

Socio-Economic Aspects of Integrated Solid Waste Management at Dhangadi Sub-Metropolitan City

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Abstract

Solid waste management (SWM) has been an integral part of 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. The Integrated Solid Waste Management (ISWM) includes waste generation, segregation, recycling and reuse, collection, decentralized treatment, transportation and finally reuse, disposal & treatment to achieve socio economic and environmental sustainability. Dhangadi sub-metropolitan city is biggest market center of the region. Rapid urbanization is happening in city and surrounding while it lacks resources and infrastructure. The sub metropolis has been crude dumping since many years. For sustainable solid waste management of the municipalities, Regional Urban Development Project (RUDP) has proposed Integrated Solid Waste Management (ISWM) subprojects in 4 municipalities of Sudurpaschim province and Dhangadi sub metropolis is one among them. This project is in implementation phase that has failed to gain social acceptance and faced sever protest from community near proposed site. The municipality has now proposed new site which lies within national forest area. This research work explores to understand real ground situation related to project and evaluating it from environmental and socio-economic aspect.

Keywords

Solid waste management (SWM), Integrated Solid Waste Management (ISWM), social acceptance

1. Introduction

The solid waste management challenge is a worldwide concern at different levels in the various parts of the world. The magnitude of the challenge is driven by the amount of effort put in by different countries to contain the solid waste problem. In the developed countries, solid waste is not as alarming a problem as it is in developing countries. The disparity can be explained by the fact that in developing countries, the rate at which solid waste is generated is not in consonance with the capacity to properly manage it [1]. The population seems to be leaving the burden of solid waste (that they generate) to the administrative units or authorities. In most developing countries, the urban authorities, such as municipalities are responsible for waste management. Waste management is one of the most visible urban services whose effectiveness serves as an indicator for good local governance, sound municipal management and

successful urban reforms.

Municipal solid waste (MSW) is a growing problem in the urban areas around the world that is increasing faster than the rate of urbanization. In 2002, 2.9 billion urban residents generated 0.64 kilogram (kg) of waste per capita per day, which increased to 3.45% in population and a whopping 87.5% in waste generation in 2012 (3 billion urban residents generated 1.2 kg of waste per capita per day). By 2025, it is projected that 4.3 billion urban residents will generate 1.42 kg of waste per capita per day. Furthermore, MSW generated by lower income countries are expected to increase significantly over the years than other income group countries [2]. It will intensify the waste management problem as this group of countries is the ones which lack the most in terms of technological advancement and socio-political setting favorable to overcome such condition. About 20-50% of municipal budget in

developing countries is spent on managing MSW but still 30-60% of the waste is uncollected and less than 50% of its population is served [3].

Nepal, one of the least developed countries in South Asia, is no exception to such situation. It is inhabited by 26.5 million people with an average annual population growth rate of 1.35% from 2001 to 2011 [4]. Within the existing solid waste management (SWM) situation, there is no proper and effective waste collection system and only limited recycling, and composting activities are practiced all over Nepal [5]. Haphazard depositing and burning piles of waste along the roads and riversides is a common sight, causing health hazards and environmental problems in-situ as well as downstream [6]. Thus, it is only a matter of time that waste generation will be multiplied and will further intensify the problem if not managed effectively well ahead of time.

Rapid urbanization has been taking place in many areas of Nepal, particularly in hills and terai. Rapid population growth and urbanization in these areas have led to the generation of large quantities of solid waste and consequential environmental degradation caused by people's indiscriminate habit of throwing away the waste they produce. Most of the municipalities of Nepal is facing solid waste problem as one of the genuine urban environmental issues. Solid waste management problem in all the 4 project municipalities of the far western region is not different from other municipalities. It is rather more serious and intensive. Due to various reasons, these municipalities are developing rapidly, and this development trend will continue for long time. The rapid population growth and urbanization is causing threat to the natural environment. In recent years, not only the solid waste generation has increased tremendously, but also its composition (in terms of physical & chemical characteristics) has undergone changes. It is estimated that only some fractions of the urban solid waste generated is collected by the municipalities and private collectors together. It is estimated that even today nearly 90% of all waste in the world is either landfilled or disposed in open dumps, creating considerable nuisance and environmental problems. This scenario is also unfortunately very similar in all these project municipalities.

Managing solid waste is one of the major challenges of urbanization. Particularly, waste volumes have increased in urban area due to the growing urban

population, concentration of industries, consumption of residents, and inadequate finance and facilities to manage waste collection and disposal. This has led to the volume of solid waste generated to go beyond what the available facilities can accommodate. Rapid and uncontrolled urbanization, lack of public awareness, and poor management by municipalities have intensified environmental problems in towns in Nepal. Municipalities are wholly responsible for collection, transport, treatment, and final disposal of solid waste. Many of the municipalities are not well equipped and almost all lack finance and management capabilities to be effective and efficient in managing solid waste. In recent years, Asian Development Bank (ADB) has been financing solid waste management projects in few municipalities of Nepal.

2. Research methodology

2.1 Research Methods

The methodology followed Qualitative and Quantitative research approach. The method used in this study will be survey/Questionnaire, Key informant interview, Observation, Secondary data sources.

2.2 Survey research

Survey research is a quantitative and qualitative method having two important characteristics. Firstly, self-reports are used to directly measure the respondent's interests to report their thoughts, feelings, and behaviors. The sampling issue needs to be considered; for instance, survey researchers have a strong preference for large random samples because they provide the most accurate estimates of what is true in the population. In this study target population is people residing near to the proposed site Patela (settlement up to 1000m from proposed site).

2.3 Sample Frame and Population

The sample design was prepared to form a sample frame before data collection, which gave an idea on the sample size. The target population was people residing near to the proposed site Patela (settlement up to 1000m from proposed site), visitors or the users who are frequently using this site e.g., people who come for picnic, to spend leisure time etc. and to the key persons who are involved in implementation of project. Household survey was carried out with the

head of the household, or an adult representative of the household through phone call and online.

3. Case Area

The ISWM subproject at Dhangadhi sub-metropolitan city is one of the subprojects proposed under RUDP. The subproject includes construction of a new landfill with compost plant, internal roads, transfer stations and boundary wall. It has been formulated to improve the solid waste management system in the municipality. At present, Dhangadhi sub-metropolitan city has a crude dumping site located at a distance of 500 m from the city center. It has scheduled waste collection two times every day in the main city street. The current waste collection rate is only 42%. All waste is collected in sub-metropolitan city trucks which are finally dumped on the bank of nearby Kailali nala, about 2 km from the city center. From the very beginning of the RUDP in Dhangadi Sub-metropolitan city, there was issue of land acquisition of proposed site for ISWM project. At first the site was proposed at Saraswati Nagar Katan in ward no. 2 and for that land acquisition process also started. Due to protests by local residents, residing along the access road to the site, geo-technical investigation work couldn't be completed. This proposed site was about 250m from settlement. This being one of the major reasons along with other political issues, local residents unremittingly disagreed for 3 years. Under this background, a site located at a road distance of about 12 km from the city centre/Chauraha Chowk within the national forest at Patela in ward no. 7 has now been proposed by the Sub-Metropolis (the only and lastly available site, as reported) with the consent of respective ward chairman and local people for development of an ISWM site. A rapid assessment of this site has also been carried out in January 2020 by technical team and detail design report and EIA are being done for development of the proposed ISWM site in Dhangadhi Sub-Metropolitan City. The proposed site covers a total area of 18.010 ha, out of which proposed design will cover 12.51 ha of built-up area and the rest will be greenery and future expansion area. The site has been proposed as landfill site for about 32 years. The nearest settlement is 500m from proposed landfill site. Though the consent of local people living nearby proposed landfill site was taken, there are risks that they might inherent negative externalities associated with it.

4. Data Collection

Field observation was done for the site and site surrounding the proposed site for Integrated Solid Waste Management Project. Short field observation was carried out by studying the site surrounding approximately about 500m around the proposed ISWM site.

Social survey was done to understand people's perception and acceptability of proposed ISWM project which is being implemented. The survey was done mainly focusing the people residing nearby the proposed site Patela (study mainly focusing to people of Patela), visitors or the users who are frequently using this site e.g. people who come for picnic, to spend leisure time etc. and to the key persons. During the survey, it was made clear to all the respondents that the study was for academic purpose. A simple random sampling technique was applied to select the households. A random sampling technique was adopted to select the HHs. Considering that people in the surrounding area or nearby areas are expected to suffer the most, the selected households were in the vicinity of landfill sites. In the research, total of 20 questionnaire survey was done through phone call and google forms due to COVID-19 situation.

Qualitative interview was conducted to get in-depth information mainly with key persons who were involved in implementation of project. This interview aims to collect the information through different professional people in the municipality, RUDP, project consultant and ward officers. In this study, the interviews were taken face-to-face and online (due to COVID-19) with key informants to gather information regarding present scenario of proposed ISWM project and its sustainable approach. Secondary data were collected from project office, municipality office and published news articles.

5. Findings

5.1 Findings of Technical Dimensions of project:

1. Total ISWM site area: 18.010 Ha

ISWM (Built-up) area: 12.510 Ha. Landfill area: 9.060 Ha.

Resource recovery facilities (recycling + composting): 1.522 Ha.

Other management & supporting facilities: 1.928 Ha.

Leachate treatment plant: 0.487Ha. Administrative area: 1.441Ha.

2. Greenery (site protection, garden etc.) & future extension area: 5.500 Ha.

3. Incoming waste to the site: 62.49 ton per day

4. Landfill waste: 32.21 ton per day

5. Landfill period: 30 yrs. (compaction: 0.80 t/m³, soil cover:15%, avg. filling ht.:18m)

6. Type of landfill system: Semi-aerobic system with following key features:

i) Standard baseliner system: Composite liner, with 1.5mm thick HDPE geo- membrane over 2 layers compacted clay

ii) Leachate management system: Design Capacity = 600 m³/d Leachate aeration cum evaporation pond (2 chamber-type, with surface aeration & recirculation) + Leachate sedimentation Pond (cascade-type) + Treated effluent dilution chamber 9) Composting Facility: A small scale municipal compost plant of:

i) Plant type: Windrow yard composting

ii) Design capacity: 10 ton per day MSW (i.e., mixed SW) input

10) Recycling Facility:

i) Sorting of recyclables at the 'Reception Area': 7 ton per day

ii) Temporary storage of recyclables in containers, and

iii) Final storage of valuable recyclables before sale in a "Recyclables Storage Shed"

11) Post-closure Plan: Reclaiming the entire ISWM site, after completion of sanitary landfilling, to a valuable recreation area/playground consisting of a gently sloped pyramid-shaped hillock within the plain green forest.

5.2 Findings of socio-cultural dimension

5.2.1 Demography:

The survey area was limited to 1000 m from the proposed ISWM site. Total 20 households were surveyed, which is nearly 20 It is a Tharu settlement with few Brahmins families. Respondents of different age, sex, and nature of residency were taken to measure their perception regarding proposed ISWM project. Most of the interviewed people were from

age group 20-30. Since the online survey was conducted due to COVID-19 the older age group didn't get involved much. Since the majority of respondent are young, they are all literate. It is observed that about 60% of the respondents were female. This indicates that the recorded response of the studied area discloses mainly the female point of view. Furthermore, the household size of the total samples of the respondents, 25 percent have 1-4 family members, 15 percent have 8-12 family members while majority of them i.e., 60 percent of them had between 4-8 family members. None of the HH have above 12 family members.

5.2.2 Existing solid waste management scenario:

When assessing if the community does source separation of solid waste or not, 70% of them practice source separation. The types of waste generated in the surveyed area shows the highest weightage of Organic waste (20 out of 20) followed by inorganic waste (18 out of 20), Reusable (9 out of 20) and recyclable (12 out of 20). About 60% of respondent's burn waste which constitutes a serious environmental risk. Bio-degradable waste is the dominant waste in the area, later treated for manure compost. The survey result shows that the municipality hasn't provided any kinds of solid waste collection/management services yet. Only 10% of the respondents are aware about 3R's of waste management. Remaining are not familiar with the concept of 3R.

5.2.3 Acceptability of project:

The survey result reveals that 90% of people are in support of this project. They were further asked the reason behind it. Those who are in support of this project think that government won't be using such huge budget to construct the dumpsite. Municipality had organized observation tour to locals where they visited sanitary landfill site of Dhankuta and ISWM site of Nepalgunj. They mentioned that they were impressed with how the waste was being managed in those places. If its going to be like those sites, they don't have issue with this project. And those who were not in support of this project mentioned that they don't have trust on government and have doubts that it might not be implemented as per promised. Municipality, ward office and local leaders are actively involved for implementation of project. The RUDP has Performance based Socio-economic Development Program under which around 55 lakh of

budget was used in Patela village to various infrastructure building activities. This has helped to get positive responses toward the project. The highest proportion of the respondents (50%) think that local participation is the key to get their acceptance. While 25% believed it is good communication among government and public, 15% choose “Explain as for everybody to understand” and 10% choose the option “other”. Highest proportion of respondent (40%) think that there will be local employment opportunities during operation phase of project. 30% of the respondent think that this project will be the identity of Patela. Remaining of them think it will help in proper solid waste management (15%) and infrastructure development in Patela (15%). On the other hand 18 out of 20 thinks that the project will cause bad odor in surrounding. The people are also concerned about water source pollution since the Khutiya river is close to the proposed site. Similarly, 70% of respondent regarded effect on public health as negative impacts of proposed ISWM project followed by effect on landscape, and forest area, traffic problem due to vehicles used in waste management and effect on cultural space.

5.2.4 Current use of proposed site for ISWM

The result showed that community use the Patela National Forest mainly for grazing cattle (40%) and firewood purpose (40%). 20% of them mentioned that forest is used for picnic. And from result its clear that forest area is not used as open space for gatherings. There is Patela community forest beside Patela national forest where there is proposed site for ISWM project. So for grazing cattle and firewood purpose local can use their community forest during operation phase of project.

5.3 Findings on economic dimension

Most of the people are farmers (40%) and another considerable amount of people (20%) are doing service and labor work. a small business. 10% of people have their own business/shop and 10% of them have other source of income than these. Most of the family has income range of 20000-30000 (10 out of 20). 5 family has income range of 10000-20000, 3 of them has income range of 40000-50000 and only 2 of the family has income range of 50000-60000. None of them has income above 60000. They survey result revealed that 47% of people think ISWM will create employment opportunities, 21% people think it will

enhance the tourism of the place, 19 % people think the project will create recycling opportunities and 13% people think it will increase the revenue of government.

5.4 Findings on environmental dimension

There is presence of water bodies nearby the site, from field observation it was confirmed that there is a Khutiya river near the proposed site. The major source of irrigation for agricultural fields is boring i.e., 50%. Rest of 30% uses river and deep boring both while 20% of people do irrigation from river. The survey result shows that 15% of people use inorganic fertilizer in their field while 85% of them use both organic and inorganic fertilizer in their field. None of the respondents use only organic fertilizer in their field but all the respondents would prefer compost manure to use as fertilizer in their fields.

6. Analysis and Discussion

6.1 Socio-Economic Sustainability of the proposed project:

According to the survey the households are not getting door to door waste collection service from municipality. They have been practicing source segregation at their house and compost manure is being made by few of them from organic waste to use in fields. However, plastic waste are open burnt by them. In present context, waste collection service is only provided to urban wards. Patela being a village doesn't have this service. People are willing to pay affordable amount for waste collection if the service is provided by municipality. There is overall positive impact of project on local people. The RUDP has been working on implementation of the proposed ISWM site on Patel since 2020. It has organized many formal and informal interactions among locals and implementing leaders of project. In last fiscal year the infrastructure construction activities worth of 55 lakh 50 thousand in Patela. This has increased the public participation and awareness regarding project. The municipality had organized observation tour to locals where they visited sanitary landfill site of Dhankuta and ISWM site of Nepalgunj. They were impressed with how the waste was being managed in those places. They don't have issue with this project if it is being operated as per proposed design.

While analyzing the issues of social acceptance, they

seem to support the project. They are also hopeful with this project regarding creation of employment opportunities for locals. It will increase the flow of people for picnic, observation tour of the ISWM site during its operation phase and help to identify the place among people. Since the survey was done online majority of respondents were youth, they tend to accept this project in positive manner. The project does not affect any tangible or intangible heritage of the area. The project has composting facility and resource recovery facility from which the revenue will be collected by selling compost and reusable and recyclable products from waste which will help to improve economic sustainability. According to this results the proposed ISWM is socially and economically sustainable.

6.2 Environment sustainability of the proposed project

The proposed site is low land grassland with only few trees present in site. So there is no need to cut down many of the existing trees during the construction of proposed project. The Khutiya river that is present on the east of proposed ISWM site, there is provision of embankment work for it. Landfill in near proximity can help regulate waste collection and management services bringing all household under its service and help to create clean city. Treatment of leachate through forced aeration in a 'leachate aeration/evaporation pond' consisting of 2 units of total 5 day retention capacity followed by:

- i) recirculation of aerated leachate back to the active landfill area,
- ii) settling of overflow of this treated leachate in a 'sedimentation pond' of 2-day retention capacity
- iii) further dilution of treated effluent by mixing with the collected rainwater (particularly in dry seasons before ultimate discharge into the river) This will be good enough to improve effluent quality and help to improve environmental sustainability of the project.

7. Conclusion

The project has been proposed as an Integrated Solid Waste Management Site by anaerobic method of landfilling for period of 30 years. The major issues that solid waste management project faces are from nearest community regarding bad odor, nuisance, unhygienic environment, water source pollution etc.

The public of Dhangadi fear of these things when municipality proposed a site which was only 200m away from settlement. The most common example we can take is Sisdol landfill site which has been developed as a sanitary landfill site 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 turned out to be 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, many people come to visit the park or for a observation tour of landfill site area. 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). 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.

The situation has turned out positive up to some extent than during start of project. The community near new site i.e., within National Forest area are in support of this project as the municipality has been working to aware people regarding sustainable solid waste management. The observation tour to sanitary landfill site in Dhankuta and ISWM site in Nepalgunj was organized for near community to introduce with the concept of proper solid waste management.

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. Recommendation

- Residents in the immediate vicinity of the facility, as well as user groups in the region, should be included in the preliminary talks throughout the planning stages to achieve an early and consistent agreement on the acceptance of facility and its sustainability.
- Incentive schemes should be developed and implemented to benefit all persons who are affected by the project, both directly and indirectly. It facilitates local acceptability of the project through active public engagement.
- Active organizational body should be established among community to discuss affairs related to construction and operation of the landfill and community support projects like funding for improving the living environment and quality of life.
- Locals should be encouraged to participate in site inspections and monitoring programs to assist overcome trust issues with the government by demonstrating that they are responsible and will complete their tasks effectively.
- Give locals the authority to terminate the project in case of ill operation. This will increase local participation as well as make them empowered.
- To increase social acceptance, awareness programs should be conducted at the local community level with audio-visual presentation & sharing success stories of local and global cases; its general mechanism, various pros and cons. Media and social media platforms can also be used for this.
- No community welcomes the construction of a waste management (or other comparable) infrastructure on their land. However, if they do not wish to handle solid waste generated near their communities, they should not produce trash in the first place, as this is not practical. People should be made aware of their social duty for appropriate solid waste management to avoid the reality of solid waste management concerns.
- Timely meeting and discussions should be done with local people and all relevant stakeholders from the starting of project.
- When it comes to landfill activities, there are some time constraints that must be adhered to (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.
- During the building of a sanitary land fill site, authorities should emphasize the utilization of locally accessible resources and labor.
- The ISWM site will be handed over to municipality after operation by contractor for two years. Municipality should train their staff during initial years of operation for smooth run of ISWM site.
- Waste to energy technologies convert waste matter into various form of fuel that can be used to supply energy. It can address two sets of environmental issues at one stroke land use and pollution from landfills and dependency on fossil fuel.
- The total quantity of waste gets reduced by nearly 60% to over 90%, depending upon the waste composition and the adopted technology
- When waste is deposited in landfills, it undergoes anaerobic decomposition, resulting in landfill gas (LFG) production. The gas includes around 50% methane, which can be used for energy purposes. Gas extraction decreases methane emissions into the environment.
- Using LFG helps businesses, governments, energy providers, and communities safeguard the environment and promote a sustainable future by reducing smells and other risks connected with LFG emissions.
- Municipality should lead the project enforcing control over all other parties involved in the project so that the project can operate smoothly without any gap or loopholes.
- Proper data on Municipal Solid Waste should be recorded in order to formulate timely and effective management strategies. • To eliminate open dumping, each home should be required to use municipal SWM services.
- Separation of waste at the source should be made mandatory, and distinct waste collection containers should be put in individual households/community nodes for strong system support (with minimum service charge).
- The roles and responsibilities for delivering sustainable systems must be specified, and progress

must be monitored and evaluated.

- Capacity building training regarding 3R (Reduce, Reuse, and Recycle) and Composting should be given in every ward of the municipality.

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