

**Final Progress Report**  
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Project Title: **Assessing impacts of increased water quantity in Kenya**

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1. Project abstract:

This project provides a rigorous evaluation of the health and welfare impacts resulting from increased water *quantity* at the household level (achieved through daily water delivery from improved water sources) in areas where household water consumption is constrained by long distances to sources and non-availability of household connections to municipal water supply systems. This method is directly comparable to an intervention in the same region improving drinking water *quality*.

Thirty-five protected springs were selected in rural western Kenya. Preliminary data were collected for these sites and the households that currently obtain drinking water from these springs. A pilot project, underway at one spring, is testing a method through which treatment households receive free daily water deliveries and large storage tanks, which ensure that water is easily accessible for use within their compounds and alleviates their costs associated with water collection. Water delivered is from protected springs and thus meets international standards for "improved" supplies. Both the treatment and the control groups receive regular supplies of the chlorine-based point-of-use water treatment product, WaterGuard, to ensure that water quality is high and consistent across households. In addition, the project provides free soap and basic hygiene information to a subset of households in the treatment and comparison groups to examine whether soap provision is an effective means of improving health behavior without costly behavior change exhortations.

To measure the impacts of increased water quantity on child health, we collect diarrhea incidence data by visiting both the treatment and comparison households on a bi-weekly basis, in addition to anthropometric measurements every three months. We are also piloting alternative means of measuring water use through meter readings and household log books. This pilot project will continue for approximately three months and, if successful, will be implemented at the thirty-five selected springs for a full year.

In addition, briefly describe:

1) How the project has advanced research promoting sustainable development in the developing world:

Diarrheal diseases kill around two million children in poor countries each year (WHO 2002b, Kosek et al. 2003). There is widespread agreement that massive reductions in diarrheal mortality will be needed to achieve the Millennium Development Goal of reducing the under-five child mortality rate by two-thirds (World Bank 2003). Randomized trials have established that several medical/nutritional child health interventions are both effective and cost-effective in treating (and to a certain extent preventing) diarrhea. The development of rigorous evidence from these trials has had a tremendous impact, motivating large-scale vaccination, oral rehydration therapy (ORT), and micronutrient provision efforts, and thus saving millions of lives.

However, much less is known about the health impacts and cost-effectiveness of various environmental health interventions—such as water and sanitation projects—and interventions aimed at achieving health behavior change to prevent diarrhea. For example, evidence from randomized trials is lacking on the relative health impact of providing safe drinking water compared with increased access to water for all uses (including bathing and washing). Because diarrheal diseases may be either water-borne (caused by drinking microbiologically unsafe water) or water-washed (caused by insufficient washing of hands, in particular), there is a need to understand how increases in water quantity compare to alternative interventions, be they programs that improve the quality of drinking water or other relatively well understood child health interventions.

This project represents an effort to help build an evidence base to guide environmental health interventions similar to the enormously influential evidence base on which child health and nutritional policies rely. This activity will also complement previous investigations on the impact of improved water quality on child health, by assessing the effects of increased water quantity on child health and permit us to address the ongoing debate over whether quantity or quality changes have the largest gains with respect to child health. We will conduct this activity in a sample drawn from the same population that received previous interventions to improve drinking water quality and this will increase the comparability of results from the studies.

2) The project's intellectual merit:

#### *INCREASED WATER QUANTITY*

Little is known about the relative effectiveness of investments that either (i) increase the quantity of water available (for use in washing, for example) through providing new, nearby water sources of potentially variable microbiological quality, or (ii) improve water quality through reducing contamination vulnerability of existing drinking water sources, but do not boost total water availability. One analysis commonly cited by foreign aid donors argues that the benefits of improved water quality are realized only when households have a sufficient quantity of water to wash dishes and clothes, and for personal hygiene (Esrey 1996). In addition, many studies of water infrastructure provision in developing countries lack a plausible comparison group and thus, without a credible counterfactual, cannot isolate a causal treatment effect from service

provision. We are aware of two studies that rely on quasi-experimental designs (Huttly et al. 1987 and Aziz et al. 1990), but from the published papers neither study appears to have used random assignment to treatment status. Both studies are also hampered by small village-level sample sizes (each study include only five villages in total), that are insufficient for precisely estimating impacts of water quality and quantity interventions. Due to the substantial methodological concerns, it is difficult to draw policy-relevant conclusions from most previous studies.

Evidence on this question is critical. If the health benefits of increased water quantity per dollar spent in a particular context exceed those of improved water quality, then policy makers could consider providing a large number of relatively inexpensive new water sources such as shallow wells even though they may be vulnerable to environmental contamination (either seasonally or over time as nearby land-use patterns change). On the other hand, if improved drinking water quality provides the greatest health benefits for a given expenditure level, donors may achieve better results by providing fewer but more expensive deep borehole wells that tap cleaner levels of ground water, or by encouraging households to disinfect the water in their home before consumption, rather than by investing in many shallow wells. Although the RWP activities described here do not build new or extend existing water infrastructure, this simple model of increasing water quantity at the household level will provide evidence for policymakers on the relative value of providing such infrastructure (in the form of wells, water kiosks, standpipes, etc.) in currently underserved communities.

#### *HYGIENE BEHAVIOR CHANGES/ SUBSIDIZED SOAP PROVISION*

There are several randomized impact evaluations that report large positive effects of hand washing and soap provision programs on diarrhea incidence. However, the feasibility of generating sustainable reductions in diarrheal morbidity via handwashing exhortation and soap provision programs is uncertain, and the relative importance of these programs compared to water quality and quantity improvements is unknown. Weekly or daily reminders to wash hands frequently, which Luby *et al.* (2004) identify as critical for adoption by the poorest households as compared to richer households, are prohibitively expensive to provide on a large-scale basis. Unfortunately, all existing randomized impact evaluation studies rely on these expensive frequent reminders. The basic hygiene information campaign proposed here would be incorporated into the anthropometric visits and therefore would occur only four times during the intervention (at three month intervals). This would fill a gap in the existing literature in that it would be much less complex (and much less expensive) than many of the commonly implemented hygiene training programs, such as PHAST.

#### *Citations:*

Aziz, K., B. Hoque, K. Hasan, M. Patwary, S. Huttly, M. Arman, and R. Feachem (1990), "Reduction in diarrhoeal diseases in children in rural Bangladesh by environmental and behavioural modifications," *Transactions of the Royal Society of Tropical Medicine and Hygiene* 84(3), 433-438.

Luby, S., M. Agboatwalla, J. Painter, A. Altaf, W. Billhimer, and R. Hoekstra. 2004. "Effect of Intensive Hand Washing Promotion on Childhood Diarrhea in High-Risk Communities in

Pakistan: A Randomized Control Trial.” *Journal of the American Medical Association* 291 (21): 2547–54.

Esrey S.A. (1996), “Waste, water and well-being: A multicountry study,” *American Journal of Epidemiology* 143(6), 608-22.

Huttly S.R.A. *et al.* (1987), “The epidemiology of acute diarrhea in a rural community in Imo State, Nigeria,” *Transactions of the Royal Society of Tropical Medicine and Hygiene* 81, 865-70.

3) How the project has contributed to solving a practical problem of sustainable development:

Because diarrheal diseases may be either water-borne (caused by drinking microbiologically unsafe water) or water-washed (caused by insufficient washing of hands, in particular), there is a need to understand how increases in water quantity compare to alternative interventions, be they programs that improve the quality of drinking water or other relatively well understood child health interventions.

4) Any developing world component, including field work, engaging a co-investigator or practitioner from the developing world, the development of institutional links with an academic or practitioner/ applications/ problem-solving oriented institution in the developing world:

All of the field work for this project is taking place in the Western Province of Kenya. We are working with our partner organization, Innovations for Poverty Action (IPA), to implement the pilot project and will continue to do so in the implementation of the larger project. In addition to collaborating with IPA, we have also engaged in extensive discussion with government officials from the regional and district level water authorities.

In executing the pilot, we selected one of the communities with a spring that IPA had previously protected and thus were able to tap into the available links with the community through the existing Water Committee members and chairperson. By utilizing these channels, we were able to spread information about a community meeting held to announce the project, at which time interested household members were allowed apply to be included in the project. At this time individuals interested in applying for the position of water deliverer were able to do so. During a second community meeting, households and water deliverers selected for the project were announced publicly to ensure transparency in the process.

Such an approach will also be employed in the implementation of the larger-scale project.

5) The engagement of a student or research fellow in the project and whether the project has provided any opportunities for a thesis or masters student exercise:

Jessica Leino, CID doctoral research fellow, and Robyn Meeks, doctoral student in the Kennedy School of Government, both worked with Professor Kremer on the design of the pilot project.

6) Any funds leveraged as a result of this project:

The pilot project currently underway will provide the basis for the larger project implemented with funding from Google.

7) Curriculum, reports, papers, publications, events or presentations building on this support (please list full citations here and attach copies or URL's if possible):

Data collection is still ongoing, but reports will be made available to CID when completed.

8) Discussion of any significant deviations from the proposed work plan:

Using funds from this grant, IPA piloted two studies that were crucial for developing and refining the current design of the project. The first pilot examined the feasibility of rehabilitating now defunct communal wells in Kenyan villages and assessing the impacts on child health of the change in drinking water quantity brought about by reducing the time that it takes to collect water. This activity involved conducting technical assessments of the physical condition of the wells, including water quality assessments, identifying the universe of potential well users (households that live near the well to determine the number of children and adults who would benefit from the project, and surveying a subsample of potential well users to investigate current water use and health practices. We determined that well rehabilitation is not a cost-effective technology with which to assess the health benefits of increases in water quantity; too few households live within close enough proximity of the wells to have substantial decreases in the time that it takes to collect water, and without such changes the increases in household water quantity from well rehabilitation are likely to be minimal.

IPA also conducted a second pilot study examining the feasibility of a randomized impact evaluation of delivering piped water to homes in a peri-urban setting and thereby increasing the quantity of water available within the home. We proposed to identify a representative sample of households that do not have piped water currently but, for a fee, could be easily connected to a municipal distribution system. We originally proposed to pilot alternative means of measuring water use and preventing or measuring sharing of piped water between homes.

Following initial work with Kenyan Ministry of Water officials to identify a study site where such a population exists with currently capacity to expand the distribution system, it was determined that no such site currently exists in the country's Western Province. It was determined that the increased water quantity would have to occur without extending current water infrastructure, as such projects are extremely expensive and require a long duration of time. Since water vendors are already common throughout much of the country, the decision was made to pilot water delivery through employment of such vendors as is discussed in the project abstract.