Delhi Water Supply & Sewerage Services: Coping Costs, Willingness to Pay and Affordability

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December 2006
Overall Study Objectives

• To understand Water Supply & Sewerage (WSS) conditions and preferences of representative consumers
  - Quantity & quality of water consumed
  - Coping strategies (including use of groundwater) and cost
  - Demand & preferences for water supply services
  - Affordable contributions for preferred options
Sample Size

Delhi (10,000)

Domestic Consumers (8000)
- Underserved
  - Juggi Jhopri JJ (Slum) Clusters
  - Resettlement Colonies
  - Unauthorized Non-Regularized
  - Unauthorized Regularized
  - Urban Village
  - Rural Village
- Authorized Flatted
  - Janta Flats/ Type I/ One room tenements
  - Low Income Group (LIG) Flats / Type II
  - Middle Income Group (MIG) Flats
  - High Income Group (HIG) Flats / Luxury Apartments
- Authorized Plotted

Non-Domestic Consumers (2000)
- Commercial
- Institutional
- Industrial
- Plots < 100 sq m
- Plots 100-150 sq m
- Plots 150-300 sq m
- Plots > 300 sq m
Representative Consumer Categories Surveyed in Different Zones
Sampling Design: Domestic Consumers

• Multi-stage stratified random sampling methodology (Voter List)
  - Stage I: Zones
  - Stage II: Colonies
  - Stage III: Households

• Sampling separately undertaken for:
  - Delhi Jal Board (DJB) Pilot Project in South 2 & 3 zones
  - Rest of Delhi under DJB, New Delhi Municipal Corporation (NDMC) & Delhi Cantonment Board (DCB)
Structure of this Presentation

• Existing Water Supply Arrangements; Compulsions for Coping Strategies and Costs

• Willingness to Pay for Improvements in WSS Services

• Affordability Analysis

• Key Findings
Existing Water Supply Arrangement …
Authorised Colonies
Sources of Water Supply by Zones – Authorised colonies

Average:
- Own bore well: 9
- Housing society bore well: 4
- DJB tanker: 3
- Bottled water: 98

Other DJB zones:
- Own bore well: 6
- Housing society bore well: 4
- DJB tanker: 2
- Bottled water: 99

South 3:
- Own bore well: 12
- Housing society bore well: 6
- DJB tanker: 7
- Bottled water: 96

South 2:
- Own bore well: 12
- Housing society bore well: 4
- DJB tanker: 2
- Bottled water: 99

% hhs:
- Piped Water Supply: 98
Sources of Water Supply by Zones - Underserved

- **Average**
  - Own bore well: 12
  - DJB tanker: 5
  - Community hand pump: 5
  - Community stand post: 23
  - Galli tap: 6
  - Piped water supply: 62

- **Other DJB zones**
  - Own bore well: 13
  - DJB tanker: 7
  - Community hand pump: 6
  - Community stand post: 24
  - Galli tap: 7
  - Piped water supply: 53

- **South 3**
  - Own bore well: 1
  - DJB tanker: 6
  - Community hand pump: 23
  - Community stand post: 2
  - Galli tap: 2
  - Piped water supply: 73

- **South 2**
  - Own bore well: 13
  - DJB tanker: 5
  - Community hand pump: 4
  - Community stand post: 22
  - Galli tap: 7
  - Piped water supply: 67

% hhs
Average Hours of Water Supply - Domestic

<table>
<thead>
<tr>
<th>Hours of Supply</th>
<th>Janta/LIG</th>
<th>MIG/HIG</th>
<th>Plots &gt;150 sq m</th>
<th>150-300 sq m &amp; &gt;300 sq m</th>
<th>Total</th>
<th>JJ</th>
<th>Reset cols</th>
<th>Unauth Reg</th>
<th>Unauth Non-reg</th>
<th>Urban-Rural Village</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi average</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

Legend:
- Orange: South 2
- Blue: South 3
- Green: Other DJB zones
- Cyan: Delhi average
Water Pressure - Non Domestic

% Establishments

- **Delhi Total**
  - Low: 47
  - Moderate: 48
  - High: 5
  - Total Hrs. of Water Supply: 3.6

- **Industrial**
  - Low: 59
  - Moderate: 36
  - High: 5
  - Total Hrs. of Water Supply: 3.9

- **Institutional**
  - Low: 38
  - Moderate: 58
  - High: 4
  - Total Hrs. of Water Supply: 3.7

- **Commercial**
  - Low: 37
  - Moderate: 57
  - High: 6
  - Total Hrs. of Water Supply: 2.9

Legend:
- Low
- Moderate
- High
Water Quality

% Households with greater than permissible limit of water quality parameter

- Total Dissolved Solids (TDS)
- Total Hardness (TH)
- Alkalinity
- MPN
- E-coli
Coping Strategies...
Coping Strategies …Authorised Colonies

% Respondents

Other DJB Zones
- Borewell: 6%
- Ground Level Reservoir (GLR): 57%
- Internal pipe line: 71%
- Under Ground Reservoir (UGR): 82%

South - 3
- Borewell: 8%
- Ground Level Reservoir (GLR): 20%
- Internal pipe line: 73%
- Under Ground Reservoir (UGR): 75%

South - 2
- Borewell: 14%
- Ground Level Reservoir (GLR): 55%
- Internal pipe line: 65%
- Under Ground Reservoir (UGR): 77%

Other DJB Zones
- Borewell: 4%
- Ground Level Reservoir (GLR): 57%
- Internal pipe line: 71%
- Under Ground Reservoir (UGR): 82%

South - 3
- Borewell: 5%
- Ground Level Reservoir (GLR): 20%
- Internal pipe line: 73%
- Under Ground Reservoir (UGR): 75%

South - 2
- Borewell: 7%
- Ground Level Reservoir (GLR): 14%
- Internal pipe line: 55%
- Under Ground Reservoir (UGR): 65%

Other DJB Zones
- Borewell: 4%
- Ground Level Reservoir (GLR): 57%
- Internal pipe line: 71%
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- Internal pipe line: 73%
- Under Ground Reservoir (UGR): 75%

South - 2
- Borewell: 7%
- Ground Level Reservoir (GLR): 14%
- Internal pipe line: 55%
- Under Ground Reservoir (UGR): 65%
Coping Strategies…Underserved

% Respondents

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Urban-Rural Villages</th>
<th>UNRC</th>
<th>URC</th>
<th>Resettlement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borewell</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Booster Pump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Level Reservoir (GLR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Pipeline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhead Tank (OHT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under Ground Reservoir (UGR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Coping Strategies - Non Domestic

% Respondents

- Filter: 12
- Pipeline: 34
- OHT: 60
- UGR/GLR: 8
- Pump: 43
- Borewell: 30
Findings – Coping costs
## Coping Cost for Households in Authorized Colonies

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Consumption per HH per month (KL)</td>
<td>22</td>
</tr>
<tr>
<td>Investment per HH (Rs)</td>
<td>6829</td>
</tr>
<tr>
<td>Capital cost per HH per month (Rs)</td>
<td>102</td>
</tr>
<tr>
<td>Recurring cost per HH per month (Rs)</td>
<td>124</td>
</tr>
<tr>
<td>Total coping cost per HH per month (Rs)</td>
<td>226</td>
</tr>
<tr>
<td>Coping cost per KL of water consumed (Rs)</td>
<td>10.3</td>
</tr>
</tbody>
</table>
Coping Cost for Households in Underserved Colonies

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Households Surveyed</td>
<td>4355</td>
</tr>
<tr>
<td>Average Consumption of Water/month/HH (KL)</td>
<td>17.7</td>
</tr>
<tr>
<td>Average investment in water assets per HH (Rs)</td>
<td>3259</td>
</tr>
<tr>
<td>Capital cost per month per HH (Rs)</td>
<td>49</td>
</tr>
<tr>
<td>Recurring expenses per month per HH (Rs)</td>
<td>73</td>
</tr>
<tr>
<td>Capital Cost + Recurring expenses/month (Rs)</td>
<td>122</td>
</tr>
<tr>
<td>Time spent on water collection/day/HH (hours)</td>
<td>0.6</td>
</tr>
<tr>
<td>Opportunity cost of time/month/HH (Rs)</td>
<td>59</td>
</tr>
<tr>
<td><strong>Total coping cost per month per HH (Rs)</strong></td>
<td><strong>181</strong></td>
</tr>
<tr>
<td>Average coping cost per KL of water consumed</td>
<td>10.2</td>
</tr>
</tbody>
</table>
Water Expenses in Authorized Colonies

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost/month (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>147 123 102</td>
</tr>
<tr>
<td>Plots &gt; 300 sq.m</td>
<td>248 237 194</td>
</tr>
<tr>
<td>Plots 150-300 sq.m</td>
<td>198 204 151</td>
</tr>
<tr>
<td>Plots 100-150 sq.m</td>
<td>155 138 150</td>
</tr>
<tr>
<td>Plots &lt; 100 sq.m</td>
<td>140 108 102</td>
</tr>
<tr>
<td>HIG flats</td>
<td>135 141 112</td>
</tr>
<tr>
<td>MIG housing</td>
<td>137 105 83</td>
</tr>
<tr>
<td>Type II Govt. Qtrs.</td>
<td>111 57 40</td>
</tr>
<tr>
<td>LIG flat</td>
<td>115 92 74</td>
</tr>
<tr>
<td>Janta flat</td>
<td>89 54 33</td>
</tr>
</tbody>
</table>

Legend: 
- Mthly water bill
- Coping cost - recurring
- Coping cost - Investment in assets
Coping Cost Estimates – other key findings

• Coping costs of domestic consumers in **authorized colonies** are about **Rs 10 per KL** of water used.

• Coping costs of domestic consumers in **underserved areas** are about **Rs 10 per KL** of water used if cost of time spent for water collections is included and **Rs 7 per KL** of water used if time cost is not included.

• Coping costs of **non-domestic consumers** are about **Rs 12-39 per KL** of water used.

• These estimates of coping costs of consumers are close to or higher than the **cost of supply**, estimated at about **Rs 9.5 per KL** (including interest and depreciation).
## Coping Cost for Non-domestic Consumers

<table>
<thead>
<tr>
<th></th>
<th>Commercial</th>
<th>Industrial</th>
<th>Institutional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Consumers surveyed</td>
<td>534</td>
<td>961</td>
<td>505</td>
</tr>
<tr>
<td>Average Water consumption per consumer per month (KL)</td>
<td>10</td>
<td>19</td>
<td>31</td>
</tr>
<tr>
<td>Average Investment per consumer (Rs)</td>
<td>3375</td>
<td>6974</td>
<td>5768</td>
</tr>
<tr>
<td>Capital cost per consumer per month (Rs)</td>
<td>51</td>
<td>105</td>
<td>86</td>
</tr>
<tr>
<td>Recurring expenses per consumer per month (Rs)</td>
<td>309</td>
<td>636</td>
<td>298</td>
</tr>
<tr>
<td>Total coping cost per consumer per month (Rs)</td>
<td>360</td>
<td>741</td>
<td>384</td>
</tr>
<tr>
<td>Average coping cost of Water/KL (Rs)</td>
<td>36</td>
<td>39</td>
<td>12</td>
</tr>
</tbody>
</table>
Coping Cost - Non-domestic Consumers

- Institutional Other: 11 Rs/kL
- Institutional South2&3: 15 Rs/kL
- Industrial Other: 24 Rs/kL
- Industrial South2&3: 57 Rs/kL
- Comm Other: 32 Rs/kL
- Comm South2&3: 40 Rs/kL
Willingness to Pay for Improved Water Services...
Analysis of WTP in this study - methodology

• Contingent valuation method has been applied
• Care has been taken to minimize biases by appropriate scenario building and choice of value elicitation format
• For value elicitation, the payment card method is used: likely improvement in water and sewerage services are explained to the respondents (consumers) who are then asked to indicate acceptable monthly water bill (including sewerage charges) out of a list of possible payments shown to them.
Willingness to pay for improved services, by zone and service level

% of HH willing to pay

monthly tariff (Rs)

South II & III for A1 service
South II & III for A2 service
Other zones for A2 service
% HH in JJ cluster WTP for Group Connection
(mean = Rs 64 to 78 per month)
Estimated Mean WTP of Various Non-Domestic Consumers for Improved Water Supply

- **Institutional**: Rs 457/month
- **Industrial**: Rs 428/month
- **Commercial**: Rs 322/month
Comparison of Coping Costs and WTP for Improved Services - Non-domestic Consumers

- **Commercial**: Coping costs = Rs 32, WTP = Rs 36
- **Industrial**: Coping costs = Rs 23, WTP = Rs 39
- **Institutional**: Coping costs = Rs 12.4, WTP = Rs 15

Coping costs: yellow bars; WTP: dark blue bars.
Factors influencing households’ willingness to pay for improved services

• Econometric analysis points out some of the important factors that influence WTP:
  - Income
  - Household size
  - Education of respondent
  - Coping cost currently being borne, particularly electricity charges for booster pumps, maintenance of large storage, repair and maintenance of filter, and expenditure on purchase of water
  - Perception factor: if the respondent perceived a marked improvement in supply after the project is implemented
Factors influencing households’ willingness to pay for improved services

• Other important factors influencing WTP:
  - Quantity of water consumed (higher water requirement, higher WTP)
  - Whether the respondent is the owner rather than tenant (WTP more for owners)
  - Whether current supply is adequate (WTP more if supply inadequate)
  - Whether the household is incurring expenses for maintenance of pipeline (WTP more for households incurring such expenses)
  - **Whether the household has invested in a borewell (low WTP if invested in borewell)**
  - Whether the household is currently getting water at high pressure (low WTP for improved services, if getting water at high pressure)
Affordability Analysis ...
Considerations underlying determination of affordability (continued)

• Major difficulty in applying this approach to Delhi is that a significant proportion of low income households are not paying any water bill
  - because they collect water from public sources, or
  - because they have their own source of water

• Therefore, to ascertain affordability, 80th percentile of the ratio in question among low income households (up to Rs 7000/month, accounting for 38% of sample) has been taken.
**POSSIBLE SCENARIOS:**

**RATIO 1:** Water bill as a proportion of income

**RATIO 2:** Water bill + O&M cost of Booster Pump as a proportion of income

**RATIO 3:** Water bill + O&M cost + Water purchase + Maintenance cost of storage as a proportion of income

**IMMEDIATE EFFECT**

80th Percentile (Low-income HHs): 2.4%

**SHORT-TERM EFFECT**

3.3%

**LONG-TERM EFFECT**

3.7%

Water supply improvements do not lead to savings in HH coping costs (eg. Continue to use Booster Pumps)

Water supply improvements enable most HHs to save O&M cost (electricity charge) of Booster Pumps

Improvements in water supply enable HHs to save O&M cost of Booster Pumps, cost of water purchased and maintenance cost of large storage
Findings of affordability analysis

- Among medium and high income households almost all can afford to pay water tariff high enough to cover cost of operations, interest and depreciation.

- Among low income households, about 68% can afford to pay water tariff of Rs 4/KL (+50% sewerage charge) which is high enough to cover operating cost.

- About 44% of low income households can afford to pay water tariff high enough to cover operating cost, interest and depreciation.
Key Findings …
Comparison of Average Coping Cost, WTP and Affordability by household category, authorized colonies

![Graph showing comparison of water bills, WTP, coping cost + current water bill, and affordable water bill for different household categories and plot sizes.](image)
Comparison of Average Coping Cost, WTP and Affordability by household category, underserved colonies

![Bar chart showing comparison of average coping cost, WTP, and affordability by household category. The categories include Resettlement Colonies, Unauthorized Regularised Colonies, Unauthorized Non-regularised Colonies, and Rural-Urban Villages. The y-axis represents Rs/month ranging from 0 to 400. The chart compares Water bill, WTP, coping cost + current water bill, and Affordable water bill.](chart.png)
Recommendations to Delhi Jal Board

• Use of Survey information to design consumer feed-back indicators for monitoring improvements in DJB service performance

• Use of Coping Cost, WTP and Affordability information for Design of Tariffs

• Use of tariffs to reduce groundwater (borewell) consumption