Waste Collection Systems in Developing Countries

Sandra Cointreau

Collection Costs are High and Service Levels are Low

- Total Collection Costs Require 0.5% to 2.5% of per capita income (as Gross National Product)
- Service Typically Covers only 30%-70% of the Urban Population
- Service is Infrequent (often less than once every two weeks for the urban poor)
INEFFICIENCIES IN SOLID WASTE COLLECTION ARE CAUSED BY:

- Poor Labor Management and Supervision,
- More Workers on the Roles Than Needed
- Inadequate Cooperation from the Citizenry with Collection Schedules and Methods
- Inappropriate Type and Size of Collection Vehicles

INEFFICIENCIES IN SOLID WASTE COLLECTION ARE CAUSED BY:

- Non-Rational Routes for Collection Service
- Failure to Optimize Vehicle Productivity by Selecting the Appropriate Crew Size and Shift Duration
- Inadequate Communal Container Capacity at the Communal Collection Points
INEFFICIENCIES IN SOLID WASTE COLLECTION ARE CAUSED BY:

- Long Vehicle Down Times from Poor Equipment Maintenance and Repair
- Long Haulage Times to Disposal Sites Coupled with Lack of Transfer Stations
- Harsh Driving Conditions at Disposal Sites Cause Vehicle and Tire Damage

Collection Options to Consider for Optimizing Costs and Productivity

- Route Type
- Vehicle Type
- Vehicle Size
- Crew Size
- Length of Shift
- Number of Shifts
- Public Operator
- Private Operator

Private Contractor, Quito, Ecuador, 1998
Route Types

- Piles along street
- Door to door
- Communal container stops with liftable bins
- Larger communal container stops with roll-on containers

Liftable Container, Izmir, Turkey, 1994

Arm-Roll Container, Sekondi, Ghana, 1997

Route Type

- Bell/Schedule System, Riga, Latvia, 1995
- Collection Point for Carts, Enugu, Nigeria, 1992
Vehicle Types

- Small – power tiller, hand cart, mini-truck
- Slow moving – tractor and trailer, animal cart
- Fast moving – open tipper truck, rear loader truck
- Container lifting – roll on, skip, mechanical arm for carts

Accra, Ghana, 1997
Kukkattally, India, 2001

Vehicle Types

- Market Skip Lift Containers, Tema, Ghana, 1994
- Arm Roll Container, Ahmedabad, India, 2001
Vehicle Types

Mini Private Truck, Bangalore, India, 2001
Open Tipper Lifts Hand Carts, Hue, Vietnam, 1996

Private Open Tipper, Quito, Ecuador, 1998
Rear Loading Compactor, Shanghai, China, 1998
**Crew Size and System of Loading**

- Vehicle productivity more important in LDC’s than worker productivity
- Arrange crew size to optimize vehicle productivity
- Facilitate method of loading

Bombay, India, 1995

Ica, Peru, 1984

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**Crew Size**

Izmir, Turkey, 1994
Bangalore, India, 2001
Length of Shift

- Arrange shift length to get full loads in collection vehicle
- Private sector may be more flexible to have extended shift lengths

Private Contractor, Jakarta, Indonesia, 1992

Number of Shifts

- Two shifts may have lower costs than one shift by getting more productivity per vehicle (and transfer facility)
- Issue of change in drivers and time for maintenance/repair
- Private sector more flexible to work different hours and night shifts

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Public versus Private Operator

- Different financing costs
- Different overhead costs
- Different salaries and benefit costs
- Different insurance, tax, registration, and marketing costs (also corruption costs)
- Different length of hours of work and productivity per worker
- Different vehicle availability
- Different accountability – per contractual specifications

Private Sector Service

Woman-Owned Micro-Enterprise, Quito, Ecuador, 1998

Women-Owned Cooperative, Kukkatpally India, 2001
Private Sector Service

NGO-Managed Waste Recyclers with New Collection Routes, Bangalore, India, 2001
Private Contractor, Tema, Ghana, 1996

Vehicle Type

Solid Waste Collection Vehicle Costs in Almaty, Kazakhstan, 2000

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Cost per tonne in $US</th>
</tr>
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<tbody>
<tr>
<td>LG RL COMP MANUAL 20</td>
<td>5</td>
</tr>
<tr>
<td>LG RL COMP CONTAINERS 20</td>
<td>10</td>
</tr>
<tr>
<td>SM RL COMP MANUAL 10</td>
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<tr>
<td>SM RL COMP MANUAL 10</td>
<td>10</td>
</tr>
<tr>
<td>FARM TRACTOR TRAILER 6</td>
<td>10</td>
</tr>
<tr>
<td>OPEN TIPPER 6</td>
<td>10</td>
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</tbody>
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km from collection to discharge

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Crew Size Comparison

- 5-person crew had lower cost/tonne than 4-person crew
- Larger crew could load vehicle faster and optimize vehicle productivity

Public versus Private Worker Productivity
Public versus Private Vehicle Productivity

![Graph showing collection vehicle productivity in Quito, Ecuador - Government - 1998]

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Public versus Private Costs

- Total costs for private versus public were so close in Quito, it was decided to maintain a balance of each, and gradually decrease government to about 30% through natural attrition.
Transfer Economics

- Assess the breakpoint for each type of truck
- 6 cm. tipper was at 25 km, compared to 10 cm rear loader at 40 km

COST ($US/Tonne) FOR COLLECTION AND TRANSFER SYSTEMS - GOVERNMENT SERVICE - Almaty, Kazakhstan - 2000

COSTS CAN BE REDUCED SIGNIFICANTLY:

- Appropriate Collection Technologies for Route Conditions
- Demand-Driven Approach to Involving People in their Service Choices - Social Surveys
- Rationalize Operations – Crew Size, Vehicle Size, Route Design, and Transfer Stations
- Monitor Performance with Weighbridges
- Accountable Financing - Leak Proof Segregated Accounts
- Transparent Competitive Private Sector Procurements