

## ECONOMIC COST OF OPEN WASTE DUMP SITE: WITH SPECIAL REFERENCE TO GOHAGODA DUMP IN KANDY DISTRICT

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### ABSTRACT

*Solid Waste management is most challengeable and hazardable issue around the world and especially in the developing countries like Sri Lanka with its open dumping practice and financial constraints as it causes huge cost along with its impacts. Thus, this study evaluates the economic and cost of the waste dump site located at Gohagoda and alternate methods. The total population residing in the target area was used to collect data for this study. Primary data were collected through questionnaires and interviews with people living nearby the dump site and officers, laborers of Municipal Council. Statistics of Municipal Council and related journals, reports, website were used to collect secondary data. Collected data were analyzed and interpreted in a descriptive method by using SPSS, MS Excel computer packages. The results reveal that dump site causes a significant amount of economic cost approximately LKR. 11 million per month to the societies living nearby the dump site and to the government. Among different components of economic costs, land cost is higher as it comprises 88 percent of costs respectively on each. Therefore, this study recommends alternate methods of waste disposal such as composting and recycling and to vacate households nearby the dump site by providing fair compensation.*

**Key words:** solid waste management, dump site, economic cost and Municipal Council (MC).

### 1.0 INTRODUCTION

This research was conducted on the topic of 'Economic Cost of Waste Dumpsite: With Special Reference to Gohagoda, Municipal Council in Kandy District'. Waste generation rates are increasing widely around the world with growing population due to the continuous growth pattern of consumption and urbanization development. In 2012, world's cities generated 1.3 billion tons of solid waste per year, where world population grew to 7.06 billion and waste generation rate is estimated to rise to 2.2 billion tons by 2025 with 9.8 billion populations (Population Reference Bureau, 2012). Therefore, managing solid waste is challenging issue in the current world, particularly in developing countries which are usually experienced with under-utilized resources and technologies and financial constraints.

In Sri Lanka, these solid waste management are operated by local authorities such as Municipal Council (MC) and Predhesha Sabha (PS). According to AIT (2004), the per capita per day waste generation on the average was 0.85 kg in Colombo Municipal Council (CMC), 0.75 kg in other Municipal Councils (MC), 0.60 in Urban Councils (UC) and 0.4 kg in Pradeshiya Sabhas (PS) (Nilanthi J.G.J. Bandara). Among the components of solid waste management such as compost, recycle, reuse and disposal, the disposal is a critical issue in Sri Lanka just as in other developing countries. Open dumping is more practiced in Sri Lanka for disposal activities, around 85 % of collected waste is subjected to open dumping (Lakshi Karunarathne, 2015) while 5% is composting, 0% of landfilling & incineration and others are 10% (Source:

Project report on “Sustainable Solid Waste Landfill Management (SWLF) in Asia ” (SIDA 2001-2007)

There are more dump sites in Sri Lanka particularly in more urbanized areas like Colombo ‘Meethotamulla’, Jaela ‘Muthurajawela’ and Kandy ‘Gohagoda’. These improper waste dump sites impede many severe effects on the environment, economic and on the society. For example, two months ago above 60 human resources died due to the uncontrolled performance of Meethotamulla dump site and also it caused unpredictable costs for the government, which already runs on a deficit and with debts.

Not only these dump site causes cost sometimes or periodically but it has many cost along with its existence. Disposal of solid wastes is very expensive, and on average, most local authorities in our country spend more than fifty percent of their annual income for this purpose (Chathura M, 2008). Therefore, analysis existing impacts, quantifying it and costs provide opportunities or chances and ways to reduce negative impacts and cost which may prevent uncontrollable disasters and unpredictable high costs. Thus, the objective of this research is to identify economic cost of waste dump site ‘Gohagoda’, which is the second largest dump site in the country.

Waste disposal is more challengeable and hazardable in the current world. From 1980s Sri Lanka has taken many laws, regulations, policies, and programs. The objectives of those programs are to manage solid waste problems such as reduce the quantity produced and impacts of solid waste, promote economically feasible and environmentally sound solid waste management practices for the country at all levels with creating good health and prosperity through green cities. One of the main objectives is responsibilities of local authorities for proper removal and providing suitable dumpsite. The government allocated five billion rupees from national budget of 2008 to the national solid waste management program ‘pilisaru’ (Hikkaduwa et al., 2015).

Even though these policies and programs somewhat have improved solid waste management, it fails to develop proper and efficient waste dump site in the country which is proved by garbage dump landslide in Meethotamulla this year. It’s the second major disaster after the tragedy in Koshe dump site in Ethiopia. And these dump sites form many socio-economic and environmental costs along with its impacts.

Among 23 Municipal Councils and 271 Pradeshiya Sabhas (The local government system in Sri Lanka, 2011), most of the councils have established good solid waste management system. However, operating, maintaining, monitoring and evaluating are not properly organized by the councils and authorities which leads to many waste related issues and then high costs.

As the second largest dump site in the country is Gohagoda which is situated in Thekkawatte, Kandy. In Kandy normally, waste generation is 176 tons per day which composed 75% of kitchen waste, 8% of papers, 5% of plastic and others are 12%.

Among those 176 tons generated waste, 88% (155 tons/day) are collected and only 11% (17.35 tons/day) is used to recycling, while other large amounts (159 tons per day) usually dumped (Source: Waste Amount and Composition Surveys (WACS) implemented in the Central and Southern Provinces of Sri Lanka, SATREPS report (May 2014). It's running against many objections of people and organizations and with many costs. Therefore, the main problem of this research is to find those economic cost and to find out whether these costs by the government, organizations, and people creates negative or positive results to the country.

There are many more researches have been conducted under the title "solid waste management" and dump site with different perspectives like service quality, composition analysis and more around the country and world. However, previous empirical studies focused on costs with the wider objective, this study identify economic cost related to waste dump site. In order to fill the gap between literature and knowledge, this study will fulfill the gap with the theoretical and empirical supports using econometrics tools. Objective of this study is,

01. To examine the economic cost in the study area.
02. To identify possible methods of waste dump in the study area.

The scope of this study was limited only to one major waste dump site in Sri Lanka, called "Gohagoda" which is located in Kandy. That is currently experiencing high costs and represents other dump sites. This study has focused on economic cost of the waste dump site only, other cost related to solid wastes, such as collection and transportation cost has not included. Considering the availability of data, this study was conducted with the time period of 2017.

## **2.0 RESEARCH METHODOLOGY**

In this study, to achieve the objective of the study, Quantitative and qualitative data and not only primary data but also secondary data were collected in order to use such data for analysis. For the data collection process, all the elements of target population was used.

Primary data of this study was collected using questionnaires, interviews and observation tools. First of all the Technical Engineer, Namal, of Solid Waste Management section of Municipal Council and Environmental Officer of Harispattuwa Pradheshha saba was interviewed with semi- structured questions to get overview detail and main ideas of the study. And also interviews were conducted with 02 supervisors, 05 laborers; 02 drivers and 03 securities work at the dumpsite. Questionnaires were issued for 17 families who live around the dumpsite. The dumpsite was observed in order to view the area of the site and get to know the progress and process going on the site.

Secondary data for this study was collected both from the published and unpublished documents. Unpublished budget report of Municipal Council for 2017 and cost data

from Harispaththuwa Pradheshha sabha were gathered in order to achieve the objective 'economic cost' of this study. And also internet website, online journals and newspaper sources were used to fulfill further information of the study.

This research has used descriptive estimation method. Excel and SPSS software were used to analyzed Total capital expenditure was calculated based on the present value of the land and investment cost on the particular waste dumpsite and expenditure on capitals which are used for long period. Operation and maintenance cost was calculated through costs of labors who are working in the dumpsite as operators and maintainers, environmental costs were estimated to the year 2017 which had already calculated per functional unit based on the default values of emissions and resources consumption reported in the Swedish Environmental Priority Strategies (EPS) model, and expressed as willingness to pay (WTP) by society in the Sustainability assessment of municipal solid waste management in Sri Lanka study (Menikpura, S. N. M., 2012).

Damage to human health, the evaluation of impacts on human health caused by the dumpsite measured as total expenditure spend to the treatment and loss of salary due to the absent days in sickness. Opportunity cost (cost of land productivity loss), the existing waste dumpsite consumes a significant area of bio-productive land for disposal. Thus, it is estimated as loss of agriculture production in the area which is used for disposal of wastes through calculating agricultural production of the land in the nearby the dump site to represent the same land productivity.

Disamenity cost is estimated using contingent valuation techniques by calculating willingness to pay to remove the dump site or overcome the problems created by the nearby dump site and willingness to accept as compensation to bear those problems and the site. And human or psychological cost is considered a significant portion or percentage of total cost as there is no any calculation methods for psychological human effects. These impacts include low preference of to visit the houses nearby dumpsite and lack of recognition in schools for the student.

Finally, disaster cost is equalize with the amount of compensation that government has given or allocated to the household to protect them.

### **3.0 RESULTS AND DISCUSSION**

This analysis contains the number of members of the families, jobs, and incomes of the people who live nearby the Gohagoda dump site. Totally around 83 individuals are living nearby the dumpsite. The population lives around the dump site involve in different kind of jobs for earning income such as Business, laboring and Municipal labor etc. The majority of people who live around the dump site do business which is accounted for 38 percent of total population. 25 percent of the total population work as laborers in the Municipal Council, 13 percent and 8 percent of the population are engaged in laboring and foreign housemaid jobs respectively. Accounting, farming and Hotel, garment labor jobs contain 4 percentages of population in each.

17 percent of the people earn below Rs.30000 and 29 percent of people earn between Rs.30000 to 35000 per month. Others 36 percent of families earn between Rs.35000 to Rs.50000 while 18 percent of families earn Rs.50000 and above per month. Average income per month of these people is 48647.0588 where the minimum monthly income is Rs.18000 and maximum is Rs.250000. Totally, per month Rs.8720000 is earned by the people who live nearby the dump site.

### 3.1 Economic Cost

The economic cost of the dump site includes capital cost, operation, and maintenance costs of the dump site and the environmental cost as they are components of LCC approach. Cost of land is the main capital cost of the dump site. As the site has used to dump for 45 years, its value before 45 years was Rs.160000 per acre. The current price of the land has increased while the value of land has decreased with the increasing inflation and interest rates. In order to calculate the present value of the land used to dump, following FV equation has used.

$$FV = C_0 * (1 + r)^n \dots\dots\dots (3.1)$$

Where C<sub>0</sub> is the current cost of the land, r rate of return and n number of years. As the above equation used to calculate future value, here the present value of the land has calculated based on the value of land Rs.160000 before 45 years. The rate of return (r) was 6.5 before 45 years. Thus, the present value of land would be Rs.2721775.701per acre. Therefore, as they use 32 acres (interview) the total value of land would be Rs.87096822.43 in 2017. Thus, per month land used for dumping would cost 7258068.536.

The Municipal Council has invested Rs.5000000 for waste dumping yard from the annual budget 2017. Thus, cost of per month would be Rs.416666.7. And they use JCB backhoe loader to level the wastes which are dumped at the sites daily. The current value of the vehicle would cost Rs.25000000. Thus, the monthly cost of the vehicle would be Rs.2083333. Total monthly cost of capital would be Rs.9, 758,068.

There are 08 laborers, 03 securities; 02 of them for the night and 01 for daytime, 02 drivers and 02 supervisors working at the waste dump site. Even though wages and salaries of these workers differs with the basic amount and overtime work, the current amount of wages and salaries are paid for them and the diesel cost for the vehicle are considered to analyze the operation cost.

Table 3.1  
Workers of Waste Dump Site and Their Monthly Salaries

Types of workers	Total number of workers	Wages/ salary for each	Total amount of wage/ salary
Labourers	8	37000	296000
Securities	3	35000	105000
Drivers	2	40000	80000

Supervisors	2	48000 + 38000	86000
<b>Total</b>	<b>15</b>		<b>567000</b>

Source: Interview survey, 2017

Diesel cost of JSB Backhoe vehicle operate at the dump site would be 800 liters per week and price of a liter is Rs.95. So, the monthly cost of diesel would be Rs.304000. Therefore, total operation cost would be Rs.871, 000. And the maintenance cost is Rs.83, 333.3 per month which government has invested or allocated Rs.1, 000,000 for the maintenance of dumping site in the budget of 2017 for the entire year. So total monthly cost of operation and maintenance of the site is Rs.954, 333.3.

In order to calculate environmental cost of the dump site, this study uses previously estimated environmental cost of Gohagoda dump site in the study Sustainability assessment of municipal solid waste management in Sri Lanka (Menikpura, S. N. M., 2012). As that has estimated Rs.1803 per ton of waste as the environmental cost in 2012, the current cost is estimated using Future value formula.

$$FV = 1803 * (1 + 7.25\%)^5 \dots\dots\dots (3.2)$$

So, the present environmental cost would be Rs.2, 558.481 per ton of waste. Thus, the total environmental cost for 176 tons is Rs.12, 792.41 per day. Thus, the total environmental cost of the dump site per month would be 383,772.3.

Total economic cost for the waste dump site is Rs.11096173.00 in Kandy Municipality. As it comprises 03 costs: capital, environment and operation and maintenance costs, total economic cost comprises 88 percentages of capital cost, 9 percentages of operation and maintenance cost and 3 percentages of environmental cost. Thus, at present capital costs are the major expenses for the local authorities.

**3.3 Alternative Possible Methods of Waste Dump**

Apart from dumping wastes on open sites, there are only two alternative methods of disposal: recycle, compost are continuously undertaking by MC.

**3.3.1 Recycling**

In 2012, Municipal Council formed 3 Sampath Piyasa Centers in Kandy District: to buy non- decaying waste items from people such as Plastic, Coconut shell, and glass waste items etc. And Municipal Council formed the Plastic Recycling Center near the dump site to make plastic wastes into useful plastic materials.

There are many economic costs involved in the process of recycling of the Plastic Recycle Center. They are cost occur during purchasing from the Sampath Piyasa Centers, Wages for laborers, Salary for the Supervisors, Machine depreciation cost and maintenance cost. Usually Plastic Recycle Center buys a Kilogram of plastic for Rs.35 from Sampath Piyasa Centers. For a day with 8 hours of working, at average they use to recycle 400 to 500 Kilograms of Plastic. This implies that Plastic Recycle Center need to buy maximum 15, 000 Kilograms of Plastic per month to carry out

recycle process. Thus, the Purchasing Cost would be 525, 000 per month (Rs.6300000 per year). The total cost for laborers and supervisors of Plastic Recycle Center is Rs.368, 000 per month.

Plastic Recycle Center is using Plastic Recycling Crusher Machine of China for the recycling process which would cost US \$ 1000 – 8000. Thus, the machine cost would be minimum Rs.153, 660 and maximum Rs.1, 229,280 (US\$ 1 = SLR 153.66). And the cost of gun use for oiling the machine is Rs.3, 500. As the plastic recycling machine uses blade and grease as fuel it has capital depreciation cost and maintenance costs. Thus, the total cost of blade renewal per year would be Rs.50, 000. Total annual cost of grease would be range minimum Rs.1, 152.45 to maximum Rs.3, 457.35 for 7.5 Kilograms of grease use per year. And Plastic Recycling Machine depreciation cost per year is Rs.2, 500. So total repair and maintenance cost of machine would be Rs.55, 957.35 per year. Total Financial Cost of Recycling Center to purchase machine and plastic items, to repair and maintain and to operate all the progress, would be Rs.897, 663.1125 per month.

There are two possible health and environmental effects through the process of plastic recycling. High- density polyethylene and polypropylene plastics are usually recycled in the center. Per Kilograms of plastics put into the recycle machine will produce 98 Percent of crushes of plastic while only 2 percent of them will be wasted. Thus, it would produce 14, 700 Kg of crushes for a month. The center sells one Kilogram of crushes for minimum Rs.75 and maximum Rs.85. So, total earnings from 14, 700 Kilograms of crushes would be minimum Rs.1, 102, 500 and maximum Rs.1, 249, 500 per month. Altogether this alternative method of plastic recycling would be profitable (Rs.4, 222, 043) as MC can earn more revenue (Rs.14, 994, 000 per year) than its cost (Rs.10, 771, 957.35).

### **3.3.2 Composting**

Another alternative method currently in practice is composting. Every day, among 176 total waste generation, 10 - 15 tons of decaying wastes are used involve in traditional (layers) composting. For about 03 months, those 10 tons of wastes maintained with ensuring aeration by regularly turning the mixture. After 03 months 1 to 2 tons of fertilizer can be obtained from 10 tons of decaying wastes. It is being undertaken by the Municipal Council in a part of the dump site itself. Thus, the process of composting is carried by the laborers and supervisors employed at the dump site. Municipal Council has invested Rs.4000000 for compost manufacturing site from the budget of 2017.

Large proportion of decomposed fertilizers are used for the public place gardens under the Municipal areas and small proportion only which is, accounted as 5 Kilograms of 1 to 2 tons of fertilizers produced from 10 to 15 tons of waste, sold in Market on Sunday (Pola) organized by Municipal Council at lower rate of price Rs.10 to 15per Kilograms of fertilizers. As estimated, within a year, 240 to 480 tons of fertilizers can be obtained

where only 1200 Kilograms of fertilizers are sold. The revenue for 1200 Kilograms of fertilizer range from Minimum Rs.12000 to Maximum 18000 per year apart from it uses for the public places and gardens under the MC. By adding value to those fertilizers, we can get a total income from fertilizers for the MC. Thus, if MC sell all the tons of fertilizers produced per year at current Rs.10, it would earn minimum Rs.2400000 to Rs.3600000 and if it sells at Rs.15, it would earn from minimum 4800000 to maximum Rs.7200000.

This alternative method also would be profitable minimum Rs.800000 at a Rs.15 price as MC invest Rs.4000000 for this composting. Even if it don't earn income from all the fertilizers produce, it could reduce the maintenance cost of public places, gardens by using own fertilizers produce by it.

## **5.0 CONCLUSION AND RECOMMENDATION**

With ever-increasing population and economic development, waste generation is highly increasing in Sri Lanka and the worldwide. As waste generation increases, it accelerates the problems and the costs associated with open dump site which is more practiced disposal method of waste in many countries like Sri Lanka. Thus, identification inefficiencies through detailed cost analysis would help the existing system, therefore, this paper examines the economic cost of the open waste dump site.

The findings of this study present three major headings; employment details of people around the dump site, economic costs and the progress of alternative methods following descriptive analysis of primary and secondary information. The empirical findings recognized that there is a huge amount of economic cost arise from the open waste dump site as it is Rs.11096173 (11 million) per month. By all accounts, the dump site poses a significant cost for government, people and for the environment. Therefore, this study recommends two alternate methods, composting and recycling, of waste disposal, have a significant role in economic benefits by reducing the amount of waste being dumped, generating revenue.

The Municipal Council should utilize the land for like agricultural production or recycling, compost and some more alternative methods like bio gas, electricity production and polythene recycling. It should look to enlarge two alternative methods which are undertaken at small level with some machines and small land area. And should organize effective field awareness programs which change mindset and attitudes of people and as 'waste' into 'resources'.

As two sides of a coin, both Municipal Council and Public should understand their responsibilities and perform with their best to achieve the goals. Thus, Municipal Council should plan and organize activities to reduce wastes at household levels such as providing guidance and subsidies for doing compost, recycle etc. and also people should concentrate on those activities as to bring effective participation. The public



should give supports to the local authority by separating wastes into decaying, non – decaying things at the households' level. Policies of tax and subsidies should effectively support to solve these waste related issues and to increase the demand for goods recovered from wastes. Because those two are better motivators of activities of desired results. Even little is known about these concepts, this is an important area on which future research could be conducted.

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