छान्नाहरू (खोलाको छेउमा भएका)
ट्याङ्कबाट सिँचे खोलाको जति कलायको पाइएको ।

नगरपालिकाले संकलित फोहोरको व्यवस्थापन कसरी गर्ने गरेको छ ?

संकलित फोहोर सडक कुहिन फोहोरलाई सक्नुमा जाडोघ, नहाना
नागरिकहरूलाई जनशक्ति - जति गरिएको । नगरपालिकाले संकलन
जति फोहोर घरे जति नभ नकुहिन भएका । संकलित फोहोर
वडा नं. ४ स्थित सेतो पहाडको छेउमा खाल्डो खनी पुगे गरिएको ।

गोपाल

१५
नगरपालिका समितिको

१०. न.पा./शहरी गा.वि.स. हरमा जल, वायु, माटो, ध्वनि प्रदुषणको अवस्था कस्तो छ ?

हरमा जलको अवस्था राम्रो रहेको छैन। मिठो मिठो गुणको पानीको अभाव भएको छ।
 वायु प्रदुषणको अवस्था राम्रो छैन। जहाँसम्म माटोको प्रदुषणको अवस्था राम्रो छैन।
 ध्वनि प्रदुषणको अवस्था राम्रो छैन। (सोमनाथ स्कोलाम) जहाँसम्म स्कोलामको अवस्था राम्रो छैन।

११. प्रदुषण न्युनीकरणको लागि के-के उपायहरू अपनाइएको छ ?

- कालो विस्तार गर्दा टायावाया गरिएको जलको प्रदुषण न्युनीकरण गर्न सकिने।
- नक्सा पारदर्शी बनाई एउटा घरमा २ वटा किराणा लगाउने गर्दा प्रदुषण न्युनीकरण गर्न सकिने।
- जल वर्ष २०७०/७१ मा २६ र २०७१/७२ मा १२० वटा सुधारिएको पानीको वितरण गरिएको।

१२. वातावरण संरक्षण तथा प्रवर्द्धनको लागि न.पा. वा जि.वि.स.ले हाल गर्दै आएको कार्यहरू के-के छन् ?

- (क) सार्वजनिक जग्गा संरक्षण कार्यक्रमको ३१ हेक्टर जग्गा संरक्षण गरिएको।
- (ख) सार्वजनिक जग्गा तारवार गर्ने गरिएको।
- (ग) कालो विस्तार निर्माण हुँदै।
- (घ) जल वर्ष २०७१/७२ मा २ वटा क्लब पार्क र ७ वटा पोल्सो निर्माण तथा मर्मत गरिएको।

१३. फोहोर व्यवस्थापनमा स्थानीय निकाय (जि.वि.स./न.पा.) बाट प्रयोग भएका उपकरण के-के छन् ?

- फोहोर ठोक्न एउटा ट्याक्टर प्रयोग गरिएको।

(Handwritten signature)

(Handwritten signature)

कार्यकारी अधिकारी

