The Right Thing to Do: International Research Collaborations

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Acknowledgements

- University of Central Florida's Office of Research & Innovation
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- USAID and NSF through their PEER Science Program
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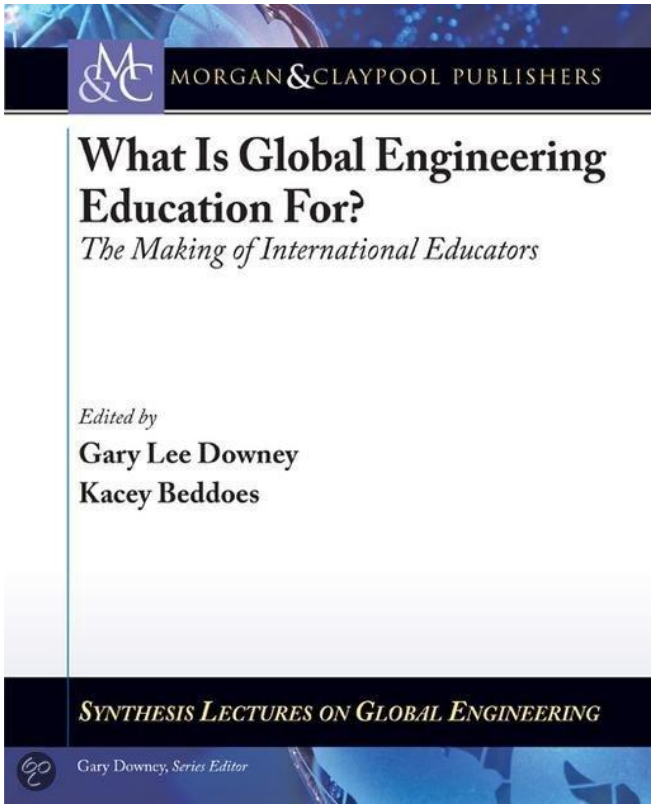
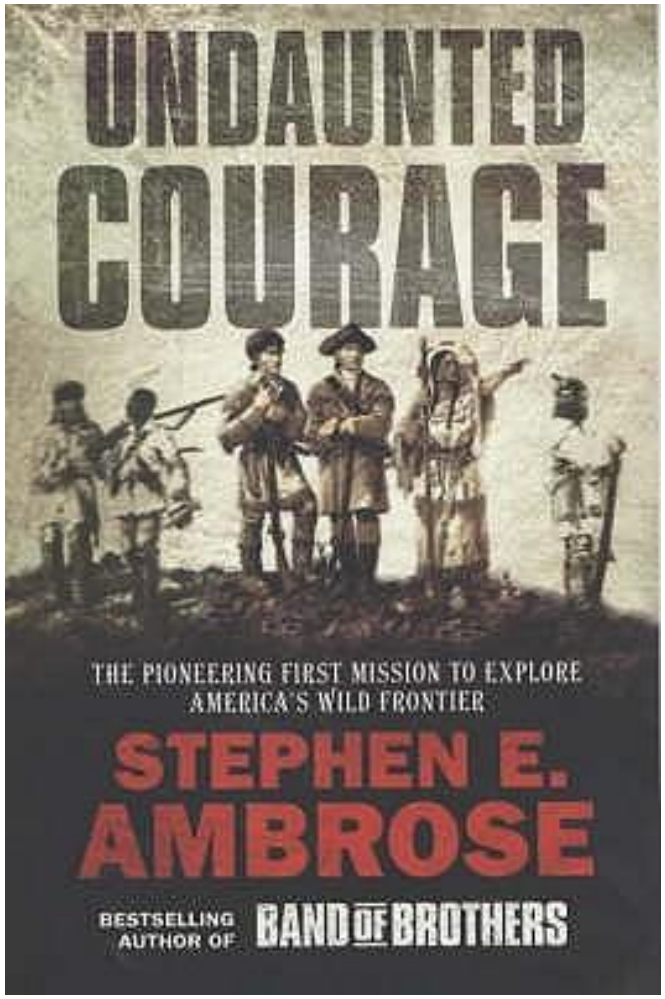
- Peace Corps
- Many, Many, Many, Students

So why am I here?



Mihelcic, J.R., "The Right Thing to Do: Graduate Education and Research in a Global and Human Context," in *What Is Global Engineering Education For? The Making of International and Global Engineering Educators* (Eds: G.L. Downey and K. Beddoes), Morgan & Claypool Publishers, San Francisco, pg 235-250, 2010.

Which way is the frontier?



Answer:

- **I skate to where the puck is going to be, not to where it has been.**

- **- Wayne Gretzky**

Locations where our students conduct research

So lets start the journey…

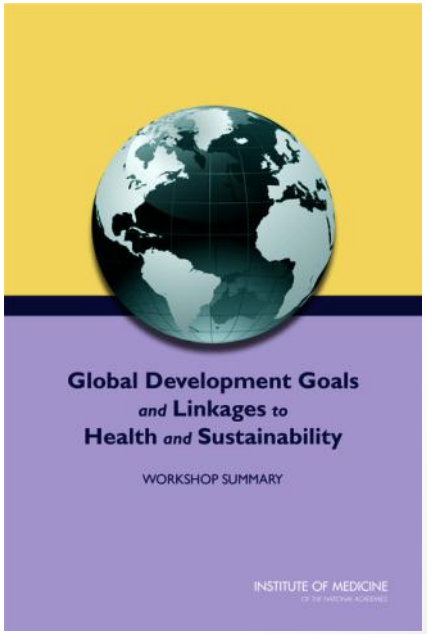
How do how do we get young people interested in their communities and the world,
and in science and engineering?

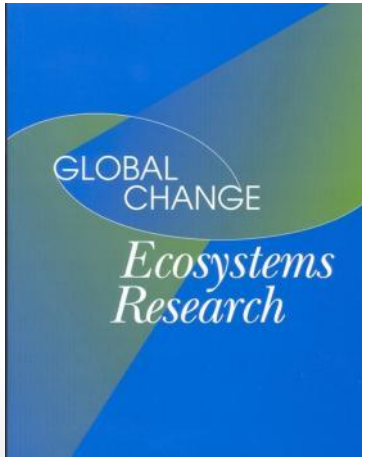
What does NSF say?

- **“International partnerships are essential to addressing critical science and engineering problems.**
- **In the global context, U.S. researchers and educators must be able to operate effectively in teams with partners from different nations and cultural backgrounds.”**

Framing our research in areas that have broad and important societal impact

The 8 Millennium Development Goals





UNDP

UNEP

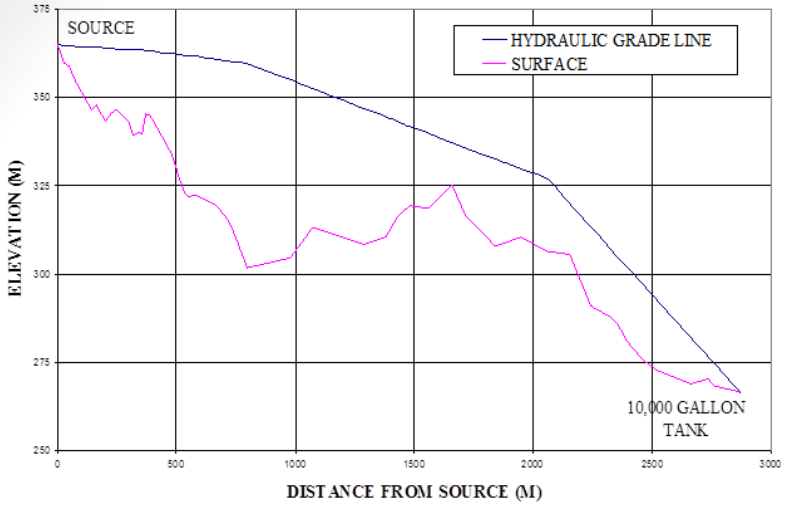
Example of a non-Conventional University Partnership - Peace Corps Master's International Program

What did this non traditional university graduate partner provide?

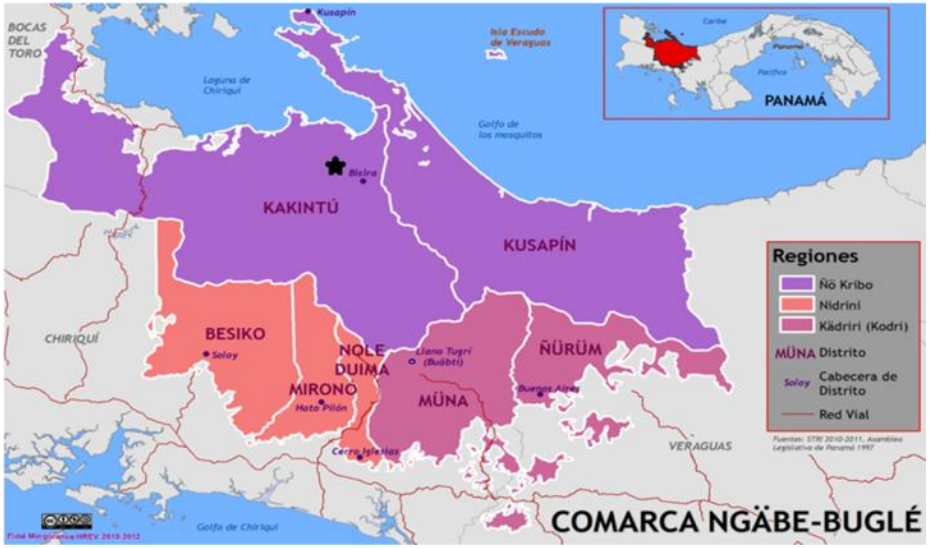
In country research expenses (2+ years) (travel, lodging, medical, safety supervision, etc).

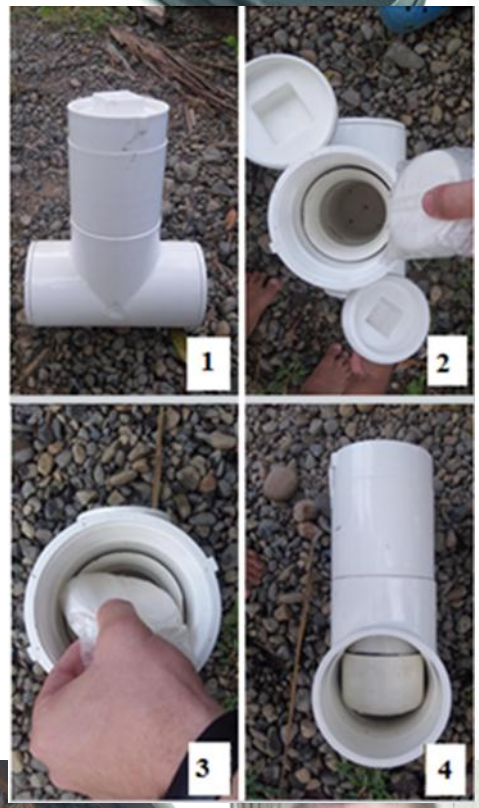
Peace Corps provides extended hands-on training combined with experiential learning and an environment that shows trainees how their research benefits society, while also providing competency in:

1. foreign language,
2. incorporating gender, sociocultural context, and ethics into practice and research,
3. participatory planning and assessment, and
4. appropriate technology.


SOURCE
HYDRAULIC GRADE LINE
SURFACE
10,000 GALLON TANK
ELEVATION (M)
DISTANCE FROM SOURCE (M)
375
350
325
300
275
250
0
500
1000
1500
2000
2500
3000

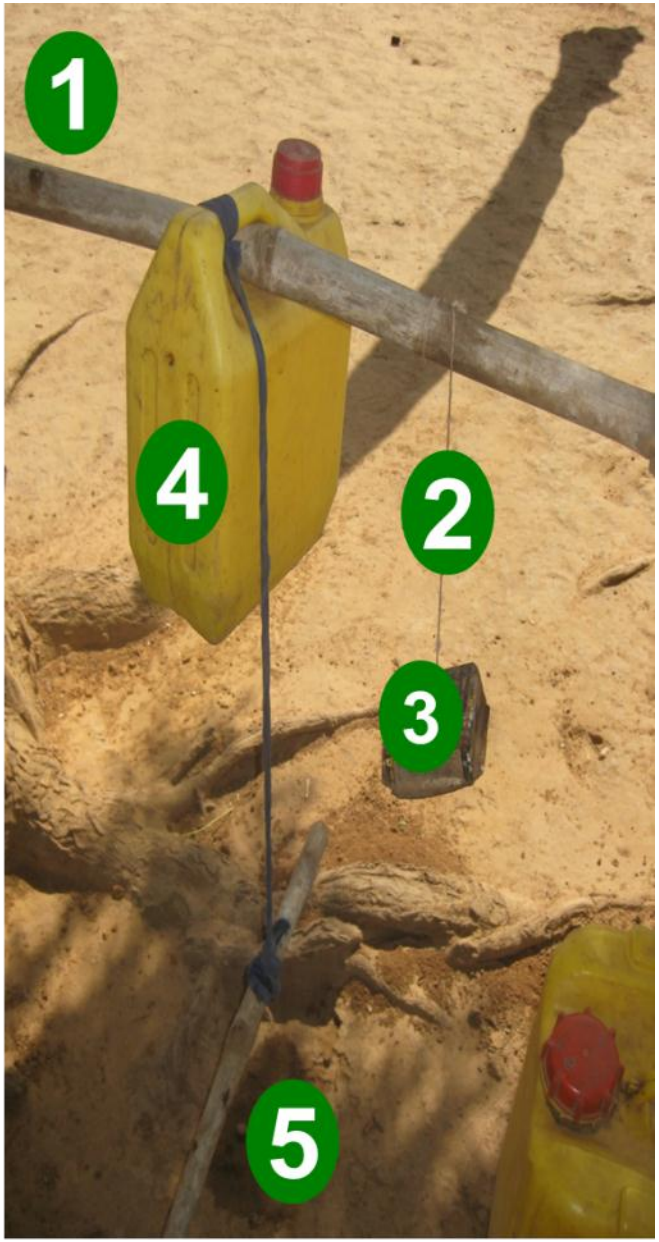
UCF alumni Ben Yoakum





Examples of Peer-Reviewed Scholarship

- Schweitzer, R.W., J.R. Mihelcic, "**Sustainability Analysis of Community Managed Water Systems in the Developing World**," *Journal of Water, Sanitation and Hygiene for Development*, 2(1):20-30, 2012.
- Owens, E.L., Mihelcic, J.R., Zhang, Q. "**Material Flow Analysis to Improve Solid Waste Management in Small Island Developing States**," *Journal of Environmental Engineering*, 137(10): 937-944, 2011.
- Mehl, J., D.A. Gibson, R. Izurieta, J. Kaiser, D. Hurtado, J. R. Mihelcic, "**Pathogen Destruction and Solids Decomposition in Composting Latrines: Study of Fundamental Mechanisms and User Operation in Rural Panam**a," *Journal of Water and Health*, 9(1):187-99, 2010.
- Mihelcic, J.R., Fry, L.M., Shaw, R. "**Global potential of phosphorus recovery from human urine and feces**," *Chemosphere*, 84(6):832-839, 2011.
- Held, B.R., Q. Zhang, J.R. Mihelcic, "**Analysis of Embodied Human and Materials Energy Associated with Provision of Improved Water through Source and Household Interventions**," *Journal of Cleaner Production*, 60(1):83-92, 2013.
- McConville, J.R., and J.R. Mihelcic, "**Adapting Life Cycle Thinking Tools to Evaluate Project Sustainability in International Water and Sanitation Development Work**," *Environmental Engineering Science*, 24(7):937-948, 2007.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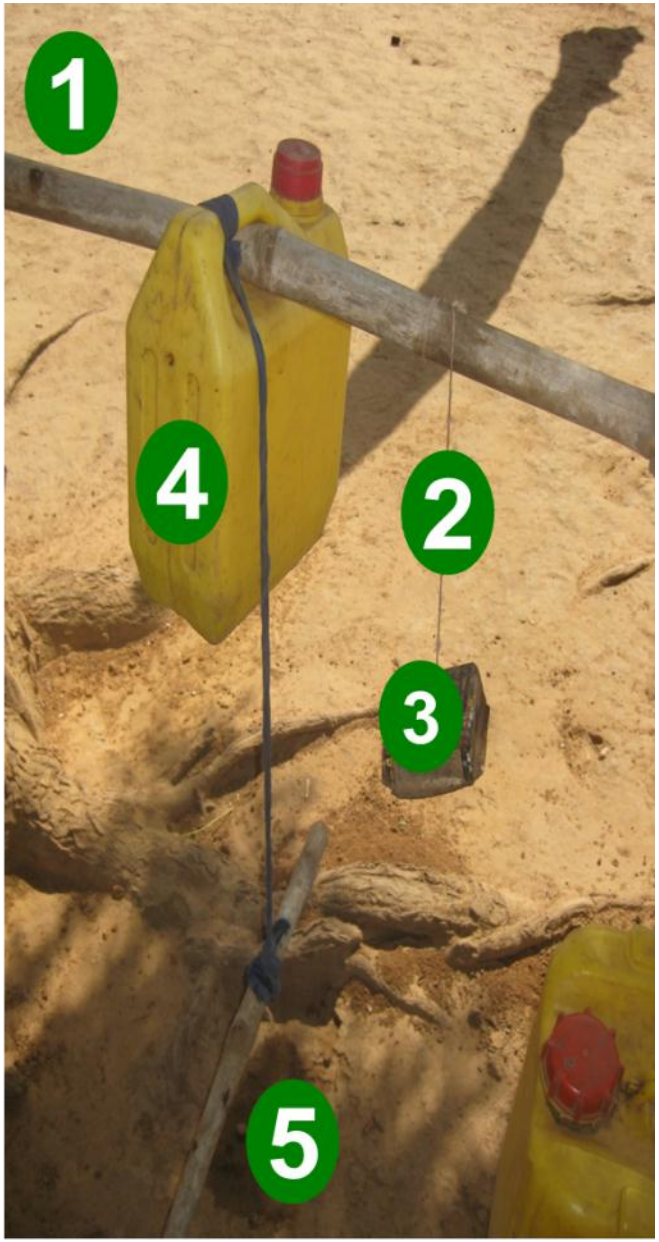
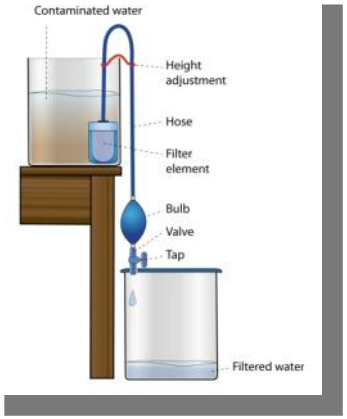


Naughton, C.; Haoua Traore Sissoko, Haoua; Mihelcic, J.R., "**Assessing Factors that Lead to Usage of Appropriate Technology Handwashing Stations in Mali, West Africa**, in review, 2014

CARE & Catholic Relief Services through the USAID supported RANO-HP Project


15-MINUTE
FRENCH

CARE & Catholic Relief Services through the USAID supported RANO-HP Project

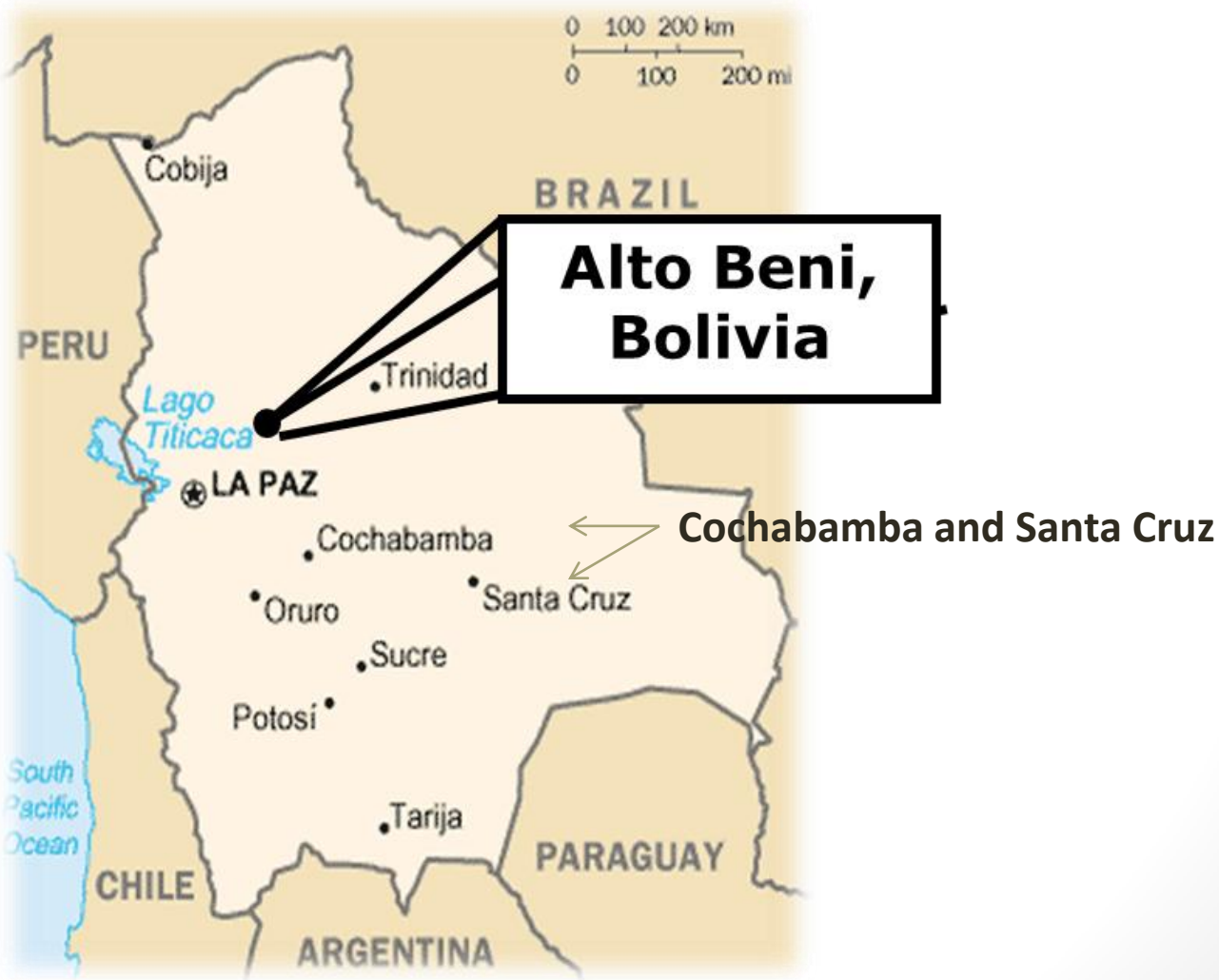


Schweitzer, R.W., Cunningham, J.A. Mihelcic, J.R. "**Hydraulic modeling of clay ceramic water filters for point-of-use water treatment**," *Environmental Science & Technology*, 47(1):429–435, 2013.

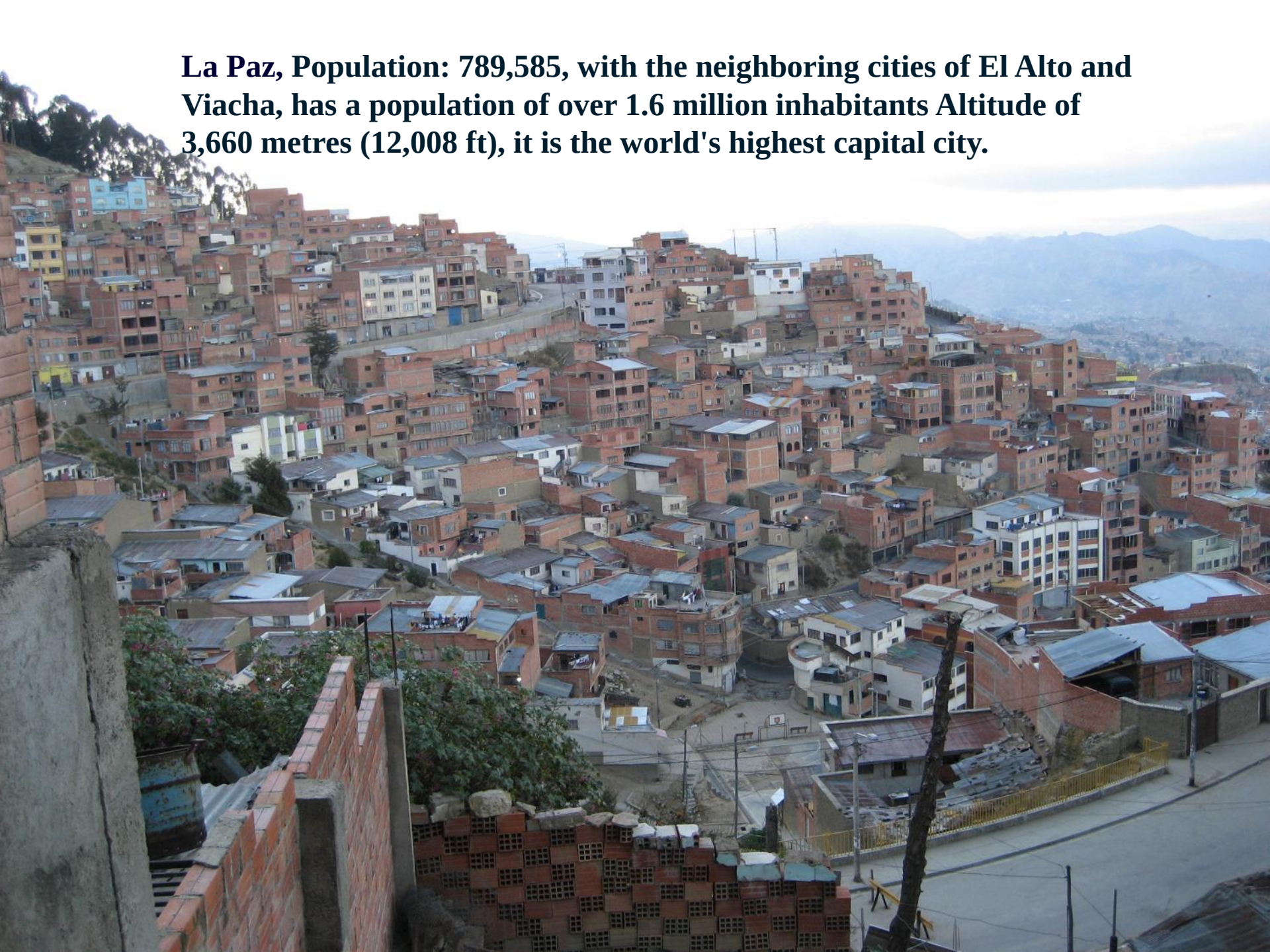
NSF International Research Experiences for Students (IRES)

The International Research Experiences for Students (IRES) program supports development of globally-engaged U.S. science and engineering students capable of performing in an international research environment at the forefront of science and engineering. The IRES program supports active research participation by students enrolled as undergraduates or graduate students in any of the areas of research funded by the National Science Foundation. IRES projects involve students in meaningful ways in ongoing research programs or in research projects specifically designed for the IRES program.

So here is where I traveled for 7 summers

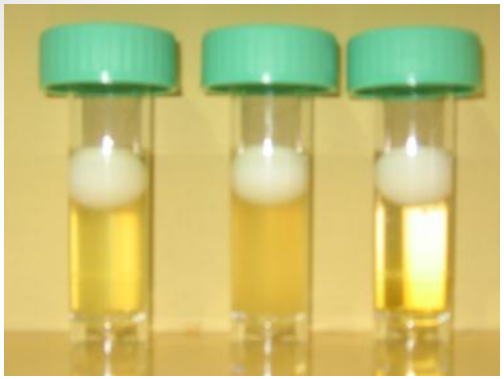


La Paz, Population: 789,585, with the neighboring cities of El Alto and Viacha, has a population of over 1.6 million inhabitants Altitude of 3,660 metres (12,008 ft), it is the world's highest capital city.




Sprite


SUERO DE LA VIDA
SALES DE REHIDRATACION ORAL
BAJA OSMOLARIDAD
PVP: 3.20 BS. COD: 36049
RECUPERA Y DA FUERZA
AL NIÑO CON DIARREA

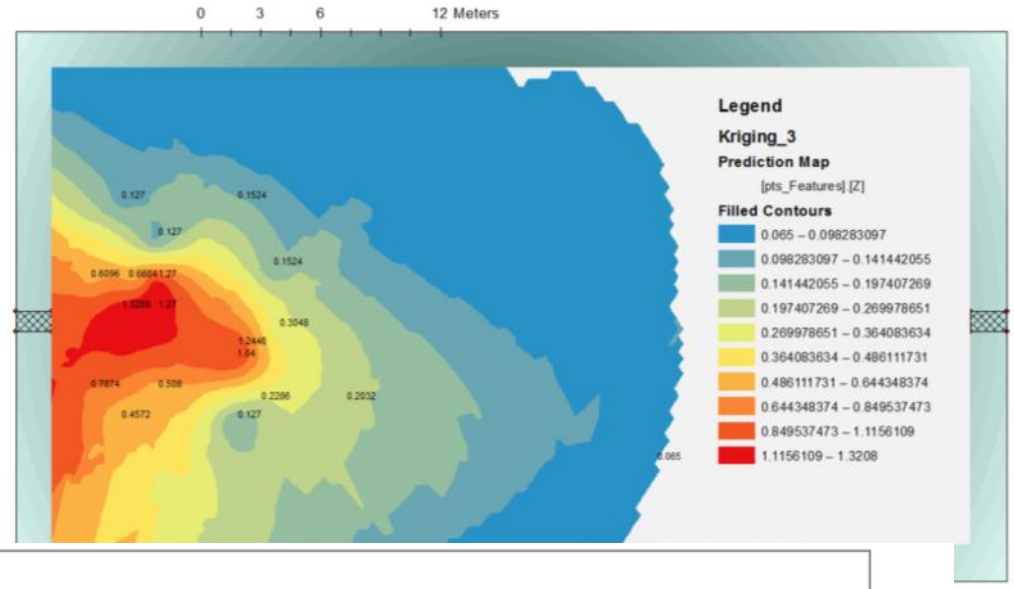


Research


NFR

We were joined by applied anthropology graduate students

We integrated our research with computational fluids mechanics faculty and students



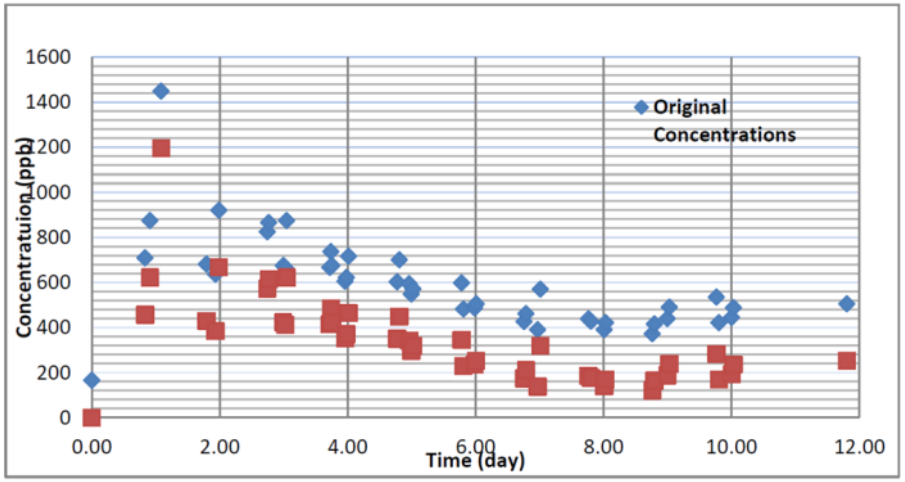
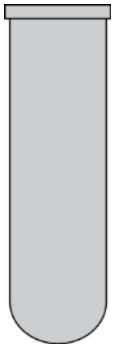


Figure 38 Tracer results with (red) and without (blue) dye measurements corrected for background fluorescence

We now partner with marine scientists

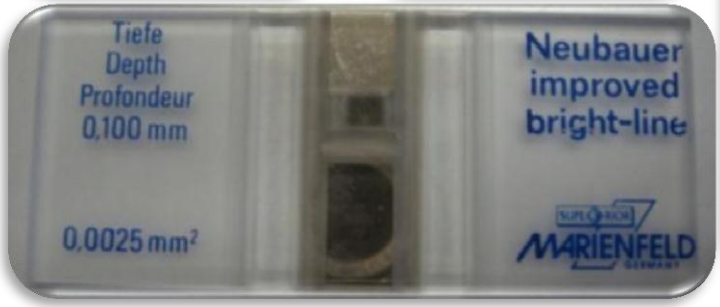
- Samples Collected to Assess Enteric Virus Removal -

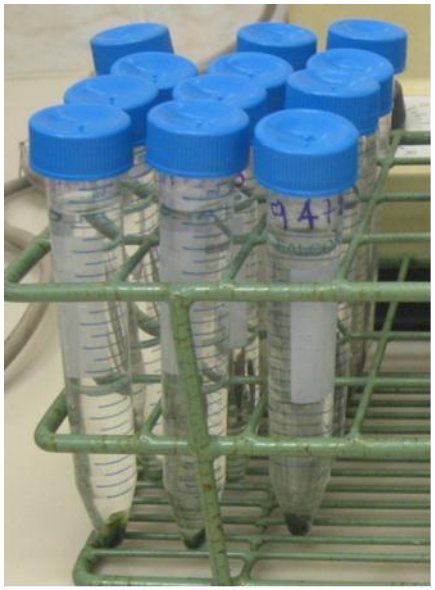
- Sampling: 24 hr composite, collected in 3x

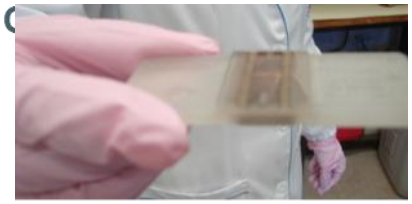
60 ml sample acidified to pH 3 – 3.5 → 0.45 µm filter → 

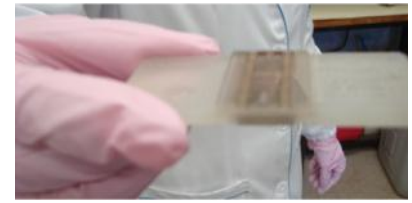
qPCR
- Rotavirus
- Norovirus
- PMMoV

And we found a research laboratory at the University San Simon in Cochabamba









Observed Volume
(2 repetitions of 1.8 µl)

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And I always had happy students

Students took the leap of faith with me during those early years

USAID - NSF Partnerships for Enhanced Engagement in Research (PEER) Sciences

The United States Agency for International Development (USAID) is exploring new opportunities to use science and technology to meet the world's development challenges. As part of its science and technology strategy, USAID is supporting various mechanisms to leverage the investments that other U.S. government agencies make in scientific research and training. In this context, USAID, in partnership with the National Science Foundation (NSF), have launched Partnerships for Enhanced Engagement in Research (PEER) Science. PEER Science is a competitive grants program that invites scientists in developing countries to apply for funds to support research and capacity-building activities on topics of importance to USAID and conducted in partnership with their NSF-funded collaborators.

Areas in which both NSF and USAID have strong mutual interests include, but are not limited to, the following:

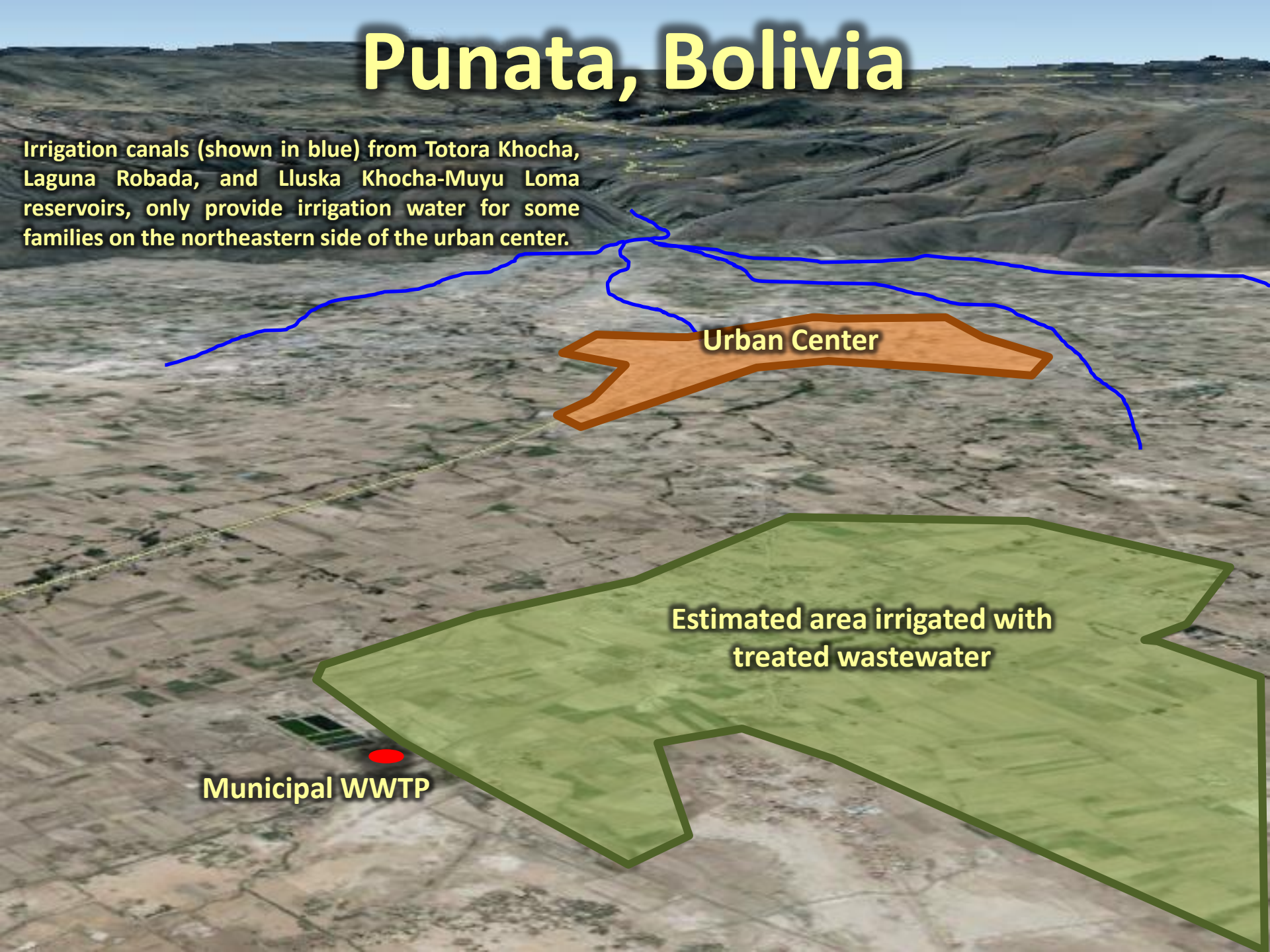
- **Food security** topics such as agricultural development, fisheries, and plant genomics
- **Climate change** impacts such as water sustainability, hydrology, ocean acidification, climate process and modeling, and environmental engineering
- **Other development topics** including disaster mitigation, biodiversity, water, and renewable energy

The fate of enteric pathogens in fluids, fields, and food products: On-farm solutions for the safe reclamation of water and nutrients from sewage

The geographical realities of wastewater reuse in Cochabamba, Bolivia

USF

Punata, Bolivia



Pond System in Punata with Irrigation Canals

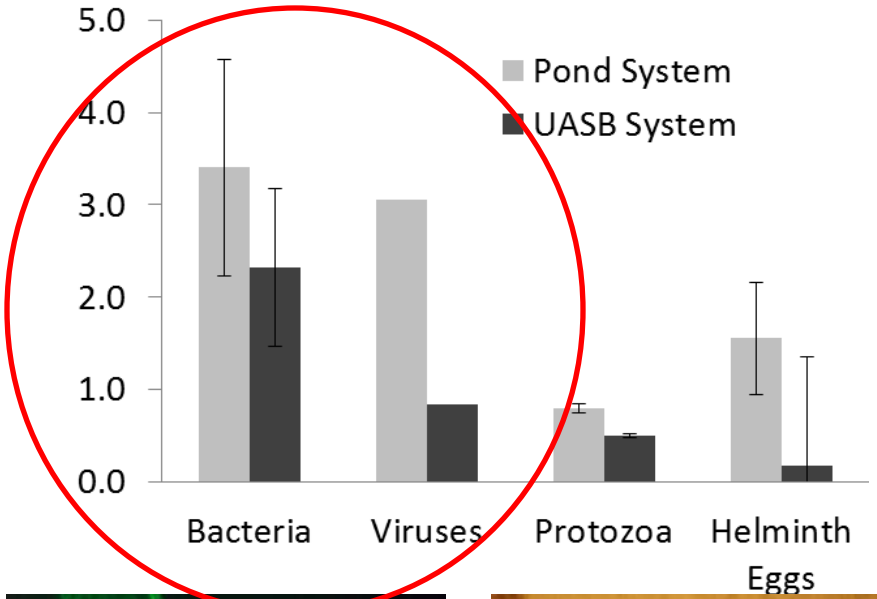
Crops irrigated with reclaimed wastewater

100% of effluents reused directly for Irrigation between May and November
500 Bs. fine for using water out of turn

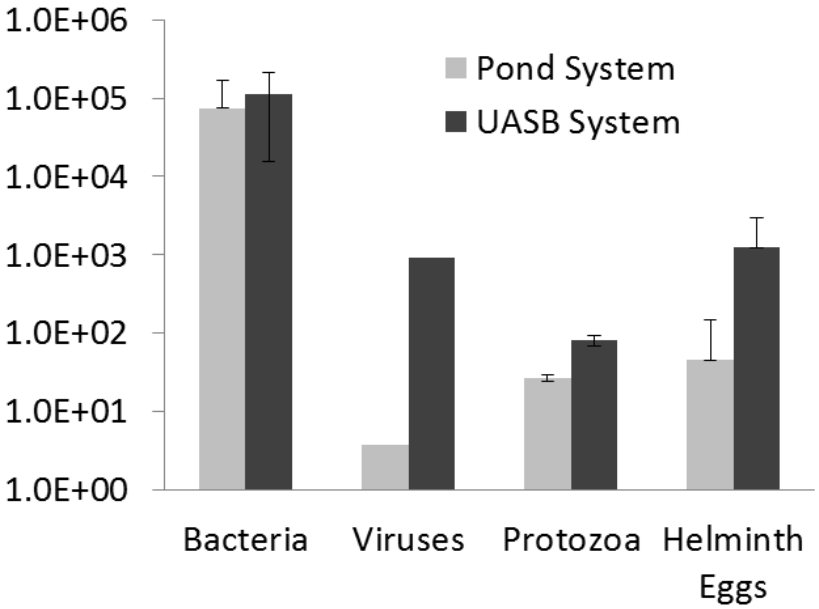
Farmers place a value of ~$0.25 per m^3 of treated wastewater (estimated based on costs for pumping water to fields, not including labor invested to build canals)

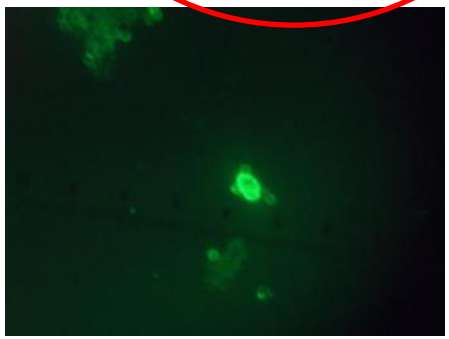
Health Implications and Risk of using different sources of water

Log_{10} Removal of Pathogens

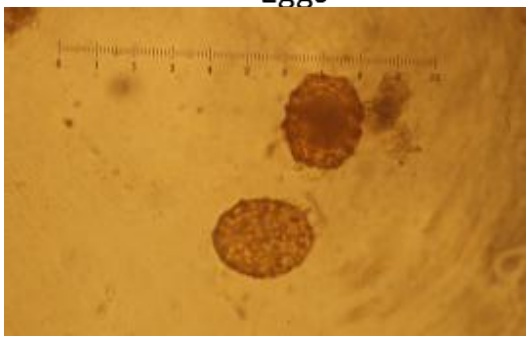


Effluent Pathogen Concentrations

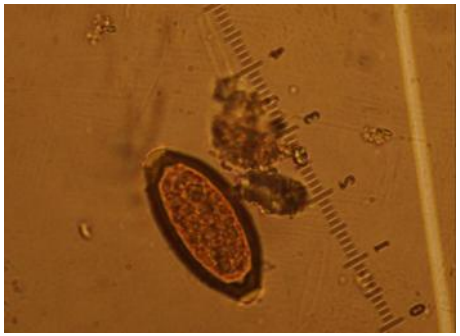




Giardia/Cryptosporidium



***Ascaris* spp.**



***Trichuris* spp.**

***Taenia* spp.**

Verbyla, M.E., S.M. Oakley, J.R. Mihelcic, "Wastewater Infrastructure for Small Cities in an Urbanizing World: Integrating Protection of Human Health and the Environment with Resource Recovery and Food Security," Environmental Science & Technology, 2013, DOI: 10.1021/es3050955.

USF






Examples of Peer-Reviewed Scholarship – work in Bolivia

- Symonds, E.M., Verbyla, M.E., Lukasik, J.O., Breitbart, M, Mihelcic,, J.R. "**Enteric virus removal and associated risk of water reuse for two wastewater treatment pond systems in Bolivia,**" *Water Re*search, in review, 2014.
- MacCarthy, M.F., Annis, J.E., Mihelcic, J.R. "**Unsubsidised Self-Supply in Eastern Madagascar**," *Water Alternatives*, 6(3): 424-438, 2013.
- Cornejo, P., Q. Zhang, J.R. Mihelcic, "**Quantifying Benefits of Resource Recovery from Sanitation Provision in a Developing World Setting**," *Journal of Environmental Management*," 131: 7-15, 2013.
- Verbyla, M.W., S.M. Oakley, L.A. Lizima, J. Zhang, M. Iriarte, A.E. Tejada-Martinez, J.R. Mihelcix, "**Taenia eggs in a stabilization pond system with poor hydraulics: Concern for human cysticercosis?**" *Water Science & Technology*, 68(12):2698-2703, 2013.
- Verbyla, M.E., S.M. Oakley, J.R. Mihelcic "**Wastewater infrastructure for small cities in an urbanizing world: Integrating the protection of human health and the environment with resource recovery and food security**," *Environmental Science & Technology,* 47(8):3598–3605, 2013.
- Fry, L.M., Watkins, D.W. Reents, N., Rowe, M.D., Mihelcic, J.R. "**Climate Change and Development Impacts on the Sustainability of Spring-fed Water Supply Systems in the Alto Beni Region of Bolivia,**" *Journal Hydrology*, 468–469: 120–129, 2012.
- Schafer, C.A., Mihelcic, J.R. "**Impact of Storage Tank Material and Maintenance on Household Water Quality**," *Journal American Water Works Association,* 104(9):E521-E529, 2012.
- Wright Wendel, H.E., R.A. Zarger, J.R. Mihelcic, "**Accessibility and Usability: Green Space Preferences, Perceptions, and Barriers in a Rapidly Urbanizing City in Latin America**," *Landscape and Urban Planning*, 107(3):272-282, 2012.
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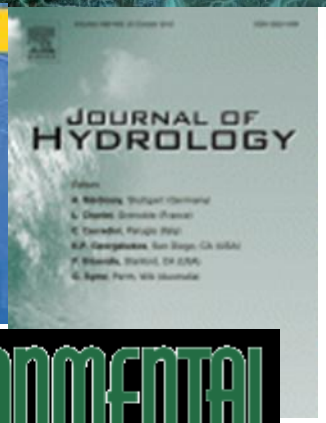
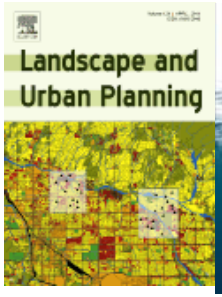


Environmental Science & Technology

Journal American Water Works Association

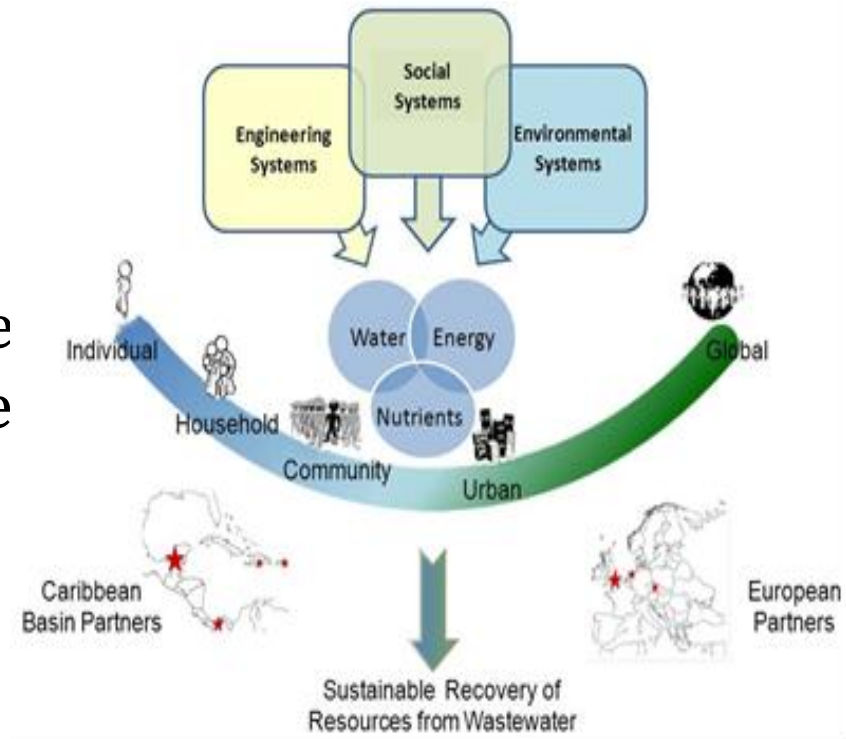


NSF Partnerships for International Research and Education (PIRE)

- Partnerships for International Research and Education (PIRE) is an NSF-wide program that supports international activities across all NSF supported disciplines. The primary goal of PIRE is to support high quality projects in which advances in research and education could not occur without international collaboration. PIRE seeks to catalyze a higher level of international engagement in the U.S. science and engineering community.
- **International partnerships are essential to addressing critical science and engineering problems. In the global context, U.S. researchers and educators must be able to operate effectively in teams with partners from different nations and cultural backgrounds. PIRE promotes excellence in science and engineering through international collaboration and facilitates development of a diverse, globally-engaged, U.S. science and engineering workforce.**
- This PIRE competition will focus exclusively on the NSF-wide investment area of Science, Engineering, and Education for Sustainability (SEES). The SEES effort focuses on interdisciplinary topics that will advance sustainability science, engineering and education as an integrative approach to the challenges of adapting to environmental, social and cultural changes associated with growth and development of human populations, and attaining a sustainable energy future. Additional details are provided in the Summary of Program Requirements below.

Our PIRE project: $3.9 million for 5-yr project, *Context Sensitive Implementation of Synergistic Water-Energy Systems*

- Can effective, geographically-appropriate, and culturally relevant engineered systems be established that utilize wastewater as a resource for recovery of energy, water, and nutrients?



Our NSF PIRE Partners

UNIVERSITY OF SOUTH FLORIDA

UNIVERSITY OF THE VIRGIN ISLANDS 1962

UNIVERSITY OF EXETER

UNESCO-IHE Institute for Water Education

INSTITUTE OF CHEMICAL TECHNOLOGY PRAGUE

UAB Education Empowers a Nation

PEACE CORPS

CASA

The Bonus…

Back in late 2012, Environmental Protection Agency had competitive solicitation to create national Centers for Water Research on National Priorities Related to a Systems View of Nutrient Management

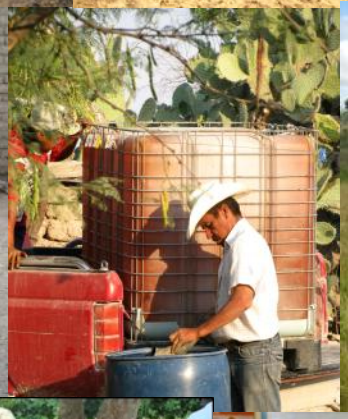
The Bonus…

- The University of South Florida department of Civil and Environmental Engineering in partnership with the University of Texas Resources for the Future, Yale University, University of Florida, University of Maryland, and Corporation to Develop Communities of Tampa hase been awarded a $2.2 million competitive grant by the U.S. Environmental Protection Agency (EPA) as part of its Science to Achieve Results (STAR) program to establish a Center for Reinventing Aging Infrastructure for Nutrient Management (*RAINmgt*).
- As a national research center *RAINmgt* will tackle a dire issue plaguing our nation's waterways that is critical to Florida's and the Nation's economic and social well being: nutrient inputs such as nitrogen and phosphorus from domestic wastewater and stormwater. The National Academy of Engineering has identified managing the nitrogen cycle and restoring and improving urban infrastructure as two of their Grand Challenges.






INGENIERÍA
AMBIENTAL







AGEND