Willingness to Pay for Clean Water:
Evidence from Randomized Trials in Ghana

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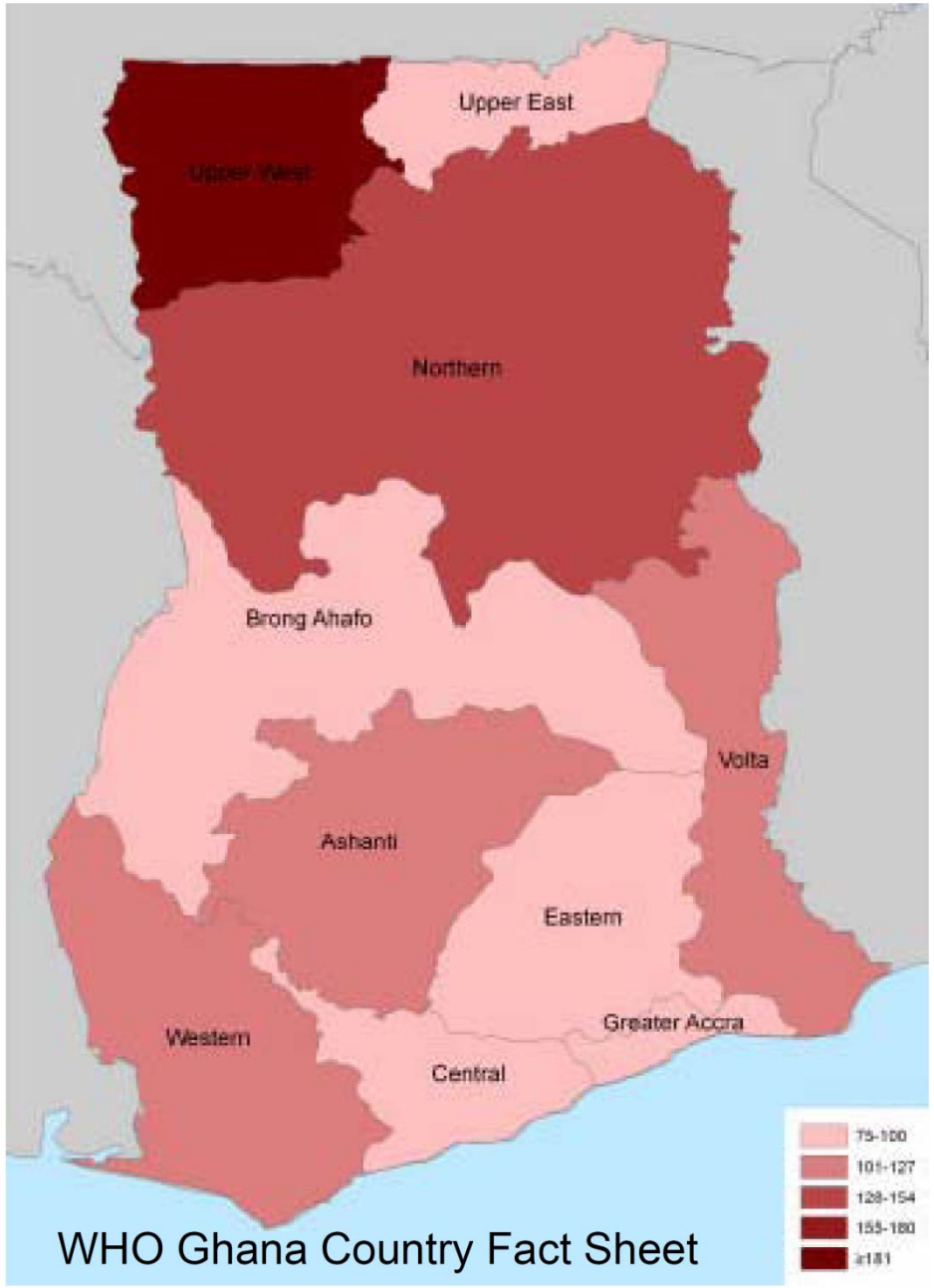
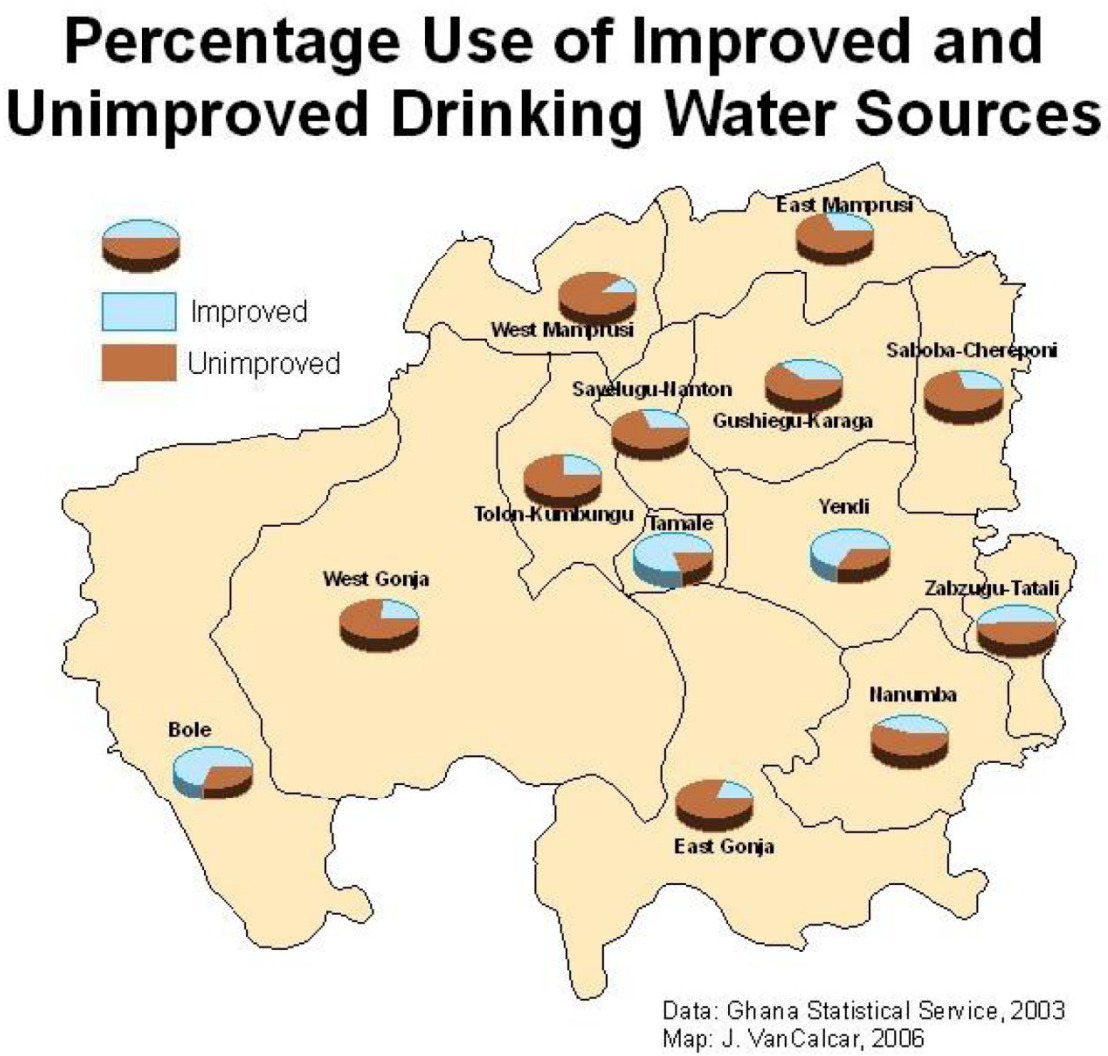
Ghanasco Dugout, Tamale

Northern Ghana

- Limited access to clean water
- High prevalence of water-related disease in Ghana
  - <5 child mortality rate 155/1,000, and diarrhea is a leading cause
  - 36% in rural areas lack access to improved drinking water sources
- One of the few places in the world where guinea worm still exists
- Water is very turbid and contaminated


Upper East
Upper West
Northern
Brong Ahafo
Volta
Ashanti
Eastern
Greater Accra
Western
Central
75-100
101-127
128-154
155-180
≥181
WHO Ghana Country Fact Sheet

50% (0.9 million out of 1.8 million people) in Northern Region, Ghana currently use an unimproved source



- Improved Sources
  - Boreholes
  - Household connection
  - Public standpipe
  - Rainwater harvesting
  - Protected springs and dug wells
- Unimproved Sources
  - All surface water sources
  - Unprotected springs and dug wells
  - Tanker trucks
  - Vendor water

Kosim Ceramic Filter

- Socially marketed
- Household-level water treatment product
- Sold by Pure Home Water, a Ghanaian NGO

Some details about the *Kosim* filter

- Ceramic with colloidal silver coating
- Removes >99% of E. coli in field tests
- Production cost ≈ US $15
- Lasts 3+ years
- Sold primarily through direct marketing
- Given away during outbreaks and floods
- Relatively new product
  - Marketing relatively small scale; Few people have heard of it
- Alternative products
  - Chlorine/alum
  - Other types of filters (UV, biosand, cheesecloth)
  - Piped water

Before/After

Study questions

- Measuring willingness to pay
- Health impact
- How does social learning affect demand?
- What is optimal pricing strategy for a social enterprise that distributes health products?
  - Demand curve
  - Screening effects (Ashraf, Berry and Shapiro, 2008; Cohen and Dupas, 2008)
  - Sunk-cost effects
  - Intra-household allocation (Hoffman, 2009)
  - Liquidity constraints

Outline of the talk

- Introduction
- Willingness-to-pay elicitation mechanism
- Main study plan
- Validation of elicitation mechanism

Use Becker-deGroot-Marshak (1964) mechanism to obtain willingness-to-pay (WTP)

- Incentive-compatible WTP revelation mechanism
- Consumer states WTP p_c
- Random price drawn p_r
- If $p_r > p_c$, customer cannot purchase
- If $p_r \leq p_c$, customer buys at *random price* p_r
- Breaking the link between price stated and price stated makes truth-telling weakly dominant
- Community demonstration; individual practice rounds

Why bother with BDM?

- Sales through a take-it-or-leave it price p_t allow you to truncate the WTP distribution at p_t
  - Buy → WTP ≥ p_t
  - Don't buy → WTP < p_t

- BDM gives you the exact WTP
  - Potentially more useful when you want to correlate WTP with demographics, social networks, etc.

Previous use of BDM

- Lab experiments (e.g., Plott and Zeiler, 2005; Voelckner, 2006)
- Artifactual field experiment: Hoffman (2009), Hoffman, Barrett and Just (2009) use a slight variation that incorporates bidding for multiple goods
- Not yet done outside of the lab in a developing country

BDM in the field

Methodology: "Main Study"

- Measure WTP through BDM sales to half of the villagers
- Return to measure WTP for the other half about two weeks later
- Peer effects and social learning
  - Instrument for peer's take-up with peer's randomized price
  - Measure effect of peer's take-up on WTP during the second round

- Health impacts
- Screening effects
- Sunk-cost effects

Credit constraints

- The filter is relatively expensive, and contemporaneous willingness to pay may just reflect cash on hand
- “Lean season” in May-July while people are planting and have very little cash on hand
- Working on partnering with an MFI to offer financing
  - Challenge: collection and monitoring is expensive

BDM Validation

- First use in the field
- Establish WTP elicited through BDM consistent with standard take-it-or-leave-it (TIOLI)
- BDM may be different from TIOLI if subjects
  - Don’t understand BDM
  - Change their behavior because of the lottery
  - Anchor their valuations based on a TIOLI price

Validation specifics

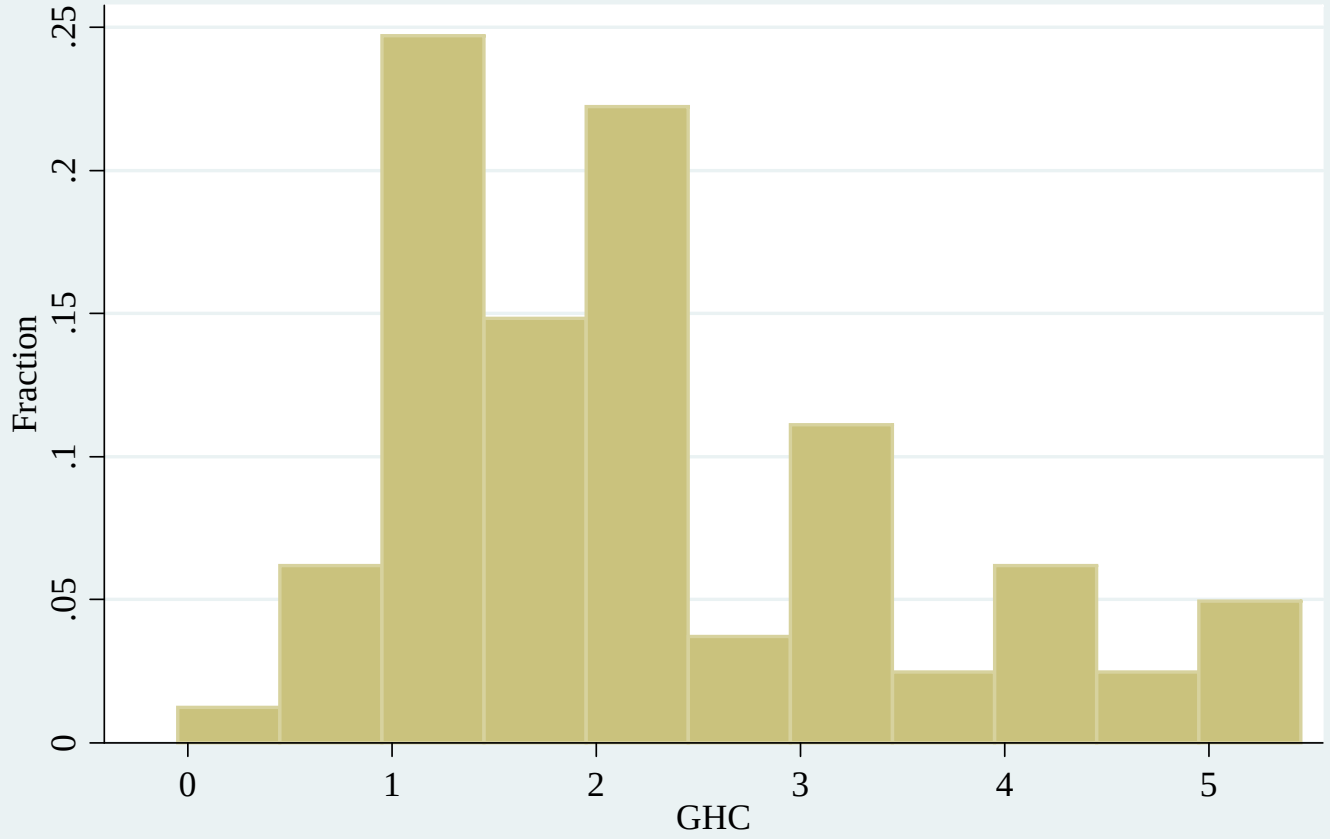
- Community census of all adults in the village
- Conduct a marketing meeting to demonstrate the filter and the BDM mechanism
- Randomize at the *wife* level within villages between BDM and take-it-or-leave-it
  - 3 take-it-or-leave it prices: GHS 2, 4 and 6
    - (exchange rate GHS:USD is about 1.4:1)
  - In a pilot in the fall, the median BDM bid was GHS 4

What is a household?

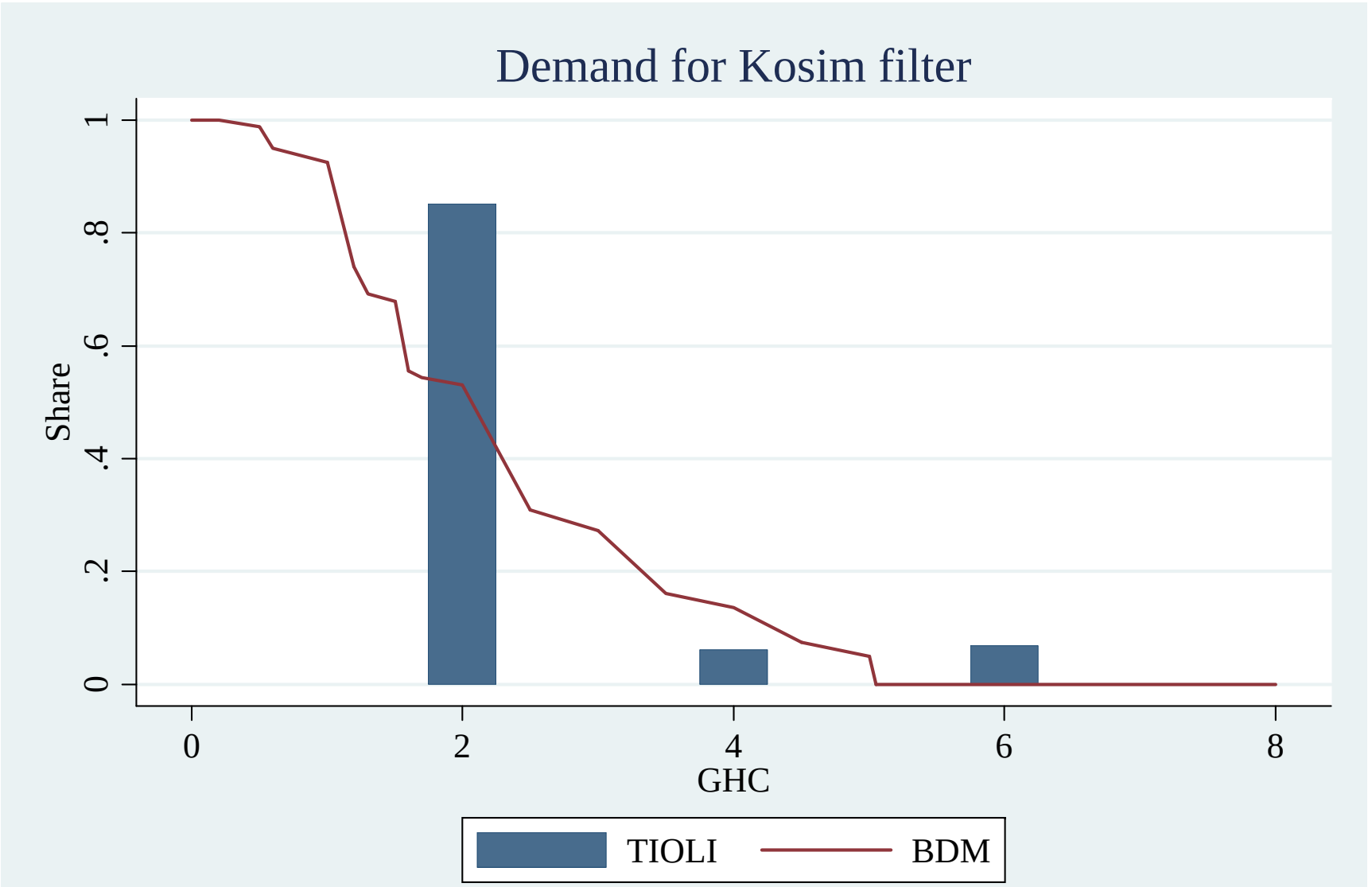
- Villages consist of “compounds” with multiple families and multiple dwelling units
- Polygamy: 40% of wives share a husband
- Sales need to be at the wife level because one filter has the capacity to treat water for 5-6 people
- Randomize between BDM and TIOLI at the husband level (for now…)

Very preliminary results from two villages

- 81 BDM observations, 89 TIOLI observations
- TIOLI observations split evenly between GHS 2, 4 and 6



Notes: Bids in GHC, approx. 1.4 GHC / USD. 81 observations in BDM mechanism.



Notes: Bids in GHC, approx. 1.4 GHC / USD. 81 observations in BDM mechanism. 89 total TIOLI observations, of whic
27 at a price of 2, 33 at a price of 4 and 29 at a price of 6.

Differences between BDM and TIOLI

Price (GHS)	Pct BDM Bids at or above	TIOLI acceptance rate	Difference	N
2	0.531	0.852	-0.321**	108
			(0.105)	
4	0.136	0.061	0.075	115
			(0.065)	
6	0.000	0.069	-0.069*	111
			(0.028)	

Issues and open questions

- How to do TIOLI
  - Distribution of prices—a few points or a continuum?

    → continuum requires functional form assumptions about differences in behavior
  - Pre-randomized offer price built into a script (simulates door-to-door sales)
  - Allow subject to pick TIOLI price out of a container (closer to BDM)
- Intra-household BDM strategies
  - Suppose a man with 3 wives wants only 1 filter (e.g., for himself)
  - Strategic bidding with 3 random draws
- Which covariates to collect?
  - Tighter estimation of differences between BDM and TIOLI
  - Possible ways to split the data (e.g., more educated vs. less educated)