Cost Modelling of Waste Management – Assessing Alternatives in Bolivia

Waste collection and disposal use are a large part of the municipal budget in low- and middle-income countries. Costs are, however, seldom evaluated systematically. A cost model was developed for a Bolivian municipality to evaluate the status-quo and possible future waste collection scenarios. A. Mertenat[1], M. R. Landaeta[2], Ch. Zurbrügg[1]

Introduction

Poor solid waste management (SWM) threatens local residents and their environment, especially in low- and middle-income settings where limited financial resources and inefficiencies are often the cause of limited service delivery. Interestingly though, many municipalities do not have accurate data on SWM service costs in their municipal budgets. This limits their capacity to assess inefficiencies and is a major barrier to strategic planning and improvements. Although SWM cost-models exist in literature, they are setup for high-income settings containing technical solutions inappropriate for lower-income settings [1]. A simple Excel-based cost modelling tool was developed to assist local authorities, and applied to a Bolivian municipality to help evaluate their current collection service costs and assess alternative waste collection scenarios.

Methodology

Total cost and revenues of current SWM service were assessed by observations, document review and interviewing key stakeholders. The aim was to identify each SWM service work unit and related operating and administrative costs, including: workforce salaries, equipment (Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) considered) and consumables. The data was put into an Excel cost-model developed in previous studies and a model developed by CSD Ingénieurs. The costs were split by four work units: 1) Collection, 2) Transfer station and treatment, 3) Transport and 4) Final disposal. For the collection work unit, cost calculations were based on waste generated per kilometre of road, allowing for estimations of number of vehicles required, route distances and travel time, number of trips and kilometres travelled.

With the cost model in place, four different scenarios were assessed: 1) Baseline scenario – a simplified and optimised mixed waste collection scheme based on the current door-to-door collection service, with transfer stations and subsequent transport to the municipal sanitary landfill; 2) Same as baseline scenario but without transfer stations; 3) A mixed waste collection scheme relying on a self-delivered system to neighbourhood containers; and 4) A two-fraction segregated waste self-delivered system with neighbourhood containers and a central composting facility for the organics. All scenarios were based on similar administrative costs.

Results

The Bolivian study confirmed the knowledge gap at the municipal level about the true total service costs. Only 55 % of the real costs were in the municipal SWM budget; the rest were hidden in expenditures of other municipal departments. The financial analysis revealed that only 4 % of the total expenditures are covered by the current tariff systems and respective user fees.

Modelling of scenarios shows that a transfer station reduces total costs by 14 % (Figure 1), comparing scenarios 1 and 2. This is mainly because fewer vehicles and fuel and less workforce is needed as collection is done by bigger transport trucks that go to the landfill. Scenario 3, waste collection in containers, would decrease total costs by up to 15 %. Here, the improved collection efficiency in terms of decreasing waste collection time, vehicles and workforce needed, outweighs the need for additional container equipment costs. Finally, scenario 4, waste segregation at source and a separate collection with organic waste composting at the transfer station, results in a 19 % cost reduction compared to the baseline. The cost of the various work units shifts, increasing for collection and treatment, and decreasing for transport and disposal due to organic waste diversion from the landfill.

Conclusion

Our study shows that analysing the costs of SWM services systematically can be an eye-opener and activator for local authorities. Knowing the true status quo costs allows them to evaluate cost efficiency and even implement easy improvements. The estimates from our analysis can support decision makers with strategic planning when considering alternative systems and services. It is, however, important to remember that cost modelling shows only one part – the financial aspects – of the complex solid waste management system. Financial modelling and assessments for evaluating service alternatives must always be accompanied by evaluations of social acceptance and environmental impact.

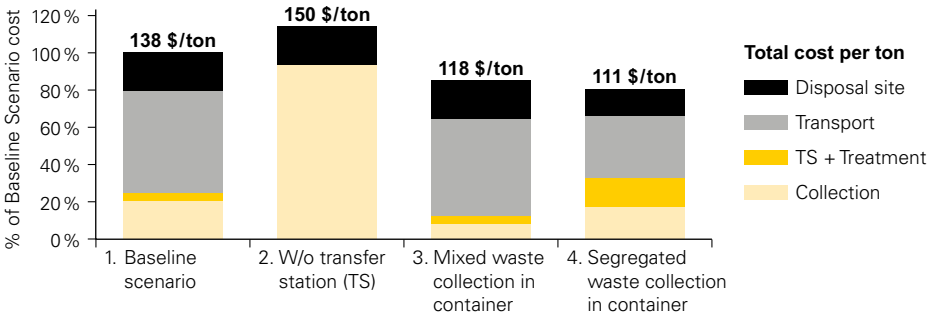

Figure 1: Total cost and cost distribution of different waste collection and transportation scenarios.

[1] Parthan, S. R., et al. (2012): Cost estimation for solid waste management in industrialising regions – Precedents, problems and prospects. Waste Management *32 (3),* 584–594.

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