BuRST: Bolstering Underserved Rural Science & Tech education via Locally-Designed Sustainable Water Filtration

When the flood of the century inundated much of Thailand with toxic sewage, volunteers gathered to toss thousands of mud and bacteria balls into the water. This curious approach, called "Effective Microorganism," or "EM," balls, was rumored to disinfect as much as five cubic meters of standing water for as long as a month[i]. Within days it became apparent that the miracle balls were completely useless as Bangkok struggled with an even greater influx of ill flood refugees than earlier estimates predicted. The story of this failed instant cure, cloaked in the mantle of scientific jargon for credibility, is a cautionary tale illustrating the damage that bad science may wreck by distracting precious time and resources from solutions that have actually proven to be effective.

Although those flood waters have since receded in Bangkok, my friends and neighbors downstream in southern Vietnam battle even more toxic water every single day. Like the Thai, this community's efforts to clean their water is similarly undermined by their lack information on how to best approach the problem. The fact that their dirty water is full of e. coli bacteria, human and agricultural waste [ii], and heavy metals [iii] further cripples the community by making many too ill to regularly attend school; many end their education by the sixth grade[iv], the period during which the practical sciences relating to sanitation and agriculture are first introduced. Through BuRST, I propose to supplement that education and train a community in the Mekong Delta to enable them to build and sustain their own water sanitation system.

Science Education

Using low-cost ceramic water filters as a starting point, I will educate a team of locals on the properties and health effects of each of the contaminant types in their water. This curriculum will be centered on the goal of producing quality water through careful research, design, and testing modifications to the basic filters to adapt them to the local waterway, and participants will continue to periodically record water quality data to add more knowledge to the body of literature on the filters. In addition to training the participants to be able to critically evaluate the veracity of rumored "miracle" solutions like the ineffective EM balls, the program will also enable them to effectively adapt the filters to however their filtration needs might change over time and convincingly promote the creation and use of these filters beyond their local community.

Recipient-directed projects

While this self-help model of aid is unconventional in Western humanitarian practice, this approach has succeeded in this particular region[v]. Such locally directed projects have led to the successful modernization of area hospitals, roads, and other infrastructure, suggesting that other self-help projects, including BuRST, will enjoy similar success.

In addition to fostering a greater sense of ownership and action among them, placing trust in the recipients to continue the same work I introduced will allow more progress to be made, and

more data to be produced, long after I return to my obligations at school. Although relying on individuals who are not professional science technicians to gather samples and record data is unconventional, recent analyses of data recorded for other studies by largely illiterate Amazonian tribes have shown that the information produced by non-scientists is just reliable[vi].

Move from "stopgap" to "self-sustaining and proliferating" systems

Armed with this knowledge and training, the recipient community will be able to replace their own filters over time, as well as disseminate this technology to the surrounding communities. Through our continued communication, I will be their bullhorn to the world, promoting their causes to my expanding network of connections to water related organizations, as well as facilitating connections to crowdfunding and microlending sites as necessary, to rally continuing support for this work.

Project Details

My project will be based in Phuoc Binh hamlet, which is located on the outskirts of Ho Chi Minh City (HCMC), Vietnam. Its proximity to HCMC, where research universities and sophisticated testing facilities are located, makes it an ideal site for this project. The site is also located a mere five miles from my hometown, where several members of my family are teachers and school administrators in the region and will advise me regarding the local science curriculum.

Phuoc Binh is an especially attractive candidate for this project because it was also the site of an earlier water filtration project by Stanford alumna Tiffany Dao, who in 2009 introduced the same ceramic water filters that will be basis of my project. According to Dao's reports, the residents of Phuoc Binh were very receptive of the filters and sought additional ones for their families, a fact that is encouraging for my project. Those filters, however, are only capable of producing high quality clean water for up to three years, and the residents of Phuoc Binh do not currently have a way to replace them when they "expire" this summer.

Approximate Timeline

I will carry out my project according to this rough timeline, which will be subject to minor changes based on the realities of the summer monsoon season.

- *May to mid-June* – Stanford, CA – Apply for local government permission to carry out project via local contacts. Design survey to follow up on three-year-old filters. Determine number of replacement filters and filter components needed; order appropriate number of filters to be delivered to contact in Phuoc Binh. Consult with Stanford professors (identified in **Contacts**) to tailor filter and testing methods to the Dong Nai ecosystem and pollution makeup. Begin developing water sanitation-centered water filtration curriculum while corresponding with local educators in Vietnam (listed below). Consult with local priest, Father Quang, to identify five reliable and eager individuals to aid in filter distribution and water quality testing, as well as

participate in the science education curriculum.

- *Mid-June through mid-July* – Phuoc Binh, Dong Nai Province, Vietnam – Arrive in Vietnam. Begin instruction, including training participants how to test water samples. Survey families who were original recipients of filters. Distribute new, unmodified filters. Establish contract with local scientific testing facilities for one year of testing and begin testing to compare water quality of old vs. new filters.
- *Mid-July to mid-August* – Phuoc Binh – Continue scientific curriculum with participants. Begin allowing participants to lead water tests and take water samples, with my continued supervision. Introduce activated carbon filter designed with Stanford professor to participants as one design modification to the filter; brainstorm with participants on additional ways to improve water and challenge them to design a solution. Science education sessions will segue into research and design workshops, with some sessions devoted to strategizing sessions on how to best promote the filters among family, friends, and neighbors outside of Phuoc Binh.
- *Mid-August to mid-September* – Phuoc Binh – Transfer responsibility for testing water entirely to participants, with occasional independent follow up test by me to ensure continued accurate data collection. Selectively implement participant-designed filter improvement components to test performance against unmodified filters.
- *Mid-September to mid-December* – Stanford – Team continues regular water quality sampling and testing. Continue weekly correspondence with Father Quang and team to monitor water quality with data and reports through the end of the monsoon season.
- *Mid-December* – Phuoc Binh – Conduct follow up site visit. Consult with participants on additional needs they have encountered or foresee for the future. Conduct brainstorming session with participants on how to move project forward and expand to neighboring areas. Document progress via images and video for future fundraising and promotional campaigns.
- *January 2013* – Stanford – Synthesize multimedia recorded during visit into electric and paper promotional material. Continue monitoring water quality via correspondence; compile data and findings into report to send to Potters for Peace and other interested parties, and for possible scientific publication.
- *February and beyond* – Begin publicizing work in Phuoc Binh to water-focused NGOs such as charity:water, WellDone, and the Clean Water & Sanitation branch of East Meets West to engage future funding and support. Promote work via Kiva micro-loans or Kickstarter, both crowd-funding websites, as appropriate to the participants' needs for expansion.

Estimated Budget

Expense Type	Items	Quantity	Cost per Unit	Total Cost
Travel	Round trip flight	2	$2,000	$4,000

Living	Room, Board	-	-	$0*
	Transportation to site, daily	100	$3	$300
Filters	Whole units	100	$10	$1,000
	User instructions to distribute	100	$.05	$5
	Shipping from Cambodian plant	-	-	$100
	Cloth for carbon filter	-	$10	$10
Testing	Monthly lab costs	12	$50	$600
	6-month testing stipend, per person	5	$300	$1,500**
Educational	Projector (used)	1	$60	$60
	Misc school supplies (notebooks, pens, etc)	-	-	$10
	6-month Internet subscription	6	$10	$60
	Design materials, as needed	TBD	TBD	$2,145
Promotional	Flyers/Brochures	100	$1	$100
Misc	Government Fees	-	-	$200
Total	-	-	-	$10,000

*I will be staying with family nearby to save on room and board costs.
**Stipend will be disbursed by Father Quang increments until testing responsibilities have been completed.
***Materials reflect Vietnam prices will be purchased or printed in Vietnam whenever possible.

Contacts

The following individuals have kindly offered their expertise to aid me in carrying out my project. Their network of support will form the backbone on which this project will grow.

Geology professor Scott Fendorf – Stanford University: researched sources of arsenic contamination and methods for removal along the Mekong in Cambodia; will assist in tailoring ceramic filter components to fit the Mekong and Dong Nai waterways.

Civil and Environmental Engineering professor Jenna Davis – Stanford University: expert in collecting and testing water samples in the field, with experience in Vietnam; will aid in developing appropriate water quality testing techniques.

High school mathematics teacher Ngoc Son Vo, English teacher Le Uyen Vo – Ba Ria, Vietnam: local educators with a combined 50 years of teaching and administrative experience; will aid in science curriculum design.

Professor Linh Vu, Viet Ecology Foundation – HCMC, Vietnam: local scientist who will connect me to testing facilities.

Father JB Huu Quang – Phuoc Binh parish, Vietnam: facilitated the distribution of the first Filters in 2009; will be my primary point of contact with Phuoc Binh while I am in school.

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[i] Mahtani, Shibani. "Thai Flood Decontamination Balls are Great – If They Work." *Asia Realtime*. The Wall Street Journal, 07 Nov 2011. Web. 10 Nov. 2011. <http://blogs.wsj.com/searealtime/2011/11/07/thai-flood-decontamination-balls-are-great-if-they-work/>.

[ii] Anh, Mai Tuan, et al. "Micropollutants in the Sediments of the SaiGon-DongNai River: Situation and Ecological Risks." 2009. Chimia. 1 November 2011. 541-573. <http://www.sach.ch/doc/chimia/sept03/anh.pdf>

[iii] Osmond, D.L., et al. WATERSHEDSS: Water, Soil and Hydro-Environmental Decision Support System. North Carolina State University 1995 <http://h2osparc.wq.ncsu.edu>

[iv] Trinh, Quoc Thai. Socialist Reublic of Vietnam. Ministry of Education and Training. *Vietnam Primary Education*. Ha Noi: 2006. <http://en.moet.gov.vn/?page=6.7&view=4401>.

[v] Jerve, Alf Morten. "Asian Models for Aid: Is there a Non-Western Approach to Developmental Assistance?." *CHR Michelsen Institute*. Oslo, 2007. Web. 8 Nov. 2011. <http://www.cmi.no/publications/file/2767-asian-models-for-aid.pdf>.

[vi] Luzar, Jeffrey B. "Large-scale Environmental Monitoring by Indigenous Peoples." *BioScience*. 61.10 (2011): 771-781. Print.