Hands of Water? Sources of Contamination: A Field Study in Agew Gimjabet, a Town in the Highlands of Ethiopia

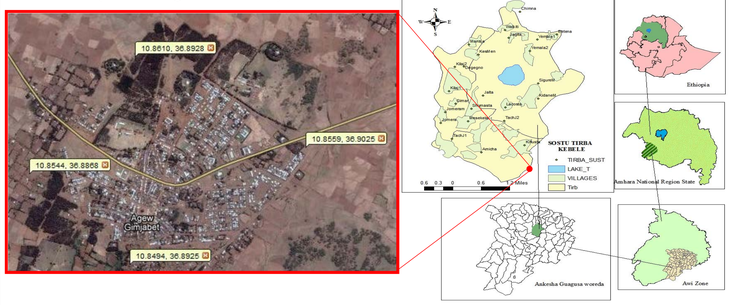
Matthew W. Hurst

School of Civil and Environmental Engineering, Cornell University

BACKGROUND/SITE SELECTION

Diarrheal illness remains one of the most prevalent health problems in developing countries and the related cause of approximately 1.6 million deaths worldwide (WHO, 2008). Quantified in total Disability Adjusted Life Years (DALY), diarrheal disease accounts for up to 6.4% of the total disease burden in Sub-Saharan Africa (Lopez, 2006). Unsafe water containing pathogenic organisms is the result of contamination of fecal matter (WHO, 2008). Transmission of pathogenic organisms in water occurs through a fecal-oral transmission pathway which can be a result of hygiene practices such as hand contact (i.e., hand washing and food washing), water source quality, and water handling practices in the household (Eisenberg *et al*., 2007).

A user in Gimjabet collecting water into a plastic container (jerikan) shown in blue from an unprotected water source. Cloudy water indicates potential contamination.



Agew Gimjabet has a population of approximately 14,000 people (2,800 households) located in the western part of the Amhara region in Ethiopia. As of 2008 there were 33 cases of acute watery diarrhea (AWD) brought into the hospital that year. It is likely that there were additional unreported cases either of: (1) AWD or (2) less acute diarrhea.

MATERIALS AND METHODS

First, household observations were conducted to identify key sanitary conditions or hygienic behaviors for focus in prevention of diarrheal disease. Based upon these observations, household interviews and water quality sampling were performed to identify sources of disease transmission. Finally, hand washing samples were carried out to confirm contamination of household water sources through hand contact.

(1) (2) (3) (4)

From left to right step-wise progression of method: (1) observation, (2) water quality sampling, (3) household interviews, and (4) hand rinsing sampling.

Water Quality Assessment

Contamination of water was related to the quantity of fecal coliforms. Enumeration of presumptive fecal coliform was performed by a membrane filter method using membrane lauryl sulfate broth. Turbidity was measured with a Hach Portable Turbidimeter and in units of NTUs (Nephelometric Turbidity Units).

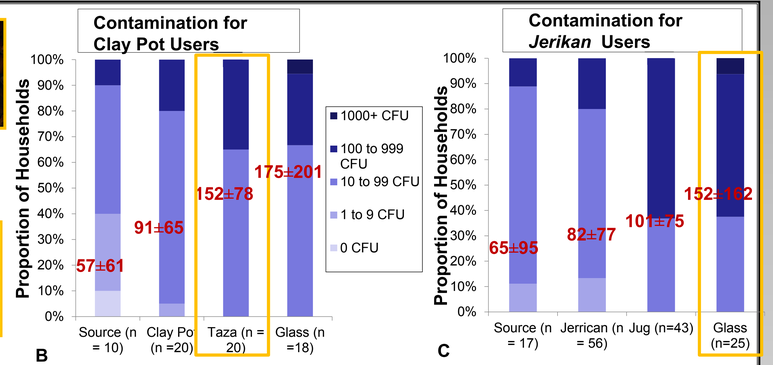
Household Interviews

Household interview questions covered seven topics: (1) socio-economic conditions, (2) water supply, (3) sanitation and hygiene behaviors, and (4) health. Questions were adapted from baseline health and sanitation surveys from (1) Health Environments for Children Survey Instrument (WHO/CEHA, 2008), (2) WHO/UNICEF Joint Monitoring Survey (WHO/UNICEF, 2004), and (3) Demographic and Health Survey (USAID, 2011).

PURPOSE

The objective of this study was to identify how water became contaminated in both rainy and dry weather phases, and factors which influence the spread of diarrheal disease in a town in Ethiopia's Amhara highlands. This was assessed through direct observation of household practices with follow-up through water quality testing, household survey instruments, and a hand washing study. Three water sources were available: piped, improved well, and unprotected. Another important part of this study was to evaluate the impact that water source had on household health. Effective preventative interventions identified in this study were reported to households and town officials.

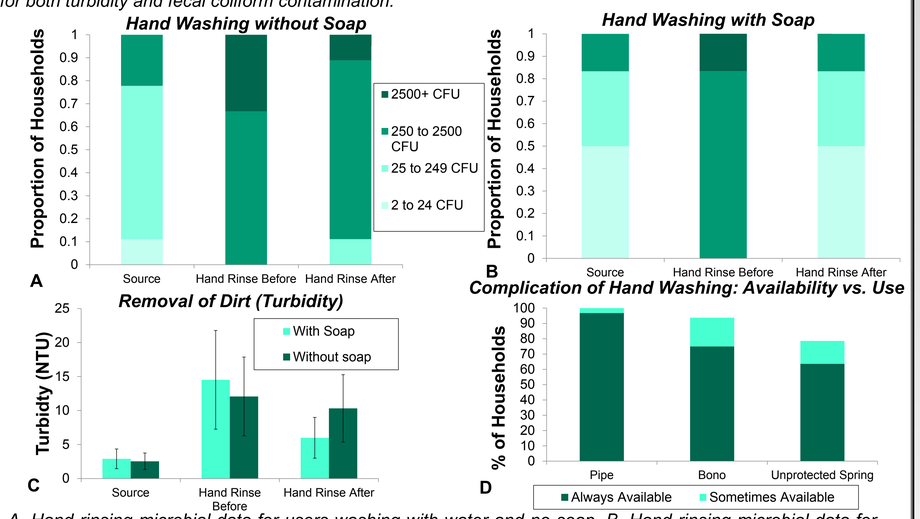
RESULTS – WATER QUALITY ASSESSMENT



A. The sources of greatest increase in contamination for clay pot users (taza, top) and jerikan users (glass, bottom). B. Results of E. coli CFUs of a 100 mL sample volume for source, transport, storage, transfer and drinking vessels for clay pot users (15 households). Vessel which exhibited the greatest increase in contamination is boxed in orange. C. Results of E. coli CFUs for jerikan users (45 households).

RESULTS – HAND WASHING

Volumes of 500 mL were sampled from hand washing source, and rinse water before and after hand washing by user's customs. Water samples were collected in a wash basin that was previously sterilized and then analyzed for both turbidity and fecal coliform contamination.



A. Hand rinsing microbial data for users washing with water and no soap. B. Hand rinsing microbial data for users washing with soap. C. Aggregate turbidity data for users washing with soap and users washing with water and no soap. D. Self-reported availability of soap in households among different source users.

RESULTS – HOUSEHOLD INTERVIEWS

A woman being interviewed during the rainy phase.

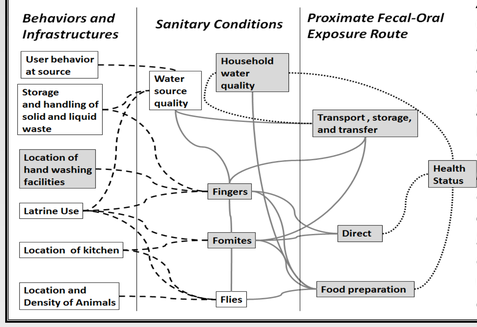
Utilizing the survey data collected at the household level, significant factors (defined as an odds ratio of greater than 1.5 from a bivariate analysis) were included as input variables in a multivariate regression model. Socio-economic status was assessed on an asset based wealth index created using principal component analysis (PCA) and broken into three categories: richest 20%, middle 40%, and poorest 40%. **Significant adjusted odds ratios (p<0.05) are bolded.**

Adjusted Odds Ratio Arranged by Wealth Index

Asset Index/Factor	All (n=235)	Top 20% (n =47)	Middle 40% (n= 95)	Bottom 40% (n= 94)
Proper Disposal for Child's Feces Under 5	**0.40**	**0.07**	1.05	**0.22**
Hand washing station located by the latrine	**0.57**	1.21	**0.21**	**0.78**
Using Unprotected Water Source	1.47	No users	1.88	1.02
Always Utilize Clay Pot for Water Storage	2.19	No users	5.97	0.82
Separate Room for Kitchen	0.71	0.41	0.87	1.22
Open Defecation	**1.42**	No users	**3.78**	**4.12**
Constant	1.31	9.17	1.23	0.37

CONCLUSIONS

- Contamination for clay pot users increases the most when using a dipping cup (*taza*). Hand contact with water was observed when users dipped the *taza* in the clay pot.
- Contamination for users of the narrow mouthed container (*jerikan*) increases the most between *jerikan* and glass. When pouring from the *jerikan*, resuspension of settled solids from the bottom is a possibility.
- Source water quality was not strongly associated with diarrheal disease. Results of the multivariate regression model suggest households utilizing piped water were healthier due to better hygiene behaviors and greater access to household-level WASH infrastructure.
- Analysis of survey and water quality results suggest that hand contamination could be a significant vessel for transmission of diarrhea. There was no strong relationship between health and the weather (i.e., rainy or dry phase).
- Hand washing with soap constitutes a vital step to remove contamination from hands. However, while soap was available to households, there are social barriers to using soap for hand washing soap. Instead soap was mostly used as lotion after showering . There is also an economic barrier for poorer people frequently using soap.



A conceptual map for Agew Gimjabet town of impacting health status based on household observations. The dashed line represents links between hygiene behaviors and WASH infrastructure and sanitary conditions. The gray line represents links between sanitary conditions and proximate fecal-oral contamination pathway. Finally, the fecal-oral contamination pathway is linked with health (represented by the dotted line).

References

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Acknowledgements

The researcher is very grateful to the residents of the town of Agew Gimjabet for their participation and wonderful hospitality. The researcher also acknowledges Mamaru Moges for his important contributions in the field. The researcher also thanks the contributions of Christopher Barrett, Tammo Steenhius, Gail Holst-Warhaft, Leonard Lion, Monroe Weber-Shirk, Janice Liotta, and Dwight Bowman. The research was funded under a travel grant as part of the NSF IGERT Food Systems and Poverty at Cornell University.