User Perceptions and Willingness to Pay for Gravity Driven Membrane Technology

Nakuru, Kenya

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Gravity Driven Membrane (GDM) filtration

\[ \Delta h \quad \Delta P \]

Feed water

UF Membrane

Clean water

No backwashing
No cleaning

Peter-Varbanets et al. (2010)
Second generation GDM filters

- 2-5 litres per hour
- 0.5 m² ultrafiltration membrane
- Plastic housing unit

- Urban markets
  - Filling centres

- Rural markets
  - Different distribution and marketing channels

- Approximate cost $40
- Willingness to Pay?
  - Rural? Urban?
Study design
Nakuru Region

Urban
Nakuru town
Piped water supply

Rural
Njoro district
Surface water, wells, streams

150 hh per area

Survey
Demographics
Water and Sanitation
Description of GDM filter
Choice Experiment, Payment Card
Socioeconomic questions

Pretesting (3 test rounds, 180 households)
Study design
Choice Experiments

Three non-price variables

- Time to treat 1 L (15, 30, 45 minutes)
- Storage capacity (1, 5, 10 L)
- Diarrhea prevalence (4, 2, 1 cases/yr)

Price (5 levels, $25 - $50 per GDM filter)

Thirty sets of five choice tasks

- D-efficient fractional factorial design
- Sawtooth

Mixed Logit analysis
<table>
<thead>
<tr>
<th></th>
<th>Filter A</th>
<th>Filter B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time to treat</strong></td>
<td>45 minutes</td>
<td>30 minutes</td>
</tr>
<tr>
<td><strong>Storage capacity</strong></td>
<td>1 litre</td>
<td>5 litres</td>
</tr>
<tr>
<td><strong>Diarrhoea prevalence</strong></td>
<td>One time per child per year</td>
<td>Four times per child per year</td>
</tr>
<tr>
<td><strong>Price (Ksh)</strong></td>
<td>Ksh 2000</td>
<td>Ksh 2500</td>
</tr>
</tbody>
</table>

**Which option do you prefer?**

- □
- □
- □ None of the two
Study design
Contingent Valuation

Characteristics
• 30 minutes to treat 1 litre
• 10 litres storage
• Diarrhea reduced from 4 to 1 episodes per year

What would be the maximum amount you would pay?

Payment card format

35 bids
• ($0,$3,$70)
• then larger steps to $175
### Results

**Contingent Valuation**

#### WTP by economic deciles

<table>
<thead>
<tr>
<th>Economic deciles</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$126</td>
<td>$289</td>
</tr>
<tr>
<td>2</td>
<td>$180</td>
<td>$570</td>
</tr>
<tr>
<td>3</td>
<td>$239</td>
<td>$871</td>
</tr>
<tr>
<td>4</td>
<td>$310</td>
<td>$1,500</td>
</tr>
<tr>
<td>5</td>
<td>$375</td>
<td>$1,994</td>
</tr>
<tr>
<td>6</td>
<td>$450</td>
<td>$2,495</td>
</tr>
<tr>
<td>7</td>
<td>$526</td>
<td>$3,484</td>
</tr>
<tr>
<td>8</td>
<td>$780</td>
<td>$4,852</td>
</tr>
<tr>
<td>9</td>
<td>$1,033</td>
<td>$7,310</td>
</tr>
<tr>
<td>10</td>
<td>$7,463</td>
<td>$15,000</td>
</tr>
</tbody>
</table>

- Value in dollars
- Percentiles
- Percapita annual income (USD)
- Rural
- Urban
Results

Contingent Valuation

- WTP as fraction of income greater in rural areas
- WTP significantly higher when...
  - Higher income
  - Higher age
  - More education
  - Male respondent
  - Higher water use
  - User of improved sanitation
# Results

## Choice Experiments

<table>
<thead>
<tr>
<th></th>
<th>Nakuru</th>
<th>Njoro</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marginal WTP</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow rate (15 minutes)</td>
<td>$2</td>
<td>$0.60</td>
<td>$28</td>
</tr>
<tr>
<td>Storage (10 litres)</td>
<td>$25</td>
<td>$4</td>
<td>$28</td>
</tr>
<tr>
<td>Diarrhea (times/yr)</td>
<td>$31</td>
<td>$19</td>
<td>$17</td>
</tr>
<tr>
<td><strong>Mean WTP</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nakuru</td>
<td>Njoro</td>
<td></td>
</tr>
<tr>
<td>CV</td>
<td>$28</td>
<td>$17</td>
<td></td>
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</tbody>
</table>
## Results

Choice Experiments, Multi Logit Model

<table>
<thead>
<tr>
<th>Choice Attributes</th>
<th>β</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow rate (minutes)</td>
<td>-0.005</td>
<td>-0.005</td>
</tr>
<tr>
<td>Storage capacity (litres)</td>
<td>0.089**</td>
<td>0.020</td>
</tr>
<tr>
<td>Diarrhea prevalence (times/year)</td>
<td>-1.751***</td>
<td>0.142</td>
</tr>
<tr>
<td>Price of filter (KSH)</td>
<td>-8e-4***</td>
<td>1e-4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Covariates</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>District (1=Njoro)</td>
<td>1.372***</td>
<td>0.546</td>
</tr>
<tr>
<td>Household income (KSH/month)</td>
<td>-0.515e-5**</td>
<td>0.26e-5</td>
</tr>
</tbody>
</table>

Pseudo-r\(^2\) 0.508  
N=1500
Discussion

Challenge of collinearity
  Rural, poor, surface water
  Urban, wealth, piped water

CV and CE estimates differ substantially
  CV: Urban > Rural
  CE: Rural > Urban

CE is more sophisticated, less prone to respondent bias