Lack of sanitation (toilets) in urban slums

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Global Access to Sanitation

- 1 out of 10 child deaths (2015) were due to diarrhoea (UNICEF, 2016)
  That means: 1 child death per minute

- More than the child deaths from malaria, HIV/AIDS and measles (WHO 2015)

- 2.4 billion without access to improved sanitation (1 in 3 people) (UN 2015)

- 70% of sub-Saharan Africa without access to improved sanitation (UN 2015)
Fast Urbanization…

Urban population in developing countries

Year

Population (millions)

- Urban - More developed regions
- Rural - More developed regions
- Urban - Less developed regions
- Rural - Less developed regions
estimates: 70 % of the urban population in sub-Saharan Africa lives in slums
...resembling European History

- ...with disastrous health consequences?

Historical Evidence on Benefits of Sanitation

Fig 2: Driving down child mortality rates
Dramatic improvements in child mortality that coincided with a peak in sanitation investments in the UK.

«Contemporary» impact of sanitation on health

Esrey, Potash et al. (1991)
“…water supply and sanitation facilities resulted in substantial reductions in morbidity of diarrhea (26%), ascariasis (29%), guinea worm infection (78%), schistosomiasis (77%), and trachoma (27%).”

Fewtrell, Kaufman et al. (2005)
“…sanitation reduces child diarrhea by 22%-36%”

«The toilet and the latrine, which helped revolutionize public health in New York, London and Paris more than a century ago, are among the most underused tools to combat poverty and disease in the developing world.»

“Improved sanitation could prevent 1.5 million deaths from diarrhea illnesses a year…adequate sanitation is the most effective public health intervention the international community has at its disposal”
Summary of Research Project 1

What is the health impact of improved sanitation?

Data – DHS surveys

70 countries
30 years
796 557 observations
about 500 toilet technologies
## Health Impact of Sanitation (odds ratios)

<table>
<thead>
<tr>
<th></th>
<th>Mortality</th>
<th>Diarrhea</th>
<th>Stunted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermed. quality water</td>
<td>1.04 (0.98–1.11)</td>
<td>0.92 (0.90–0.95)</td>
<td>0.97 (0.95–0.99)</td>
</tr>
<tr>
<td>High quality water</td>
<td>0.97 (0.88–1.04)</td>
<td>0.91 (0.88–0.94)</td>
<td>0.92 (0.89–0.94)</td>
</tr>
<tr>
<td>Intermed. quality sanitation</td>
<td>0.97 (0.92–1.02)</td>
<td>0.92 (0.90–0.94)</td>
<td>0.88 (0.87–0.90)</td>
</tr>
<tr>
<td>High quality sanitation</td>
<td>0.77 (0.68–0.86)</td>
<td>0.87 (0.85–0.90)</td>
<td>0.73 (0.71–0.75)</td>
</tr>
</tbody>
</table>

- Effects are smaller than previous research based on RCTs.
- Technology level matter.
- Sanitation has a higher protective effect than water.
- Protective effects of sanitation similar than moving mothers from no education to primary-secondary education.
## Health Impact of Mother’s Education

<table>
<thead>
<tr>
<th></th>
<th>Neonatal mortality (1)</th>
<th>Mortality 1–12 months (2)</th>
<th>Mortality 13–59 months (3)</th>
<th>Diarrhoea (4)</th>
<th>Stunted (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother primary</td>
<td>0.92</td>
<td>0.90</td>
<td>0.89</td>
<td>1.02</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>(0.89–0.96)</td>
<td>(0.87–0.93)</td>
<td>(0.84–0.94)</td>
<td>(1.00–1.04)</td>
<td>(0.83–0.86)</td>
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<tr>
<td>Mother secondary</td>
<td>0.83</td>
<td>0.63</td>
<td>0.58</td>
<td>0.91</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>(0.79–0.87)</td>
<td>(0.50–0.67)</td>
<td>(0.53–0.64)</td>
<td>(0.88–0.93)</td>
<td>(0.61–0.64)</td>
</tr>
<tr>
<td>Mother tertiary</td>
<td>0.67</td>
<td>0.41</td>
<td>0.39</td>
<td>0.73</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>(0.61–0.75)</td>
<td>(0.35–0.48)</td>
<td>(0.28–0.40)</td>
<td>(0.70–0.77)</td>
<td>(0.38–0.42)</td>
</tr>
<tr>
<td>Partner primary</td>
<td>0.99</td>
<td>0.92</td>
<td>0.94</td>
<td>1.00</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>(0.96–1.03)</td>
<td>(0.88–0.95)</td>
<td>(0.89–0.98)</td>
<td>(0.98–1.03)</td>
<td>(0.93–0.97)</td>
</tr>
<tr>
<td>Partner secondary</td>
<td>0.91</td>
<td>0.81</td>
<td>0.80</td>
<td>0.96</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>(0.87–0.95)</td>
<td>(0.77–0.85)</td>
<td>(0.75–0.85)</td>
<td>(0.94–0.98)</td>
<td>(0.77–0.81)</td>
</tr>
<tr>
<td>Partner tertiary</td>
<td>0.85</td>
<td>0.61</td>
<td>0.64</td>
<td>0.86</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>(0.79–0.92)</td>
<td>(0.55–0.67)</td>
<td>(0.53–0.75)</td>
<td>(0.82–0.89)</td>
<td>(0.64–0.69)</td>
</tr>
<tr>
<td>Observations</td>
<td>887 440</td>
<td>671 882</td>
<td>466 782</td>
<td>796 557</td>
<td>567 011</td>
</tr>
</tbody>
</table>

**ETH**

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

**nadel**

Center for Development and Cooperation
...but little economic research on increasing sanitation coverage.
Summary of Research Project 2

How to increase private investments in sanitation in urban slums?

- U-ACT Policy Brief 2016: How to increase toilet coverage among the urban poor?
- U-ACT Policy Brief 2013: Ventilated Improved Latrine construction in the slum areas of Kampala, Uganda.
- U-ACT Policy Brief 2012: When is shared sanitation improved sanitation?
- U-ACT Policy Brief 2011: Where do Kampala's poor 'go'?
Sanitation in Urban Slums

- **Recommended technology:**
  - Decentralized on-site sanitation systems
  - Ventilated improved pit latrine (VIP)
  - Fast growth of cities, governance, lack of water

- **Most ongoing policies by development agencies focus on**

  **Social marketing**
  
  = increasing information (with varying content) on sanitation benefits

  **Subsidies** for mostly public toilets (but not for private toilets)
Sanitation Marketing

Impact has never been empirically tested

("A Good Toilet is Possible! We’ve developed up to a toilet!")
High price elasticity of demand with little difference in use

Market Price Bednet: 5$
Market Price Water Disinfectant: 0.5$
Prive of VIPs (latrines): 100$-1000$

Impact has never been empirically tested for VIPs
Randomized Controlled Trial (RCT)

What is the impact of

(1) price

(2) information

on sanitation investments?
Randomized Controlled Trial on Sanitation Demand

- random selection of 50 slums out of 350 slums
- random selection of 30 households per slum
- 1500 households

Kampala, Uganda
On average, 22 people share one toilet

95% use a toilet but 84% share toilets

68% of slum dwellers are tenants

VIP: ~ $700

\[ \approx \text{annual mean p.c. hh income in urban slums} \]
Is sharing toilets or public toilets a viable option?

- Coding pictures of 1500 slum toilets
- 2 independent students without access to the survey data
- next time: machine learning
Randomized Controlled Trial (RCT)

What is the impact of

(1) price (budget constraints) -> subsidies
(2) information -> social marketing
(3) liquidity -> micro-credit (18 months, 20% interest rates)
(4) tenure -> targeting

on latrine investments and hygienic sanitation?
Experimental Set-Up (only to people without private toilet)

- **Owners (32%)**: promotion 20% subsidy
- **Households**: promotion 20% subsidy, promotion 75% subsidy, promotion 85% subsidy
- **Tenants (68%)**: promotion 20% subsidy, promotion 75% subsidy, promotion 85% subsidy

### Tenure
- Owners: 32%
- Households: 100%
- Tenants: 68%

### Information
- Promotion: 20% subsidy

### Price
- Promotion: 75% subsidy, 85% subsidy

### Liquidity
- Investment
- Micro-credit (18 months, 20% interest)
Timeline

2010 – Baseline Survey
50 slums, 1500 households

2011 – Promotion/Vouchers/Contracts

2012 – VIP Construction

2013 – Follow-Up Survey
Sanitation Uptake by Intervention

- Social marketing (+20% subsidy): no effect
- Subsidies: large effects (almost doubling investments) if substantial
- Micro-credit = same as about 50% subsidy
- Targeting most important → so far rarely taken into account
Sanitation in Slums – an (informal) land property issue

- tenants have on average the same income than house owners
- tenants have about the same average WTP for VIPs than owners

<table>
<thead>
<tr>
<th></th>
<th>WTP</th>
<th>Market Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owners:</td>
<td>UGX 828,500</td>
<td>UGX 1,500,000</td>
</tr>
<tr>
<td>Tenants:</td>
<td>UGX 6,700</td>
<td>UGX 13,000 (22% of rent)</td>
</tr>
<tr>
<td>NPV:</td>
<td>UGX 876,000</td>
<td>NPV: UGX1,700,188</td>
</tr>
</tbody>
</table>

(NPV=15 years and 5%.)

- the problem is land: 1 housing unit=3-4 toilets. Alternative investment opportunities for (informal) house owners
- refined regulations needed for tenants
- mobile and smaller on-site technologies needed
New complementary research results (on information and budget constraints)

SANITATION SUBSIDIES

Encouraging sanitation investment in the developing world: A cluster-randomized trial

Raymond Guiteras,¹ James Levinsohn,² Ahmed Mushfiq Mobarak²*

Poor sanitation contributes to morbidity and mortality in the developing world, but there is disagreement on what policies can increase sanitation coverage. To measure the effects of alternative policies on investment in hygienic latrines, we assigned 380 communities in rural Bangladesh to different marketing treatments—community motivation and information; subsidies; a supply-side market access intervention; and a control—in a cluster-randomized trial. Community motivation alone did not increase hygienic latrine ownership (+1.6 percentage points, \( P = 0.43 \)), nor did the supply-side intervention (+0.3 percentage points, \( P = 0.90 \)). Subsidies to the majority of the landless poor increased ownership among subsidized households (+22.0 percentage points, \( P < 0.001 \)) and their unsubsidized neighbors (+8.5 percentage points, \( P = 0.001 \)), which suggests that investment decisions are interlinked across neighbors. Subsidies also reduced open defecation by 14 percentage points (\( P < 0.001 \)).
Summary

- Budget constraints matter for household sanitation investment, information constraints don’t.
- Micro-credits have about the same effect as reducing the price by 30%, but program costs of micro-credits were high within the project.
- **Most important for policies: target house owners (30%).**
- Tenants (70% of slums) need strong regulation and enforcement (subsidies and micro-credits only help little) or new technologies.
- Open research question: how to keep public toilets clean?
Additional results

- Attrition: 37% after a year (urban slum inhabitants stay on average only 3 years in their housing unit – and constantly change their mobile numbers)

- Big impact on cleanliness & satisfaction. Small effect on user numbers and waiting times.

- Similar to previous research on bednets and mosquito nets: lower costs don’t imply lower usage and social benefits.

- Housing rents increase for medium price, housing rents remain the same for low price latrines.
Good policies on toilets are important for policy makers.
Thank you!

and thanks to...

Alexandra Horst
World Bank

Liz Tilley
University of Malawi

Charles Niwagaba
Makerere University

Chris Luethi
EAWAG
Experimental Set-Up: Targeting

<table>
<thead>
<tr>
<th>Direct</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample house owner</td>
<td>House owner of sample tenant</td>
</tr>
<tr>
<td></td>
<td>Promoter explains offer and gives voucher</td>
</tr>
<tr>
<td></td>
<td>Tenant should forward information and voucher</td>
</tr>
<tr>
<td></td>
<td>Sample tenant</td>
</tr>
<tr>
<td></td>
<td>Promoter explains offer and gives voucher</td>
</tr>
</tbody>
</table>

Encouragement promotion & voucher distribution
## Randomization Verification

### Baseline Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low Price</th>
<th>High Price</th>
<th>Medium Price</th>
<th>Medium with Microcredit</th>
<th>Joint hyp. test of equal means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Obs</td>
<td>Mean</td>
<td>Obs</td>
<td>Mean</td>
</tr>
<tr>
<td>Household is a tenant(^1)</td>
<td>0.57</td>
<td>295</td>
<td>0.54</td>
<td>290</td>
<td>0.56</td>
</tr>
<tr>
<td>Household size</td>
<td>4.27</td>
<td>293</td>
<td>4.61</td>
<td>290</td>
<td>4.46</td>
</tr>
<tr>
<td>Household has at least one child below-5</td>
<td>0.62</td>
<td>294</td>
<td>0.63</td>
<td>290</td>
<td>0.63</td>
</tr>
<tr>
<td>Household head age in years</td>
<td>38.7</td>
<td>286</td>
<td>36.2</td>
<td>280</td>
<td>38.7</td>
</tr>
<tr>
<td>Household head has higher education(^1)</td>
<td>0.62</td>
<td>294</td>
<td>0.61</td>
<td>290</td>
<td>0.59</td>
</tr>
<tr>
<td>Asset Index (0-100)</td>
<td>0.6</td>
<td>289</td>
<td>0.6</td>
<td>287</td>
<td>0.57</td>
</tr>
<tr>
<td>Monthly income per capita (UGX)</td>
<td>167,059</td>
<td>227</td>
<td>176,920</td>
<td>210</td>
<td>183,124</td>
</tr>
<tr>
<td>Household owns land around house(^1)</td>
<td>0.85</td>
<td>114</td>
<td>0.78</td>
<td>127</td>
<td>0.89</td>
</tr>
<tr>
<td>At least one household member has a bank account</td>
<td>0.45</td>
<td>281</td>
<td>0.45</td>
<td>274</td>
<td>0.46</td>
</tr>
<tr>
<td>Household has moving plans(^1)</td>
<td>0.19</td>
<td>288</td>
<td>0.2</td>
<td>289</td>
<td>0.16</td>
</tr>
<tr>
<td>Household has a private sanitation facility (improved)(^1)</td>
<td>0.20</td>
<td>294</td>
<td>0.19</td>
<td>290</td>
<td>0.17</td>
</tr>
<tr>
<td>Number of user households per stance</td>
<td>5.30</td>
<td>263</td>
<td>3.53</td>
<td>270</td>
<td>4.37</td>
</tr>
<tr>
<td>The sanitation facility is clean(^1)</td>
<td>0.44</td>
<td>294</td>
<td>0.54</td>
<td>290</td>
<td>0.46</td>
</tr>
<tr>
<td>Household is suspected to practice OD(^1)</td>
<td>0.16</td>
<td>294</td>
<td>0.12</td>
<td>290</td>
<td>0.14</td>
</tr>
<tr>
<td>Household lives in OD environment</td>
<td>0.07</td>
<td>294</td>
<td>0.08</td>
<td>287</td>
<td>0.06</td>
</tr>
<tr>
<td>There would be space for a new sanitation facility(^1)</td>
<td>0.65</td>
<td>260</td>
<td>0.64</td>
<td>262</td>
<td>0.62</td>
</tr>
<tr>
<td>Willingness to pay for a private improved sanitation facility (in UGX)(^2)</td>
<td>849,391</td>
<td>115</td>
<td>847,823</td>
<td>124</td>
<td>951,074</td>
</tr>
</tbody>
</table>

\(^1\) Dummy variable for which 0 means "no" and 1 "yes".

\(^2\) This includes respondents who had paid for a private facility.
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usage</strong></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Use project facility</td>
<td>0.042</td>
<td>0.076</td>
<td>0.031</td>
<td>0.037</td>
<td>0.117*</td>
<td>0.037</td>
<td>-1.081*</td>
<td>-0.444</td>
<td>-0.133</td>
<td>-0.143</td>
</tr>
<tr>
<td></td>
<td>[0.664]</td>
<td>[0.508]</td>
<td>[0.740]</td>
<td>[0.812]</td>
<td>[0.064]</td>
<td>[0.496]</td>
<td>[0.065]</td>
<td>[0.491]</td>
<td>[0.335]</td>
<td>[0.284]</td>
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<tr>
<td>Use project facility is clean</td>
<td>-0.031</td>
<td>0.109</td>
<td>0.109</td>
<td>0.072</td>
<td>0.071</td>
<td>-0.156</td>
<td>-0.705</td>
<td>-0.639</td>
<td>-0.177</td>
<td>-0.234</td>
</tr>
<tr>
<td></td>
<td>[0.929]</td>
<td>[0.654]</td>
<td>[0.369]</td>
<td>[0.716]</td>
<td>[0.315]</td>
<td>[0.169]</td>
<td>[0.246]</td>
<td>[0.193]</td>
<td>[0.279]</td>
<td>[0.127]</td>
</tr>
<tr>
<td><strong>Mean in Comparison Group (medium Price)</strong></td>
<td>0.861</td>
<td>0.861</td>
<td>0.531</td>
<td>0.531</td>
<td>0.80</td>
<td>0.80</td>
<td>3.50</td>
<td>3.50</td>
<td>0.50</td>
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<td><strong>Conditions</strong></td>
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<tr>
<td><strong>Project Sanitation Facility</strong></td>
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<tr>
<td>Facility user is satisfied</td>
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<td>Facility user is satisfied</td>
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<tr>
<td><strong>Number of user households</strong></td>
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<tr>
<td><strong>Need to wait</strong></td>
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<td><strong>Need to wait</strong></td>
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<tr>
<td>Low Price</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Microcredit Financing</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Mean in Comparison Group (medium Price)</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>129</td>
<td>78</td>
<td>111</td>
<td>68</td>
<td>126</td>
<td>78</td>
<td>125</td>
<td>77</td>
<td>127</td>
<td>78</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.004</td>
<td>0.208</td>
<td>0.012</td>
<td>0.337</td>
<td>0.022</td>
<td>0.249</td>
<td>0.039</td>
<td>0.378</td>
<td>0.020</td>
<td>0.284</td>
</tr>
</tbody>
</table>
Health Impact of Living in Slums

The chart illustrates the odds ratios conditional on rural as a reference for different outcomes depending on whether someone lives in a rural area, town, or city. The outcomes include Mortality, Stunting, Diarrhea, and ALRI.

- **Mortality**: The odds ratios for living in town and city are significantly lower compared to rural areas, indicating fewer deaths.
- **Stunting**: Similar patterns are observed, with lower odds ratios for town and city compared to rural areas.
- **Diarrhea**: The odds ratios for town and city are also lower, suggesting less incidence of diarrhea.
- **ALRI**: The odds ratios for town and city are again lower, indicating fewer cases of acute lower respiratory infections.

The bar chart shows that living in urban areas, particularly in towns, reduces the risks associated with these health outcomes compared to rural areas.
GET YOUR OWN TOILET NOW!
Ffuna kabuyonjo yo kati!

The NGO „Sustainable Sanitation and Water Renewable System“ (SSWARS) offers you a special price for a high-quality toilet for your family or your tenants.

Get your own advanced pit latrine with a plastered superstructure, cement slab and ventilation (VIP) and enjoy the benefits!

- Avoid Diseases and Be More Healthy
- Gain Comfort and Privacy
- Clean and Safe, Reduced Smell
- No Waiting Times
- Increase the Value of your Home

5 easy steps to get your toilet:

1. Contact SSWARS Project Officer (Phone: 077 4 400 189 or 070 3 400 189)
2. Meet with the SSWARS Project Officer
3. Sign the contract with SSWARS
4. Make the 1st payment to SSWARS (50% of total costs)
5. Construction of your toilet starts within 1 week

Contact Information SSWARS:
Community Sanitation Centre in Mulago III, Kifumbira
Opposite Kamiwokya Homestead Primary School
Phone: 077 4 400 189 or 070 3 400 189 or 077 233 477

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

nadel
Center for Development and Cooperation
Poor: surface water such as rivers, lakes or standing rainwater.
Intermediate: primary source was below the surface, such as all springs, boreholes, standpipes, wells and dug wells but not part of a public piped system.
High: piped water or bought drinking water from vendors.

Poor: no access to any toilet facilities;
Intermediate: access to a basic or latrine;
High: flush toilet or VIP