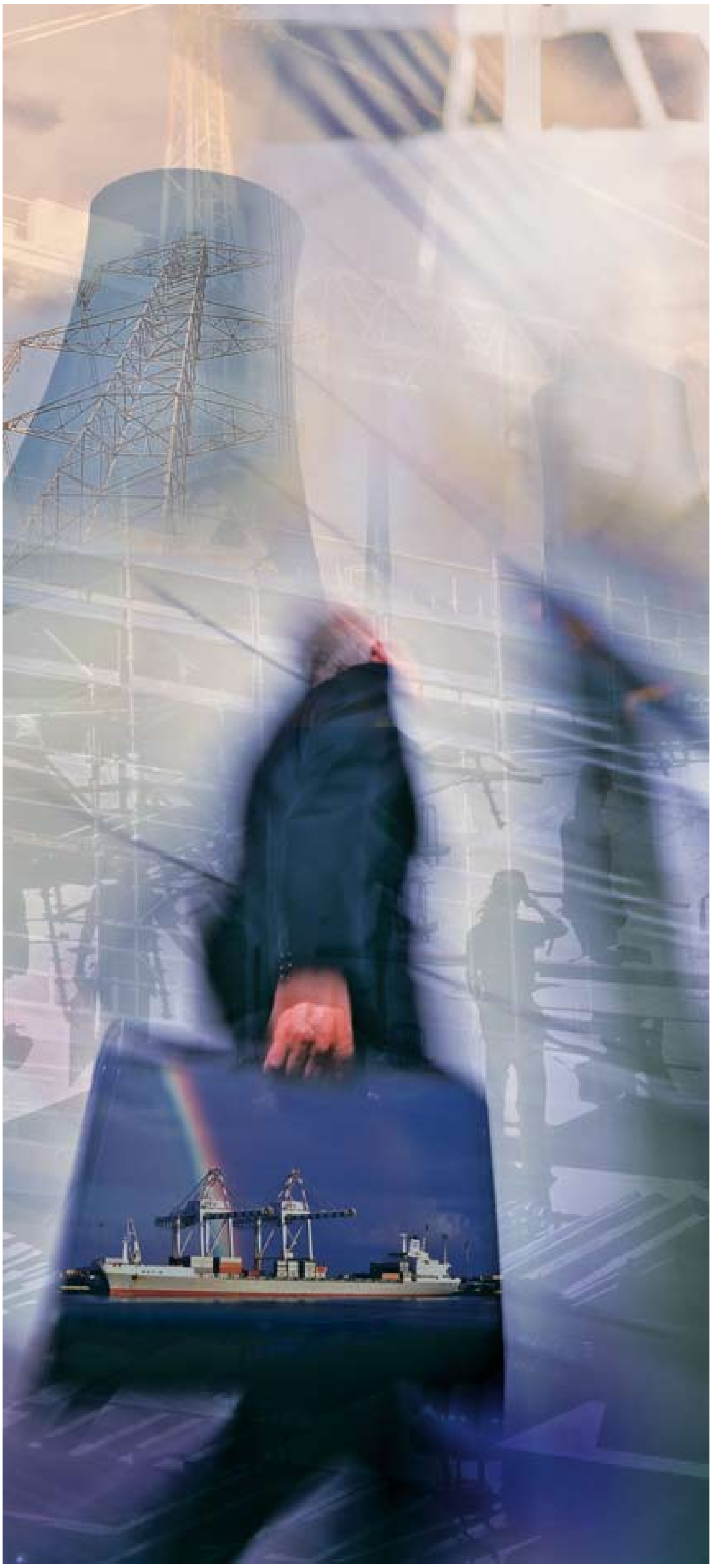

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Welcome

The Economic Society of Australia warmly welcomes you to the Gold Coast, Queensland, Australia for the 37th Australian Conference of Economists.

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The Paper following forms part of - *Proceedings of the 37th Australian Conference of Economists*
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An Economic Analysis of the Public-Private-Community Partnership: The Case of Solid Waste Management

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Abstract
This paper assesses the economic efficiency of the public-private-community partnership in urban solid waste management in Dhaka City. *Waste Concern*, a local non-government organization, trialled a partnership approach by integrating all the key stakeholders involved with waste generation, management and disposal in order to improve services and enhance living conditions. The conventional approach of solid waste management is based on the concept of 'collection-transport-dumping of waste', whilst this new approach demonstrates that recycling and composting can be a viable option to turn waste into treasure and achieve sustainability. This paper, based on the successful pilot program at the micro level in a Dhaka City suburb, builds a macro model for the city and provides an economic analysis of its social desirability. The analysis shows that the economic benefits of the partnership model exceed its costs under different scenarios.

Keywords: cost-benefit analysis, Dhaka City, sustainability, urban solid waste management

1.0 Introduction

In developing countries, management of many urban services such as collection and disposal of solid waste (SW) is traditionally entrusted to the public sector. Although proper management of SW is considered to be a public responsibility, in many countries, private enterprise has been successfully involved in the process (Eggerth, 2005; Kaseva and Mbuligwe, 2005). A user fee or a flat rate can be imposed on households for the services provided, either by the local government or private sector (Lal and Taka'u, 2006; Walls, 2005) or by public-private partnership (PPP) arrangements (Massoud and El-Fadel, 2002).

Solid waste management (SWM) is still far from satisfactory in Dhaka City, the capital of Bangladesh, despite substantial liberalization of policies and institutional restructuring over time to deregulate the public authority and improve the quality of services. According to the *Urban Local Body Ordinance of 1977*, the Dhaka City Corporation (DCC) is responsible for collection, transportation, and treatment of SW. However, the current system has generally failed to address a wide range of waste disposal problems through inefficient, corrupt, centralized and politicized management; inadequate financial resources; the low priority of SWM; and the territorial expansion and rapid increase of the urban population (Banu, 2000; Asaduzzaman and Hye, 1998; Kazi, 1998).

In an attempt to establish an alternative low-cost and sustainable SWM method, *Waste Concern (WC)*, a Dhaka-based non-government organization, recently implemented a pilot barrel-type composting project. The conventional approach of SWM is based on the concept of ‘collection-transport-dumping of waste’, whilst WC’s trial demonstrates that recycling and composting can be a viable option for turning waste into treasure, thus achieving sustainability. Based on this successful trial, a partnership model has been designed to integrate the key stakeholders. This approach is based on the concept of resource recovery, minimization, recycling, composting and safe disposal of residuals. A replication of the WC’s pilot experiment throughout Dhaka City could significantly improve SWM, thereby reducing air and water pollution, health risks and waste-volume requiring disposal.

This paper provides an economic analysis of the desirability of this partnership model of SWM from a social perspective. The next section describes the SW scenario and the evolution of the partnership model in Dhaka City, followed by the methodology of the research. The third section establishes the economic viability of the intervention, including a sensitivity analysis, and conclusions are presented in section four.

2.0 Material and Method

2.1 Partnership Model of Solid Waste Management

Dhaka City generates about 3,500 tonnes of SW per day. Of this, 1,800 tonnes are collected and dumped by the DCC, 900 tonnes go to backyard and land filling, 400 tonnes are on road side and open space, 300 tonnes are recycled by the rag pickers, and 100 tonnes are recycled at the generation point (DCC, 2007a). Although the DCC collects about 50% of the SW, it has no sanitary landfill for its ultimate disposal. Only a small percentage of SW collected is dumped at the only landfill site at Matuail. A major portion is dumped in the low-lying areas in and around Dhaka City. SW is considered to be a significant source of pollution, health hazards and environmental degradation including localised flooding through clogging of drains and canals (Tawhid, 2004). This represents a significant problem in a city where 30% of the population lives in slums and only 22% of these has access to municipal waste collection bins (GoB-ADB, 1996).

Failure by the DCC to provide a basic service to city dwellers and community demand for an efficient SWM service have prompted the evolution of some community-based organizations (CBOs) to fill this gap[1] (Banu, 2000). As a result, SW collection services improved significantly, but health hazards and greater environmental problems remain unchanged. CBOs provide a door-to-door waste collection for a monthly lump sum (normally between Tk[2] 10 to Tk 25). This provides a service for waste collection to residents’ door steps, but waste disposal and management at community dustbins and landfill areas remain unchanged (Banu, 2000). The CBOs’ operations lack public support and cooperation (Banu, 2000). Neither the DCC nor the CBOs consider waste minimisation and resource recovery an alternative option and consequently key problems of one of the world’s most densely populated cities remain unresolved.

The economic, social and environmental benefits from waste minimisation and recycling are enormous (Begum *et al.,* 2006; Massoud *et al.,* 2003; SKM, 2003) and they have emerged as the favoured methods of SWM in many countries (Aye and Widjaya, 2006).

[1] A total of 55 community-based and non-government organisations are involved in SWM in Dhaka (*The New Nations*, January 3, 2005).

[2] Tk (Taka) is the Bangladesh currency. US$1 = Tk 68.00 (as in December 2007).

However, in the DCC's approach, the concepts of resource recovery, minimisation and recycling are missing. Similarly, the CBOs' initiatives concentrate on house-to-house collection of waste, but the concept of the 4R's (*reduce*, *reuse*, *recycle* and *recover*) is absent (Sinha 2001).

Through trial and error, *WC* evolved a new approach of building partnerships between the community, private and public sectors to provide effective waste management services to one Dhaka City suburb. The purpose of this approach was to engage households in the separation of waste at its source and cooperation with waste collectors, thereby becoming part of the resource recovery process. This not only reduces the volume of waste ultimately disposed of into landfill areas, but also generates significant amounts of recyclable materials and organic composts. In this framework, the private sector is also engaged in the collection, disposal and management of SW and the production and marketing of recyclable materials and organic compost. The public sector role is restricted to the implementation and monitoring of the intervention strategy and landfill management.

Different approaches have been trialled in order to improve collection, transportation and disposal of SW in developing countries. A partnership approach in the management of environmental services in general, and SWM in particular, is not a new phenomenon (Ahmed and Ali, 2004; Post, 2004; Post and Obirih-Opareh, 2003; Massoud and El-Fadel, 2002). Cointreau-Levine (1994) found contracting, concession, franchise and open competition to be the most common types of private sector participation in SWM in developing countries. Collection and disposal of SW are carried out by private contractors in cities such as Dar Es Salaam, Tanzania (Kaseva and Mbuligwe, 2005), Kumasi, Ghana (Post, 1999), Faisalabad, Pakistan (Beall (1997) and US communities (Walls, 2005). Beall (1997) observed that private solutions could also include civic engagement. However, the effectiveness of these approaches to public resource allocation remains inconclusive.

Techniques of economic analysis have been applied to measure the allocative efficiency of resources. Massoud *et al.* (2003) assessed the effectiveness of the PPP approach to SWM in Lebanon. Their study found that while waste collection and environmental protection improved, the cost of collection increased compared to public sector provision. Denne *et al.* (2007) estimated the economic costs and benefits of diverting a number of waste streams through recycling in New Zealand. Their analysis showed the potential to increase rates of recycling at a positive net benefit for all waste streams. Hajkowicz *et al.* (2005) estimated the cost of waste related pollution to Palau as 1.6% of gross domestic product and annual costs per household as US$0.51. ACG (2003) found positive net economic benefits for zero waste strategy by reducing the quantity of waste and increasing the rate of recovery in Victoria, Australia. Applying a cost-benefit analysis (CBA) framework, Kumar *et al.* (2004) estimated a saving of about Rs 0.09 billion per annum of landfill gas recovery compared to the conventional landfill disposal in India. Begum *et al.* (2006) applied the CBA to estimate the economic feasibility of construction waste minimization in Malaysia. They found a net benefit of RM0.86 million from waste minimization. ACC (1996) found home composting an economically viable option in US cities.

Most studies focus either on the economic benefits of reuse and/or recycling of waste (see, for instance, Alamgir and Ahsan, 2007; Denne *et al.,* 2007; Begum *et al.,* 2006; ACG 2003; Leu and Lin, 1998) or on composting of organic materials (see, for instance, Rahmani *et al.,* 1999; ACC, 1996). None of these studies emphasized waste minimiszation and resource recovery as an integrated approach within the framework of a partnership of key stakeholders. This analysis fills this gap. The partnership approach of SWM in this study is designed to achieve the following sequential goals (*5R*'s):

• reduce;
• reuse;
• recycle;
• recover waste transformation through composting; and
• residuals' safe land filling.

An economic analysis would enable policy makers to determine an appropriate value for such intervention and help them identify whether such a partnership approach of resource recovery is an efficient method of resource allocation. A financial CBA was previously conducted for evaluating the feasibility of the WC's pilot trial and was found to be financially viable at the local level in Dhaka City (Zurbrügg *et al.,* 2005; Enayetullah and Sinha, 2001). However, none of these studies include issues of economic efficiency of resource allocation, indirect benefits of intervention strategy, or opportunity costs of resources. By contrast, the analysis presented in this paper includes both the opportunity cost of capital and indirect benefits of intervention action within its analytical framework. Therefore, the financial analyses of the partnership model of SWM conducted for the pilot study has also been extended to the provision of an economic analysis for a macro level intervention.

2.2 Methods of Economic Analysis

Cost-benefit analysis (CBA) is used extensively in the evaluation of resource allocation for assessment of the social desirability of a particular intervention. In this case, the situations both *with* and *without* the intervention (sometimes called the *baseline case* or *status-quo* situation) need to be clearly defined to identify the incremental cash flows arising from the intervention. Resources will be allocated efficiently if the marginal benefit of the intervention is greater than its marginal cost.

In this study, the CBA technique can consist of the following steps (Alam and Robb, 2007):
∞ identify appropriate intervention action;
∞ identify its full consequences in terms of costs and benefits;
∞ assign monetary values to each item of costs and benefits;
∞ discount them back to a common time period;
∞ sum up the costs and benefits and assess the desirability of the intervention; and
∞ conduct a sensitivity analysis to account for uncertainties.

CBA is a straightforward method when both costs and benefits are properly identified, quantified and valued. The procedure of estimating costs and benefits of the intervention action is described in the next section. CBA then sums up the costs and benefits accruing from the intervention at different points in time using discounting procedure.

Thus a CBA can be expressed as:

$$NPV = \sum_{n=1}^{10} \frac{(B_t - C_t)}{(1+r)^n}$$

where:
NPV = net present value
B_t = annualised benefits generated from the intervention
C_t = annualised costs incurred for the intervention
r = discount rate (i.e. 10%)
n = number of years considered (i.e. 10 years)

Duration of the intervention is assumed to be 10 years. The Ministry of Planning in Bangladesh suggests using a 10% discount rate in the absence of a sector-specific rate (Alam, 2007). For this analysis, a 10% rate is used as the default value, but 5%, 8% and 12% rates are used for the purpose of the sensitivity analysis to verify the effects of varying discount rates. Both costs and benefits are estimated in constant prices, i.e. Taka amounts refer to values in 2007 prices. The intervention strategy is accepted if NPV > 0, otherwise it is rejected.

Both primary and secondary sources of information are employed in order to achieve the objectives of the study. The secondary sources of information used are information published by both public and private sector agencies. Primary sources of information include face-to-face interviews carried out with different stakeholders including WC, visits made to the study area and direct observation.

2.3 Estimating Costs

This study compares the costs and benefits of the intervention action relative to conventional collection of SW from community bins and landfill disposal. The intervention action therefore consists of:

- minimization of waste and recycling through separation at sources;
- resource recovery through composting; and
- combustion of residuals at landfill sites.

This study did not consider other waste management options at final disposal such as combustion and conversion of waste into energy. The composting option is considered most appropriate given the existing institutional arrangements for SWM at Dhaka and the low-investment requirement and potential of generating other benefits such as new employment and small entrepreneurship opportunities for low-income families

The next step in the CBA is to define and quantify the costs and benefits of the intervention action. An attempt has been made to include all categories of cost including explicit (fixed and variable) and implicit costs in the total cost.

In the *with-intervention* scenario, the stream of costs includes:

- capital costs;
- operation and maintenance costs (including variable costs associated with staff, administration and refurbishment and overhead costs);
- implicit cost (i.e. opportunity costs associated with using land and other facilities already owned by the implementing authority); and
- transaction costs associated with implementation of the intervention action.

The data sources for cost estimates include actual costs based on the pilot study, estimates using historical data and experts' opinions along with other secondary sources. Some of the earlier cost estimates were validated during the field visit to Dhaka in January 2007 and were inflation-adjusted for 2007.

2.4 Estimating Benefits

It is important to include all relevant categories of benefits, whether or not they can be easily assessed and measured. There are three broad categories of benefits that are relevant to the SWM, being: (i) direct benefit, (ii) indirect benefit, and (iii) intangible or non-market benefit.

The relevant direct and indirect (tangible) benefits are the increase in economic surplus values as a result of the intervention. These include:

- revenues resulting directly or indirectly from the intervention (revenues which would have occurred regardless of the intervention are not included as an incremental benefit), such as:
    - waste collection fees;
    - revenue from selling compost; and
    - resale value of recyclable products.
- avoided costs (i.e. costs which are unavoidable if a *status quo* is maintained, but can be avoided if intervention action is implemented), such as:
    - environmental damage costs (e.g. greenhouse gas emissions, water and air pollution and resource depletion).
- cost savings (i.e. measurable reductions in existing levels of expenditure if the intervention action is undertaken) from:
    - reduced landfill space; and
    - reduced collection and transportation costs.

Both these avoided costs and cost savings become part of the marginal benefit of the intervention action. Although the focus of this study is on market (direct and indirect) benefits, effective SWM is expected to generate some non-market or intangible benefits which do not bear any price tag. To estimate these benefits requires a non-market valuation technique, such as stated preference method (Jamelske and Kipperberg, 2006).

The following categories of non-market benefits, while acknowledged as important, were excluded from this analysis:

- improved soil health and fertility from reduction of chemical fertilizers and increase in organic composts; and
- health, environmental and social benefits from reduced surface and ground water and air pollution.

In the absence of non-market benefits, the estimates can be considered to be conservative. Furthermore, the intervention is expected to generate indirect flow-on benefits, e.g. employment generation and development of backward and forward linkage industries, and increased property values near the community bins and landfill sites. These types of benefit can be captured by using an inter-industry input-output analysis, in which employment, income and output multipliers are derived (Queensland Treasury, 2006; Harrison, 2002). As the focus of this paper is on the economic evaluation of intervention action, not on measures of the impact on economic activities, no attempt has been made to capture such flow-on benefits.

3.0 Economic Analysis of the Partnership Approach of SWM

A CBA was performed to assess the economic viability of the partnership approach of SWM in Dhaka.

3.1 Estimates of Total Cost

Cost estimates for the intervention action are based on the following considerations.

WC's pilot project implemented at Mirpur Section-2 in Dhaka City was able to utilize three tonnes of SW per day collected from about 1,000 households. The WC charges between Tk 10 and Tk 15 per household per month as a waste collection fee, and 675 kg of compost was produced every day by processing three tonnes of waste.

Based on WC's experience of successful piloting and cost estimates, a city-wide model of partnership approach of SWM has been developed to create a 30-tonne capacity composting plant in each of the ten zones of the DCC covering 12,000 households (based on per household domestic waste generation rate of 2.5 kg). Capital items include land rentals, construction of plants, equipment and machinery and both skilled and unskilled labour. Operation and maintenance (O&M) items include raw materials, maintenance, utility and labour.

Details of the capital and O&M cost estimates for the intervention action over 10 years are provided in Table 1. The partnership model is able to reduce the volume of generated waste by 66%. In the first phase of the project, DCC still requires to manage the remaining 34% of the generated waste. DCC's combined expenditure of salary and allowances, utility bills and repair and maintenance expenditures is estimated at Tk 1.53 billion in 2007-08 (DCC, 2007b). Without details of DCC's conservancy expenditure, it is assumed that DCC will require 34% of this budget to landfill the remaining waste from community bins.

Without a detailed study, it was difficult to estimate the transaction cost of implementing the partnership model of SWM, which is able to divert 16.67% of the currently managed wastes by DCC. Out of an estimated annual revenue expenditure of Tk 2.38 billion in 2007-8, DCC's budget for training is Tk 31 million (DCC, 2007b). The implementation of the new model of SWM is assumed to require an equivalent of 50% of DCC's training expenditure for the first five years and thereafter 25% for the following purposes:

∞ education, training and development of awareness among residents to separate waste and cooperate with waste collectors;
∞ design, review and implementation of legal procedures; and
∞ monitoring and evaluation of the intervention action.

Implicit costs are assets and resources already in use by the DCC. Without a detailed study, 10% of the estimated expenditure of Tk 15.3 million (for salary and allowances, utility bills and repair and maintenance) is assumed to remain in use by the DCC for resources for the management of community bins and landfill sites (e.g. rents and infrastructure maintenance). Contingency is estimated at 5% of the total cost. The total expenditure for capital investment and O&M costs for a period of 10 years is estimated at Tk 566.67 million and is also provided in Table 1. The total cost of the intervention action is estimated at Tk 1,802.17 million.

Table 1: *Total cost of solid waste management in Dhaka City over 10 years (Million Tk)*

Items	Costs (Million Tk)
Capital items:	
Manpower	
Skilled	6.00
Unskilled	10.5
Rent (land) for compost plants	9.4
Construction of compost plants	46.51
Equipment and machinery	8.00
Total capital investment cost	80.41
Operation and maintenance items:	
Unskilled labour	435.00
Skilled labour	27.46
Utility (e.g. water and electricity)	4.92
Maintenance	3.49
Raw materials	15.30
Total operation and maintenance cost	486.26
Transaction cost	116.25
Implicit cost	243.84
DCC's ongoing cost	829.06
Contingency	46.34
Total cost	1,802.17

3.2 Estimates of Total Benefit

3.2.1 Sales revenue from composting

Although the major component of municipal waste is organic food waste, with almost 68% of its residential waste being compostable, it is not currently being collected by waste-pickers despite its potential value. Consequently, it can be converted into organic compost as an alternative to chemical fertilizer in order to increase soil and crop productivity. The partnership model can therefore result not only in increased compost production but also in the reduction of methane emissions from landfill sites.

Each of the 30-tonne capacity compost plants is capable of generating 6.75 tonnes of compost daily (225 kg of compost from a tonne of SW). At a market rate of Tk 6 per kg, a total of Tk 0.15 million can be earned from ten plants in Dhaka City in Year 1, rising to Tk 1.10 million in Year 10 (Table 2)[3]. Total sales revenue from compost over ten years is estimated as Tk 4.92 million taking into account the increased user fees from a bigger population and expansion of the compost capacity in Year 5 (Table 2).

[3] Given the increased supply of compost, its retail price is assumed to remain unchanged during the programme period as the share of compost to the total fertilizer requirement in the country is minimal and considering the fact the market price remained unchanged over the decade.

3.2.2 User fees
With a monthly user fee of Tk 15, the partnership model can generate a revenue income of Tk 18.00 million in Year 1, rising to Tk 42.44 million in Year 10. In addition, composting organic waste will also generate 950 new jobs (skilled employment of 150 and unskilled employment of 800) in Year 1[4].

3.2.3 Revenue from sales of recyclable products
Current practices of recycling conducted at community dustbins, streets and landfill sites (mainly by housewives, scavengers and waste-pickers known as *tokais*) do not represent any coordinated effort. For instance, although street scavengers and waste-pickers collect inorganic materials, they leave organic materials and spread waste, causing more health hazards and environmental deterioration. Currently, about 11% of generated waste is recycled. It is assumed that additionally 10% of the generated waste can be recycled. An estimated average market price of US$ 62.55/tonne for recyclable materials is used in this study (Alamgir and Ahsan, 2007).

3.2.4 Avoided costs of reduced GHG emissions
Avoided costs are indirect benefits of the intervention action. An important environmental benefit of the partnership approach is the resulting reduction of greenhouse gas (GHG) emissions. Reducing waste at source as well as recycling and composting are seen as the most effective ways of reducing GHG emissions from waste decomposition at landfill sites and other places. The GHG of primary concern in the waste sector is methane emitted from landfills and other places when organic wastes decay in the absence of oxygen. Recycling and composting can offset GHG emissions by reducing the amount of waste dump and converting waste into compost and other products.

Table 2: *Total revenue earning over 10 years*

Items	Total revenue (Million Tk)
Sales revenue from compost (Tk 6/kg)	4.92
Users fees collected from households	286.87
Sales revenue from recyclable products	1,548.60
Total revenue earning	1,840.39
Avoided cost	926.00
Cost saving	738.98
Total benefit	3,535.40

WC estimated that composting 1 tonne of organic waste could reduce GHG by 0.5 tonne annually (WC, 2005). The Australian Government (1997) estimated the emission of 0.17 kg of methane from one kg of SW, although the actual rate would depend on local environmental factors. Under the UN Clean Development Mechanism, WC is able to sell tradable certificates for US$11 per tonne of reduced methane gas which appears to be undervalued. Using a conservative estimate of 0.17 tonne of methane per tonne of waste diverted from landfill disposal and US$ 20 (Tk 1,360) per tonne of methane, the total cost

[4] Each 30 tonne capacity plant requires 15 skilled persons (10 for management of the plant and 5 for distribution and marketing of compost) and 80 unskilled (about 50 part-time waste collectors and about 30 full-time production workers).

saving from emissions avoided is estimated at Tk 926 million over a 10 year period (Table 2).

3.2.5 Cost savings

Cost saving appears to be another significant benefit of the partnership approach of SWM. At present DCC spends about US$38 to manage one tonne of waste, from collection to crude disposal (WC, 2005). The new approach of SWM can decrease this cost by reducing a huge volume of the SW. WC estimates the average cost per tonne at Tk 820 and claims that a small three tonne capacity compost plant could save 1,095 m^2 of landfill area annually (Enayetullah and Sinha, 2001). However, as the existing landfill area is saturated, it would be hard to save any cost by reduction of landfill space. With the intervention action, 330 tonnes of waste can be diverted daily from DCC's collection and landfill disposal. Therefore, the total cost saving is Tk 270 thousand per day.

3.3 Economic Analysis

Once costs and benefits are identified, quantified and valued, the next step is to assess the economic viability of the intervention action. These are estimated by comparing the costs and benefits (expressed in constant Taka (Tk) terms) of the *without-intervention* situation with those of the *with-intervention* situation.

All the costs and benefits for the *with-intervention* situation over a period of 10 years are presented in Table 3 below.

Table 3: *Economic Cash Flow*

Items	**Million Tk**
Costs	
Capital cost	80.41
O&M cost	486.26
Transaction cost	116.25
Implicit cost	243.84
DCC's ongoing cost	829.06
Contingency	46.34
Total costs	1,802.17
Benefits	
Revenue income	1,840.39
Indirect benefits	
Avoided cost	926.00
Cost saving	738.98
Total benefits	3,505.40
Net benefits	1,703.23
NPV: Tk 854.65 million *BCR:* 1.73	

The cash flow is incremental, over and above the "*do nothing*" or "*status quo*" scenario (i.e. all generated waste is landfilled). Under the intervention action, the bulk of the incremental costs come from capital items, whilst the greatest incremental benefits come from direct revenue earnings. Revenue from sales of recyclable products is the most significant contributing factor to total benefits. Without the inclusion of the terminal value (i.e. value of remaining assets of the project at the end of the ten-year period) the estimated net benefit is conservative.

Both the NPV and Benefit-Cost Ratio (BCR) figures are used to compare the money value of total benefits derived in relation to the cost of the intervention action. The NPV of Tk 854.65 million is greater than zero, implying that the intervention action will generate a greater return than the *without-intervention* action. The BCR is 1.73 which indicates that the intervention action is economically viable. It can therefore be concluded that the partnership approach is a viable alternative and has a net positive benefit and higher BCR in relation to the *status quo*.

3.4 Sensitivity Analysis

A sensitivity analysis was conducted to assess the influence of uncertain variables on the intervention outcome. It is required because of the uncertainty, risk, and accuracy of estimations for the intervention action.

NPVs are calculated using different combinations of worst and best case scenarios. These factors include:

- the effect of the change of some key cost and benefit variables such as estimates of capital cost, transaction cost and revenue income; and
- the effect of the discount rate on the cash flow.

Eleven scenarios are developed based on varying the assumptions in Table 4.

Table 4: *Sensitivity analysis*

Scenario	Description	NPV (million)
Scenario 1	varying discount rate at 5%	Tk 1,137.25
Scenario 2	varying discount rate at 8%	Tk 902.54
Scenario 3	varying discount rate at 12%	Tk 670.98
Scenario 4	increase of capital cost by 25%	Tk 760.03
Scenario 5	increase of capital cost by 50%	Tk 743.10
Scenario 6	increase of transaction cost by 25%	Tk 740.78
Scenario 7	increase of transaction cost by 50%	Tk 721.53
Scenario 8	decrease of revenue by 10%	Tk 679.90
Scenario 9	decrease of revenue by 25%	Tk 534.33
Scenario 10	simultaneous increase of capital and transaction costs by 25%	Tk 720.63
Scenario 11	simultaneous increase of capital and transaction costs by 50%.	Tk 681.23
Scenario 12	overall 25 % of total cost	Tk 512.37

The sensitivity analysis demonstrates that the intervention action is worthwhile pursuing even with significant changes in key variables. Although the variations chosen do not affect the viability of the intervention, they do slightly affect the size of the net benefits.

4.0 Conclusion

Based on the case study trialed by the WC, the focus of this paper is on examining the economic efficiency of the SWM through a partnership approach in Dhaka City. This paper examines the highly contentious question of whether a partnership approach is desirable from the resource allocation point of view to resolve a SWM crisis in low-income cities like Dhaka. This analysis provides an economic rationale for making such public policy decisions by estimating both the benefits and costs of the partnership model.

This study shows that SWM in Dhaka City is not only a social or environmental imperative, but is also an economically viable mitigation strategy and thus public funding is highly desirable. It shows that recycling-composting-landfilling under the partnership management can be a good alternative to conventional SWM options, reducing the amount of waste to be transported and dumped and recovering valuable materials. Not only can it save money on the DCC's conservancy budget but the DCC's role can also be decentralised by restricting its responsibility for the safe disposal of waste from community bins to landfill sites and diverting it to the overall monitoring of the partnership arrangement.

This study will be helpful to resource allocation decisions for improving urban services in resource-scarce developing countries. This approach not only shows a mechanism for establishing sustainable liveable cities in developing countries, but also demonstrates the capacity to integrate all the three key stakeholders into an effective and efficient framework. Its main strength is the capacity development for urban environmental governance. The analysis provides valuable information for important mitigation action to be undertaken to improve the well-being of society. It underlines the urgent need for concerted intervention primarily from the government and broadly involving all three stakeholders in the process, that is, the government, the private sector and the community.

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