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Integration of sanitary landfill in development of Eco-Park

(A Case at Nilbarahi, Madhyapur Thimi)

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Abstract
Solid waste management (SWM) has been an integral part of every human society. The exponential rise in the urban population of the developing countries in the past few decades and the resulting accelerated urbanization phenomenon has brought to the necessity to develop environmentally sustainable and efficient waste management systems. Sanitary landfill constitutes one of the primary methods of municipal solid waste disposal. Madhyapur Thimi Municipality (MTM) being one of the urban municipalities in Bhaktapur district, Nepal; has put forward a project of integrating sanitary landfill at Nilbarahi forest for sustainable solid waste management of the municipality within the municipal boundary, with a long term vision to develop reclaimed land after landfill into an eco-park. This is a live project that has failed to gain social acceptance and has faced sever protest from the nearest community to the site selected for landfill. This research work is an attempt to understand the real ground situation related to the project and visualize the challenges and opportunities associated with it. This is an attempt to analyze the situation from neutral position and evaluating it from environmental, economical and socio-cultural visions.

Keywords
Solid waste management (SWM) - sanitary landfill - Fukuoka method - social acceptance - Trust issue

1. Background

Management of municipal solid waste is a global problem and is faced by all developing countries, Nepal not being an exception. Heavy migration from rural to urban areas has made it a critical issue in urban areas in Nepal. The rapid pace of increase in population, economic growth, changes in lifestyles and consumption patterns, urbanization, and industrialization is coupled with accelerated solid waste generation. Wastes, either scattered in urban centers or disposed of unplanned in low lying areas or open dumps, is common. The lack of infrastructure for collection, transportation, treatment, and disposal of solid waste, proper solid waste management planning, insufficient financial resources, technical expertise, and public attitude has made the situation exasperating. The waste produced by the growing cities is placing overwhelming stress for its proper management to the local authorities and national governments alike.

The main purpose of SWM is to address the health, environmental, aesthetic, land-use resource, and economic concerns associated with the improper disposal of waste [1]. But here in the context of Nepal, SWM system is predominantly preoccupied with collection and removal services, so the key priority is getting the waste out from underfoot with an ”out of sight , out of mind attitude”.

Sisdol landfill site at Okarpauwa is the landfill site in operation for Kathmandu valley since 2005 till now. But time and again strikes are done by people nearby the landfill arising different issues – logical or illogical, causing halt in waste collection; thus leaving cities into waste dumps. Moreover, Sisdol landfill site has reached its maximum capacity. So municipalities of Kathmandu valley have to locate a new site for landfilling its municipal solid waste or should come up with innovative ways to manage and get rid of problems associated with solid waste management. Building an understanding of how the developed nations are tackling the problem of SWM properly, the past mistakes and learning from them can give much-needed context and insight for how best to move forward.

1.1 Problem statement

Urbanization and population growth have led to a decrease in urban green space and an increased waste generation. Among the multitude of environmental problems existing in the urbanizing cities of developing countries, solid waste has become one of the most prominent in recent years, not only because of the increase in the amount but chiefly because of the lack of an efficient system for its management. Municipality faces major environmental challenges associated with enormous waste generation and inadequate waste segregation, collection, transport, and disposal. The problems can be short-listed as follows:

- Increasing volume of Municipal Solid waste generation and the challenge of its proper disposal.
- Pressure to landfills in the outskirts of the city to accommodate the daily volume of trash.
- Lack of Green space and recreation area where children, young people, and elders can socialize.
- Lack of social acceptance.

1.2 Objective

1.2.1 Main Objective:

To study potentiality of increasing the implementation possibility of integration of sanitary landfill in urban green space.

1.2.2 Specific Objective:

- To understand the physical/morphological and socio-cultural attributes of urban green space taking the case of Nilbarahi forest area.
- To understand parameters necessary to integrate the Waste Dumping site into an Environment-friendly, healthy and socially acceptable Space.
- To seek out a balance between what can be reasonably and logically implemented and achieved in the foreseeable future in terms of improving waste management.

2. Literature Review

2.1 Solid waste management

Solid waste is the useless and unwanted products in the solid-state derived from the activities of and discarded by society and Solid Waste Management is 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, economics, aesthetic, engineering and other environmental considerations [2]. In developing countries, landfilling is a common practice for solid waste management. Landfill can be broadly categorized into anaerobic, aerobic, and semi aerobic type. Fukuoka method of landfill is a semi aerobic sanitary landfill developed in a joint study by Fukuoka University and Fukuoka City in Japan. Fukuoka landfill method is very appropriate for the developing country like Nepal as it has low life cycle cost (LCC) & wider alternatives of materials are available for construction (locally available materials can be used like bamboo, tires, clay, etc), advance technology not necessary, it is Environment friendly and landfill ground stabilizes early. Decomposition of organic waste is a bit faster than that of the anaerobic system, likewise, offensive odour disappears, and technology is simple and easy to maintain if the concept is fully understood.

Leachate quality is highly improved in this method of landfilling and landfill gas mainly methane is controlled highly. Moreover if we can decrease the amount of organic waste ending up to the landfill, it helps decrease in leachate quantity and landfill gas production thus help get rid of foul smell and decrease Greenhouse gas emission. The proper execution of landfilling by this method from the beginning – liner placement to daily soil cover over the waste layers ensures clean mechanism with minimum impacts like visual impact, dust and noise, offensive odour, fly and incest breeding, explosion and fire, groundwater contamination, human and animal scavenging. Fukuoka method of landfilling was certified as an innovative method of Clean Development Mechanism (CDM) that is specified in the United Nations Framework Convention on climate change [3].

For sustainable SWM, integrated solid waste management (ISWM) that brings a balance between environmental effectiveness, social acceptability, and economic affordability is necessary. ISWM should be

tailored to specific community goals by incorporating stakeholders' perspectives and needs; addressing local context and the optimal combination of available, appropriate methods of prevention, reduction, recovery, and disposal.

2.2 Circular economy

Circular economy is becoming a widely recognized and accepted concept that takes waste as an enormous pool of resources that can be used with minimum impact on the environment. Circular economy is about minimizing waste generation and maintaining the economic value of products, materials, and resources as long as possible. Reduce; reuse, recycle, and recover are the key to achieve circular economy. Reduce the use of virgin resources and energy to redesign products can make it less resource-intensive and help protect the environment. The driving principle here is " waste for one can be a resource for the other ". Stimulate recycling and develop innovative ways for resource recovery can play a great role to improve waste management practice and it can create a lot of job opportunities alongside and help uplift the economy as well. Well functional circular economy system reduces a significant amount of solid waste ending up in the landfill and increase landfill life.

2.3 Social acceptance

Landfill is a locally undesirable land use (LULU) and likely to face community opposition which is mainly a function of proximity. The battle cry of "not in my backyard" (NIMBY) has become synonymous with proposals for new sanitary landfill sites. It is noted that citizen resistance has become the greatest single obstacle to the sanitary landfill waste disposal siting. Public attitudes and perceptions of sanitary landfills are less than adequate and the failure to appreciate and respond to public apprehension has contributed to the problem of siting and operating landfills[4].

Various factors affect social acceptance for a waste facility like impacts and benefits, knowledge, behaviours, procedural fairness, personal fairness, relationship quality, and trust to government. Social acceptance can be increased by increasing benefits and using impacts as opportunities for targeting programs and policies to overcome impacts [5].

3. Case Area: Nilbarahi, Madhyapur Thimi Municipality (MTM)

Nilbarahi forest is the site proposed by the municipality for sanitary landfill. The forest is spread in around 400 ropanis of land and has 8 natural low valleys in which the municipality has planned to do sanitary landfill by Fukuoka method. So the study was done with the focus lying on Nilbarahi forest area, nearby settlements and the amenities within 500m from the site.

Site and important amenities around the site are shown in given figure.

Index:

- Temples

1. Tigani-Old settlement (nearest settlement)
2. KUKL (Kathmandu Upateyka Khaneypani Ltd.)
3. Private waste segregation facility
4. New mixed settlement
5. Pilot project site

Figure 1: Site and surroundings

4. Methodology

The research is a social research. Subjective perception regarding the project is necessary to understand the real situation being unbiased, so

research is carried out using pragmatic research methodology to better understand the situation and put forward recommendations for the solution. Pragmatics "recognize that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities" [6].

The research is carried out with Post positivism - a mixed paradigm combining positivism and interpretivism as a research strategy. Empirical inquiry of the real-life context of the site proposed for sanitary landfill and its surrounding up to 500m is done. Research primarily focuses on the real-world issues that are leading to local protests and see the possibilities to overcome them and increase the implementation possibility of the project. For this field survey was done with a questionnaire survey with structured and open-end questions mainly focusing the most likely to be affected group of people i.e residents nearby the site and visitors to the site. Questionnaire was designed to understand people's perception on socio-cultural, environmental, and economic impacts of introducing landfill in the area. The questionnaire survey was done till data saturation. In addition to this key informant interviews were taken with personnel's from the municipality, UN-Habitat (technical partner), and with the protesters.

Another focus apart from understanding the situation of the site; was to understand the parameters necessary to integrate the Waste Dumping site into an Environment-friendly and socially acceptable Space. All the data gathered from primary and secondary sources were analysed according to the research theme.

5. Findings

The study was done mainly focusing on the public protest scenario for the sanitary landfill siting. The project is facing strong protests and opposition from the people of Tigani, the nearest settlement. People perceive landfill as unwanted facility due to various Past experiences from different contexts. They have a strong perception of having different negative externalities as shown in fig 2; as a result of landfill siting.

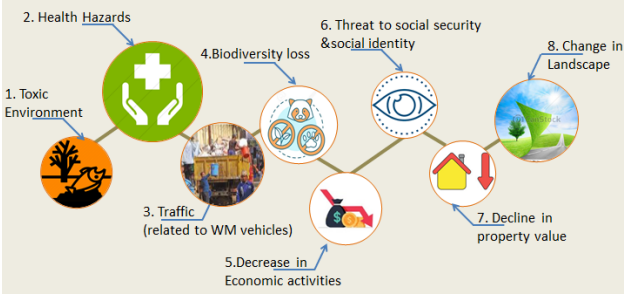

Figure 2: perceived negative impacts

Other than people's perception, there are some strong reasons based on the real ground situations that have caused people to stand against and protest the project. They are:

- The proposed site is a heritage area with lots of tangible and intangible heritages associated with it.
- The residential area lies in near proximity around 150 m (nearest) and local people are the most vulnerable to the impacts of landfill.
- Water bodies like kuwa and stone spouts are nearby the site and even the organization supplying water to the huge population of Kathmandu valley, Kathmandu Upateka Khaneypani Ltd. (KUKL) and its treatment facility lies there. KUKL supplies water by deep boring and some shallow boring. Landfill may pollute these water sources.
- Bad experience from small scale private waste segregation facility that is running nearby. People of Tigani has experienced terrible foul odor from there during summer months. So, people fear bad consequences on a much larger scale in case of landfill operation.
- Ill handling of information – proper information was not flowed to the stakeholders and local people.
- Trust issues with the government- people don't have trust upon the government regarding fair and proper execution of the project.

6. Analysis

The land-use type of Madhyapur Thimi Municipality has changed rapidly in recent years turning open agricultural lands into build up spaces. Population has

increased due to in-migration and waste generation from within the municipality is huge. Currently SWM of the municipality is looked after by the municipality and few private waste management facilities. They are not being able to handle SWM of the municipality properly as a result one can find open dumping of waste in streets, forest, and open areas.

Municipality is using Sisdol Landfill site at Okarpauwa for the disposal of MSW which is 31.4 km far away. Municipality generated about 14 tons of solid waste per day in 2004 as estimated by JICA in 2004. The population in MTM was 47,750 as per census 2001 which grew to 83,036 in the census 2011 with the population growth rate of 5.7%. So, as per the population projection for 2020, the present population of MTM is estimated to be 1,36,751. The MSW generation in the municipality at present is estimated to be 60 tons/day with an assumption of waste generation per capita per day as 0.4 kg since the municipality is medium scale urbanized city. To dispose off this volume of MSW to Sisdol landfill site would cost Rs 6,751/day to fuel up garbage trucks involved in waste transportation. It cost around 25 lakhs of the municipal budget, only for fuel for garbage trucks involved in waste transportation to the landfill site and they generate 67,740 kg of CO2 each year. So, a huge municipal budget is being spent only for fuel alone for the transportation of waste for final disposal and a huge amount of GHG is also emitted into the atmosphere. In addition to the fuel, the municipality has to spend a considerable portion of its budget on manpower and servicing and maintenance of vehicles involved. So it is resource-intensive and a global threat as well. So it is better to have a landfill site within its municipal boundary.

The project is facing strong opposition from locals which is mainly the response to youth opposition as they don't have trust in government regarding the proper execution. On top of that local youth group who are managing picnic spots in the site- Nilbarahi forest is fueling the opposition campaign as they have been raising funds, Rs 500-2500 per picnic spot per day and they fear that the project may put an end to this. Elderly people and women are not much bothered and have left the issue of acceptance to the youth group. So, the government should work closely with the youth groups.

Public participation in discussions about the project has been given little priority and proper stakeholder identification and stakeholder involvement are not done by the municipality. The municipality did interact only with local political leaders and funding agency & technical agency JICA and decision was carried out based on expert judgement without interacting with local people. Proper information regarding the project hasn't reached out to all the relevant public stakeholders raising doubt on the fairness of the project approach. So, strong protest is done by local people who are likely to be the ones most affected and the other concerned stakeholders have remained clueless and could not give their acceptance with confidence, to go ahead with the project.

6.1 Need of system approach

Solid waste is something people want to get rid of, not realizing that it is actually resources. So a proper system approach is necessary so that maximum resource recovery can be done from solid waste and thus very little portion of solid waste ends up into the landfill thus increasing landfill life and help in long term sustainable SWM. Segregation of waste at source should be encouraged with proper functional system operation by the municipality like separate collection of waste as per their types and practice 3R and composting. It is necessary to integrate the 3Rs in formal education at primary, secondary, and tertiary levels as well as non-formal education such as community learning and development. This will help to achieve active public participation and make SWM system much more systematic and easy to deal with.

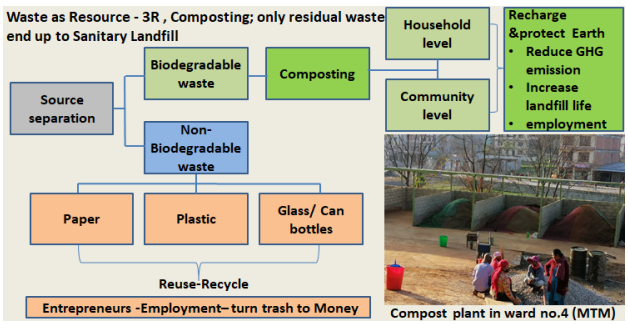

Figure 3: source separation and resource recovery

The little biodegradable waste is dumped in the landfill; the less foul odour, GHG, and leachate are produced. Compost plant in ward no. 4 in MTM is a good example of composting at the community level that is helping for SWM and is serving the agriculture community. This can be replicated in many other places. So, the maximum practice of 3R and

composting can help get rid of the negative impacts of landfills.

6.2 Pilot project

Since landfill is locally unacceptable land use (LULU) and people have a NIMBY attitude for this facility, the Government has put forward the idea of executing a pilot project in one of the valleys in the forest. The site for the pilot project is a grassy area and currently not used by people for any purposes. So the location is good enough. The entire project will gain social acceptance if the government can satisfactorily conduct this pilot project and win the trust of people.

Evidences of forest encroachment are seen in the site. This project can put an end to this as it would be under the government's close supervision.

6.3 Possibilities upon proper execution

Fukuoka method of landfilling is a proven well functional landfilling method. But the project will be a success if it can well address the concept of circular economy and only the waste that cannot be reused, recycle and compost is disposed of in landfill, and landfill operation is done properly. Circular economy helps to achieve resource efficiency and also creates lots of employment. Upon successful execution of the landfill, the reclaimed land will be developed as an eco-park which will function as an urban green space. This will help to preserve biodiversity. This space can be utilized as space for exercise and relaxation; children play area and socializing space for the elderly and thus help to boost public health. This will stand out as the identity of the area. More people will come for picnics and study tours. This gives various economic activities to bloom nearby the site and thus help boost the economic status of the community and thus uplift living standards.

7. Discussions and conclusion

The project has been proposed as a sanitary landfill site by Fukuoka method of landfilling with an idea to develop the reclaimed land as eco-park and also operate it as an environmental education center in its operational phase allowing Waste management demonstrative tours for students and professionals. But there are chances that the project may not go as planned for example we can take sisdol landfill site which has been developed as a sanitary landfill site by Fukuoka method. Sisdol landfill site was developed as a pilot project to be run for 2 years from 2005 but it is still running and has turned into a huge mountain of solid waste. This has been a complete failure.

But we also have a good example of the Dhankuta landfill site. It is a landfill site that operated from 2010-2014 with the nearest settlement at just 150 meters away. The reclaimed land from the landfill has been developed into a beautiful park. Now, Lots of people come to visit the park or for a study tour. Municipality earns 3 million per annum now (Rs 1.5 million from municipality residents as sanitation charge & Rs1.6 million from the sale of the garbage) [7]. The city has owned the title of "Nepal's cleanest city". This shows that innovative ways to manage city waste, governments' dedication, and public support and participation can make the project turn into a success.

In relation to the protest related to the forest being religious area, we can see that in Nepal forests are associated with some religious value historically, probably for the protection of green space and the eco-system. So, we can enhance the religious value of the site by protecting it, planting religious trees, etc. The holistic approach is necessary for the successful implementation of the program with proper consideration of social factors, technical, economic, and environmental factors.

The purposed landfill should not be only a new site for dumping MSW but it should provide sustainable municipal solid waste management (MSWM) with the proper practice of circular economy and ISWM. Learning from the world scenario and national scenarios, the municipality should adopt the best practice that is available and context suitable.

Planners, policy makers, executives, academicians and specifically politicians should think about this project in association to solid waste management issues genuinely otherwise it will be proved suicidal. Government should come up with proper plans that can be executed in real, with detailed work plans and time schedules, with determination and strong commitment, gaining and maintaining the trust of the public regarding project implementation and execution. Active public participation is of utmost importance. So, people should also contribute in the best possible way from their side and shouldn't run away from their social responsibility of proper solid waste management.

8. Recommendations

- To increase social acceptance, awareness programs should be conducted at the local community level with audio-visual presentation & sharing success stories of the Fukuoka landfill method. Media and social media platforms can also be used to create awareness about the project and make people aware of their social responsibility.
- Organise study tour for community representatives to landfill sites.
- Locals should be encouraged to take part in site inspections and monitoring program.
- Give authority to locals to stop this project in case of ill operation. In this scenario locals will give a chance to start the project and if the pilot project runs smoothly, the project can be operated in full scale.
- Time restrictions should be followed regarding operation hours of landfill activities (dumping waste, covering with soil cover in dawn or as suggested by the community so that it occurs the least effect on daily life).
- Vehicles involved in waste management should take a route other than from the core settlement. Here Bode-Jorpati road can be used.
- Municipality should be the head of the project enforcing control over all other parties involved in the project so that the project can operate smoothly without any gap or loopholes.
- It should be made compulsory for each household to take MSWM service provided by the municipality to put an end to open dumping.
- Source separation of waste should be made compulsory and for strong system support different waste collection bins should be placed in individual households (with polluters pay system)/ community nodes(with minimum service charge).
- Capacity building training regarding 3R and Composting should be given to people of the municipality.
- Encourage entrepreneurs involved in reuse, recycling of waste by introducing policies and measures, and by setting up financial mechanisms and institutional frameworks involving relevant stakeholders (e.g., producers, consumers, recycling industry, users of recycled materials, etc.) and collaborate with them Eg:BlueWaste to energy, Khalisisi etc and Connect the youths to job markets.
- Promote the greening of the value chain by encouraging industries and associated suppliers and vendors in socially responsible and inclusive ways. Pant system in Norway is a good example.
- For the cultural association of different valleys in the forest area, consultation with cultural experts can be done and consultation with different groups of society can be done to know the extent of their cultural association with the valley. If there is a great cultural association, proper assignment for the relocation of the project should be done by the government. Common landfill can be operated in collaboration with nearby municipalities.

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