



Bottom-up science and the politics of clean water: Evidence from southern Peru

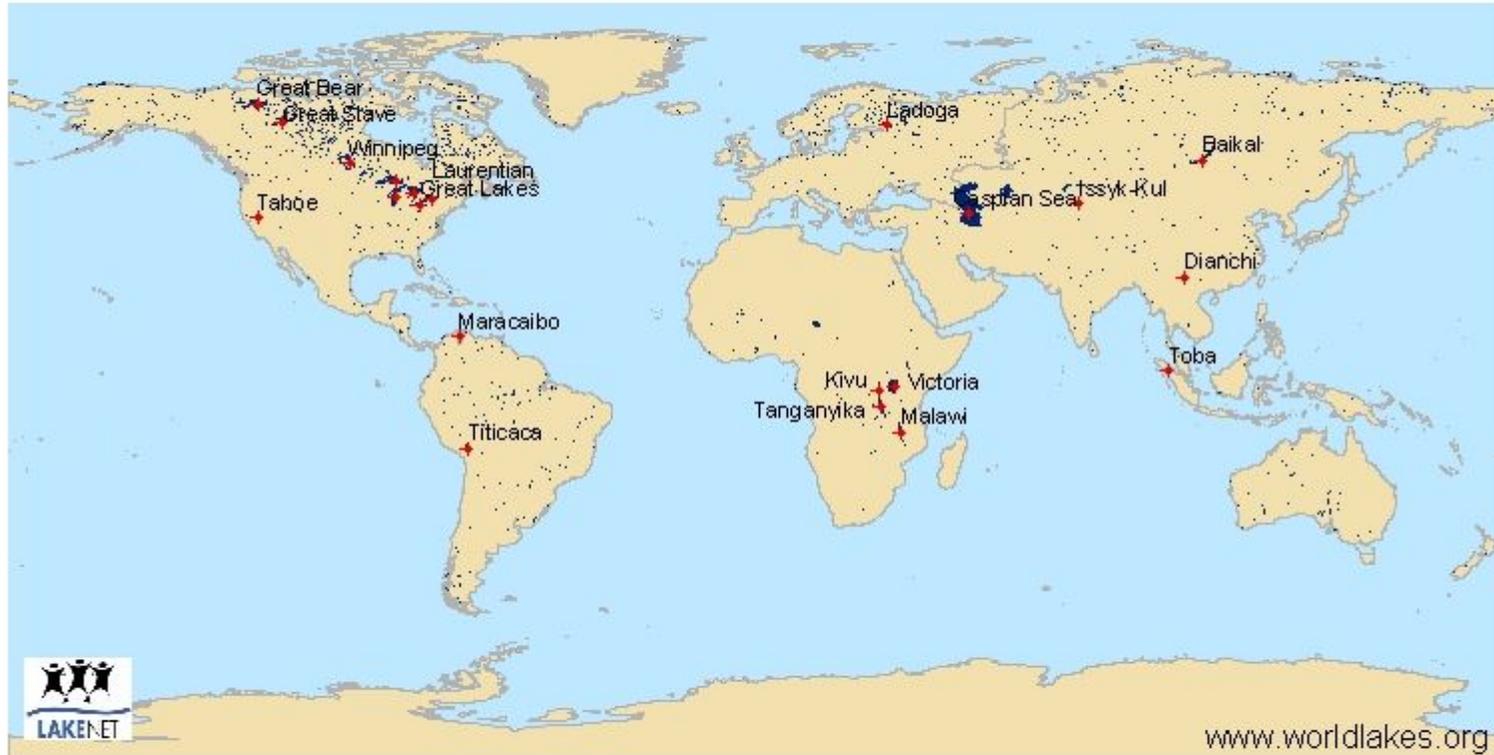


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The Chijnaya Foundation

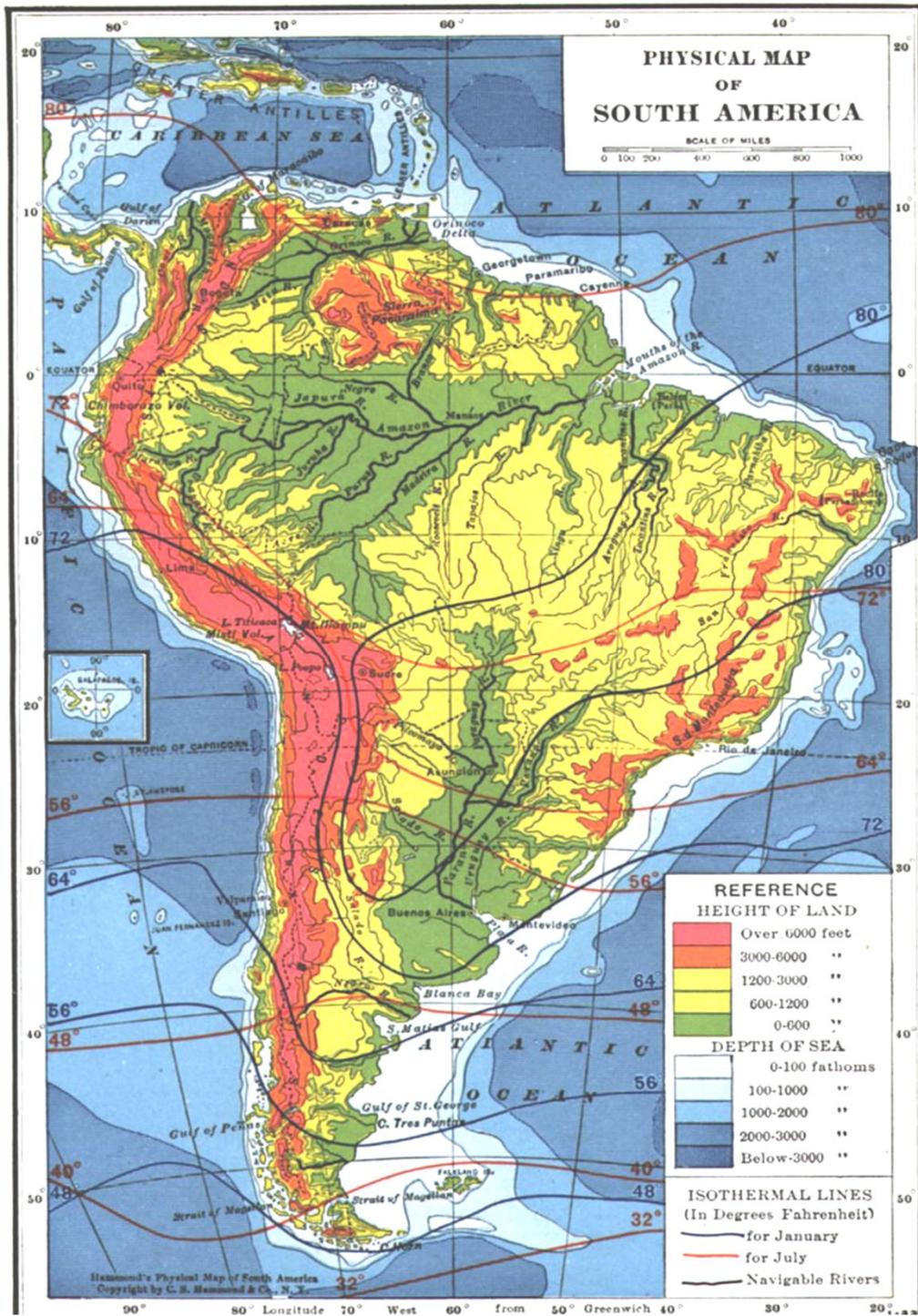
- Founded in 2006 by former Peace Corps volunteers and others with an interest in Andean cultures and communities
- Regional focus on Puno, Southern Peru
- Focus on health & environment, rural development, scholarships
- Partnership with Global Water Watch on CBWM effort begun in 2009

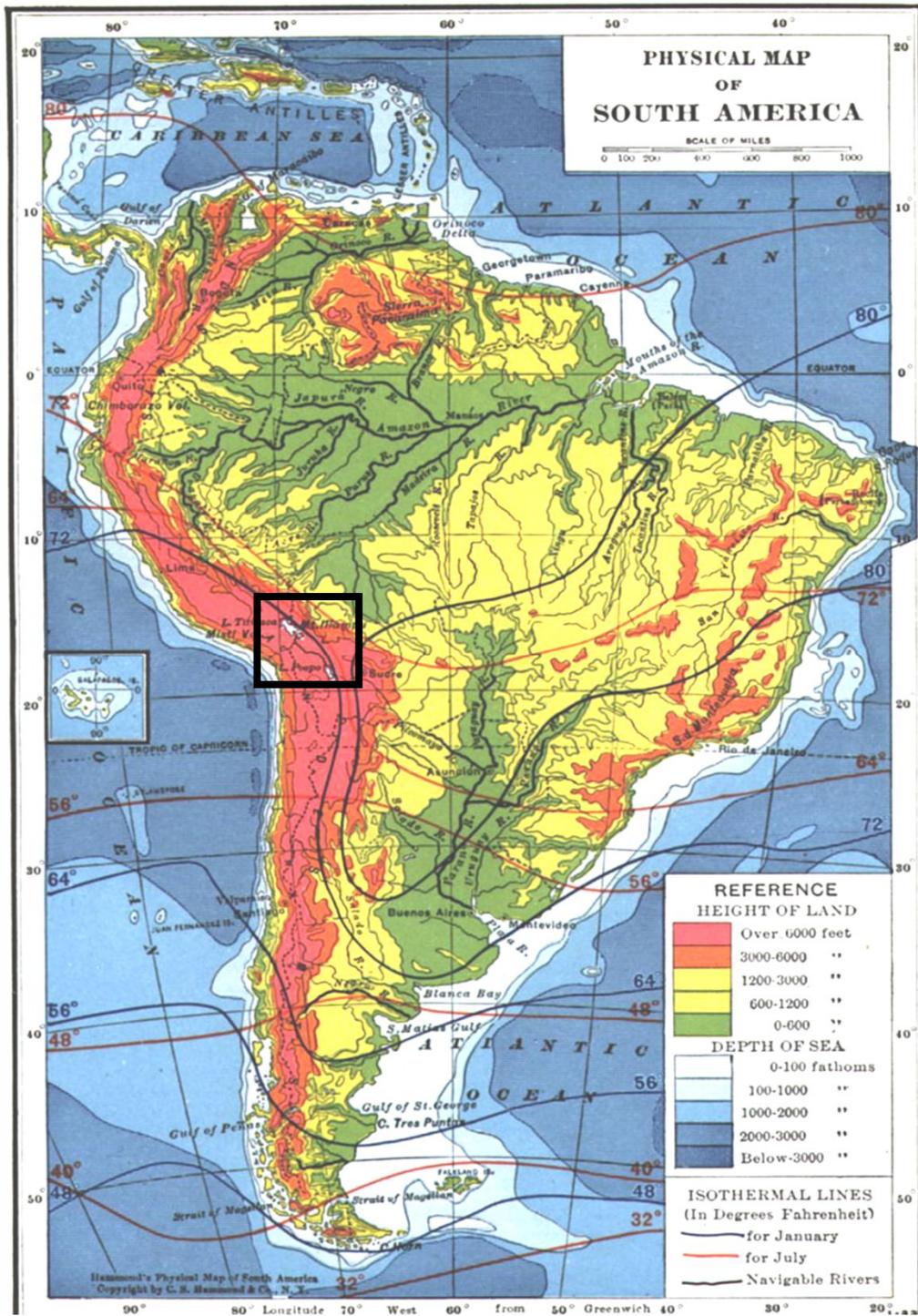
Largest Lakes of the World by Volume (Cubic Kilometers)



LakeNet Explorer 2004

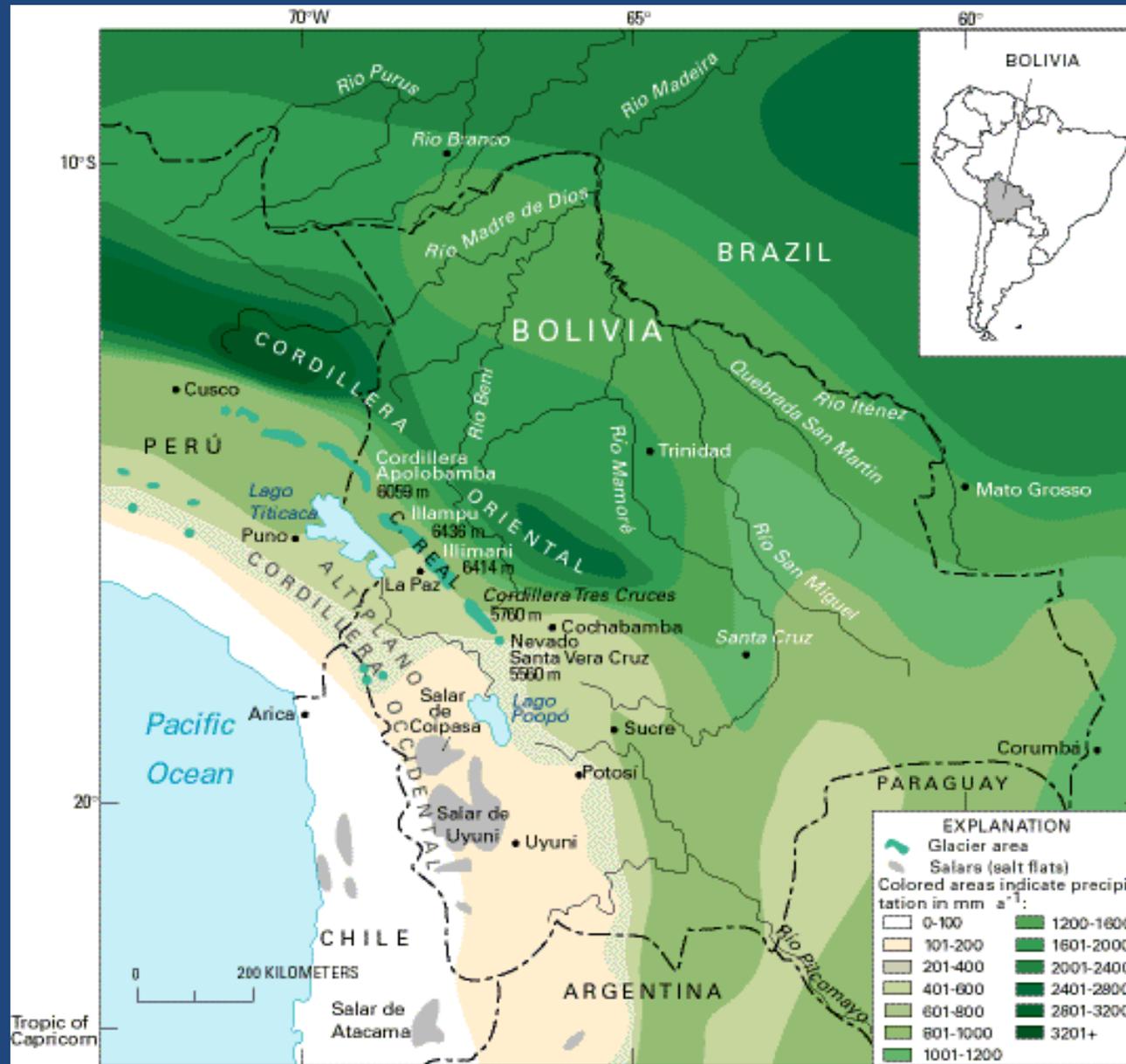
Sources: Lehner, B. & P. Doll (2003);
Birkett, C.M. & I.M. Mason (1995);
Commonwealth of Australia -Geoscience Australia (1990)
Base map: ESRI (2003)





Hammond's Physical Map of South America
Copyright by C. S. Hammond & Co., N. Y.

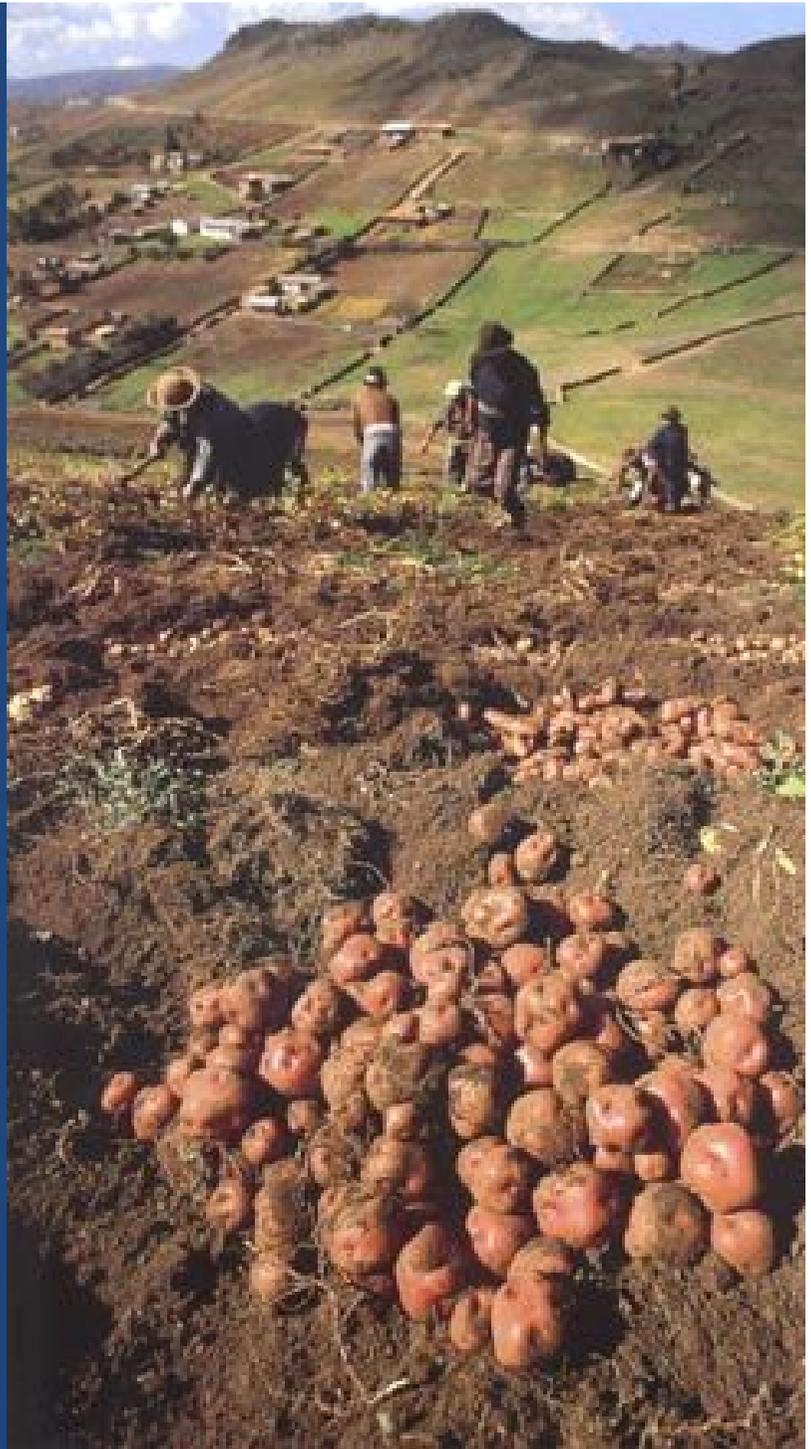




The Altiplano: location of glaciers and distribution and amount of precipitation. (E. Jordan, 1998)









Diverse uses of water and aquatic species in the Lake Titicaca Basin













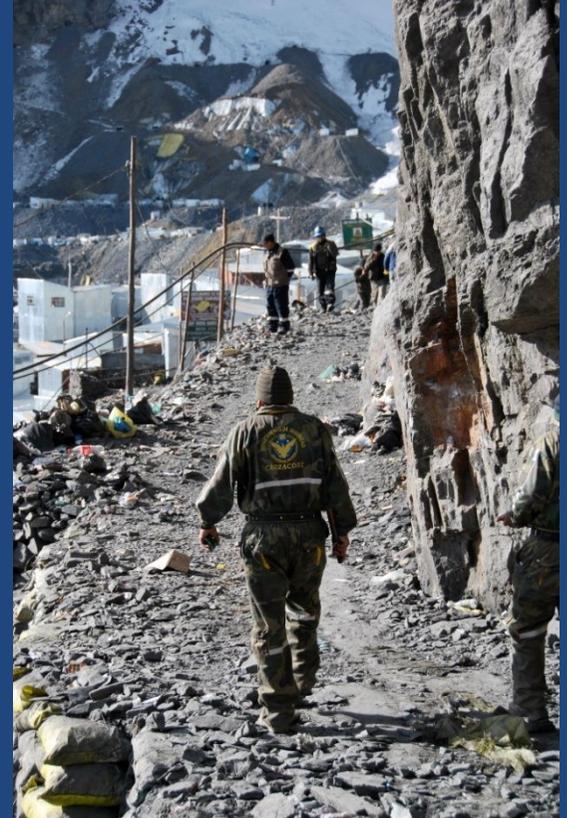
























Garbage and industrial waste in El Alto de la Paz and Juliaca



Eutrophication in the Bay of Puno



May-June 2011: Anti-mining protests shut down the city of Puno, international borders, and highways throughout the province.





El Proyecto SumaQuta

Monitoreo ciudadano para mejor manejo del Lago Titicaca



Goals

- **provide citizens with civic and scientific tools for protecting their lake basin**
- **produce public information about pollution and water quality**
- **introduce appropriate technologies and best practices that will improve public health and/or provide livelihood activities that promote conservation of the lake basin**

Un plan de acción

Consultar

Investigar

Concientizar

Remediar

Tools for measuring what's in the water



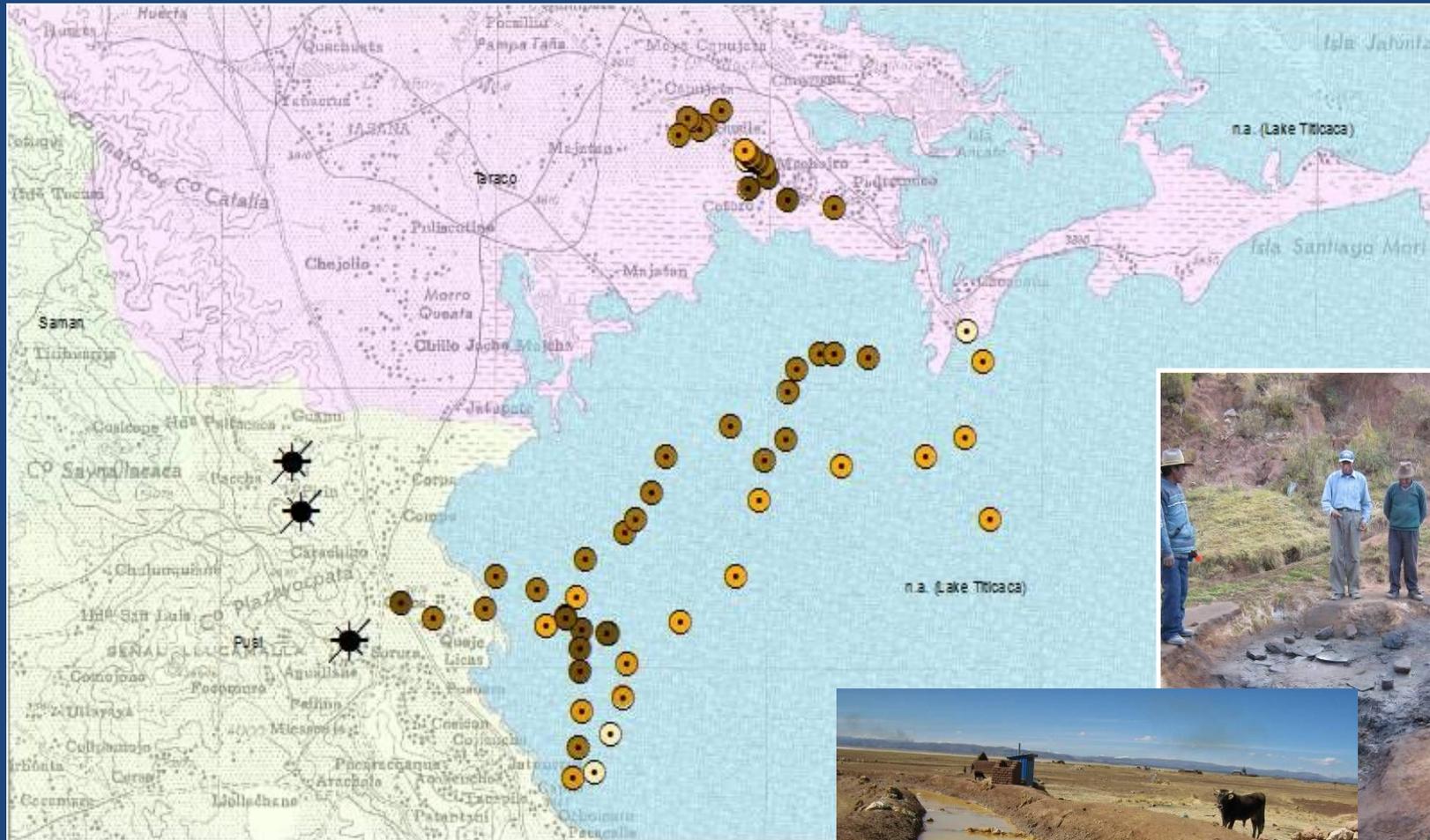
Outreach and training



Growing college student and community involvement



Cleanups: Data for citizen empowerment and for better practices in communities



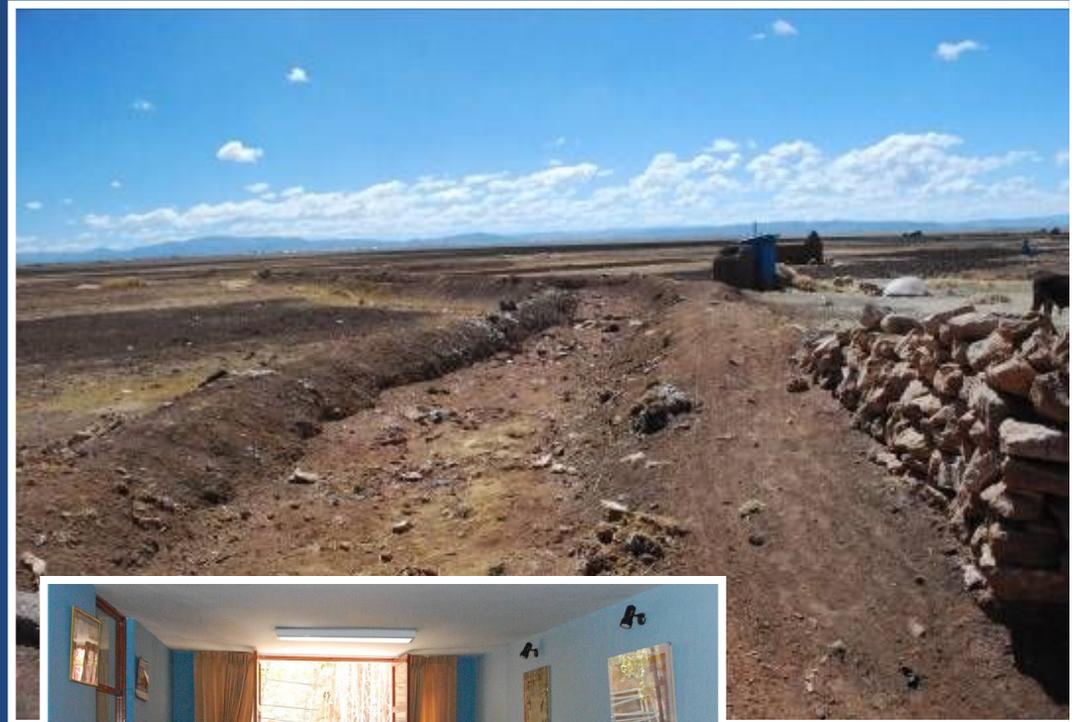
Total dissolved solids in the bay of Taraco, northwest shore of the lake. Black spots are pollution point sources: leaking oil wells and brine spring

Our "grain of sand?"

1960s: leaks begin, requests for remediation fall on deaf ears

1990s: authorities in Pusi district lobbying hard for solution

2005: Congress allocates money for a cap; money disappears in coffers of PetroPeru; authorities unwilling to heed complaints from mayor, APOC, Reserva Titikaka



2007: Ahuallani residents assist in data collection; Pusi mayor and Reserva Titikaka authorities use data and slide show to press for solution

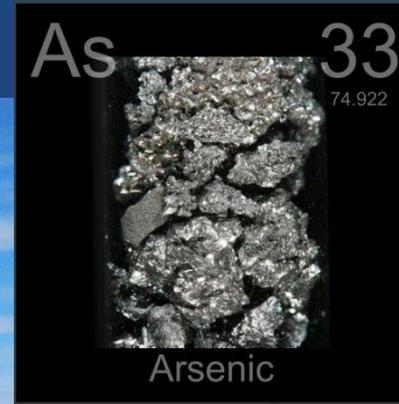
May 2008: wells are capped!



Best practices: Monitor-trainer Ricardo Quispe convinced his community to clear garbage and weeds from a spring, get setbacks for animals, and build a cistern to secure a water source used by 50 families.



Arsenic remediation



Good news!

January 2011: Newly formed UC Berkeley chapter of Engineers without Borders adopts the arsenic project and commits to a five-year collaboration on arsenic remediation. 2 delegation trips so far, third in July 2012. MOUs with pilot communities in progress.



Project Phases

Assessment

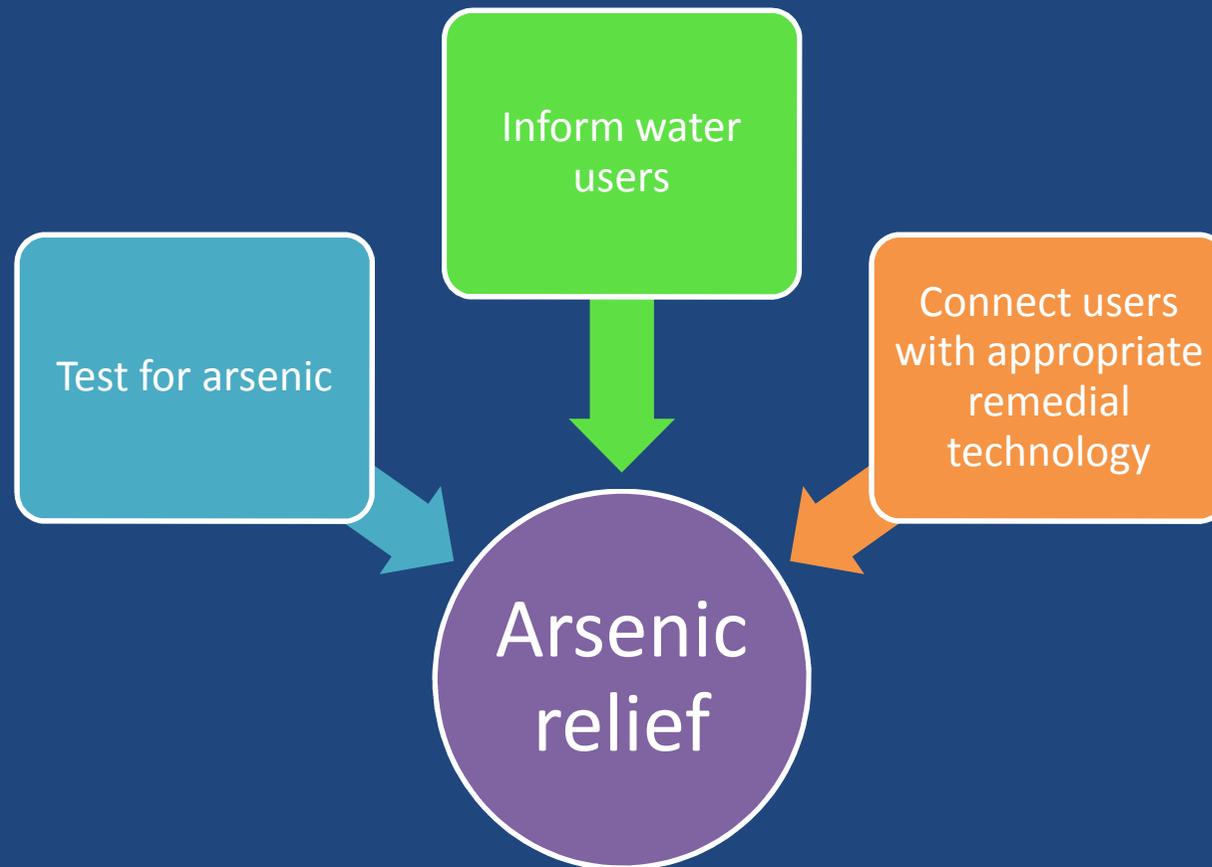
Implementation

Evaluation of results



GENERAL GOAL

To develop a functioning arsenic alleviation program in two communities in the Peruvian Altiplano, leaving in place a response protocol and a future scaling-up strategy for local authorities, communities, and civil society organizations .



Collaboration and division of labor

Develops menu of water treatment options and recommendations for construction

Engineers without Borders



DIRESA
(government)

Integrates arsenic testing and outreach, plus cancer screening, into agency work

Develops solutions *in situ*, evaluates problems, develops outreach strategy

Suma Marka
(Peruvian nonprofit)

Chijnaya
Foundation

Facilitates collaboration between Peru partners and U.S. partners, helps propose action plan

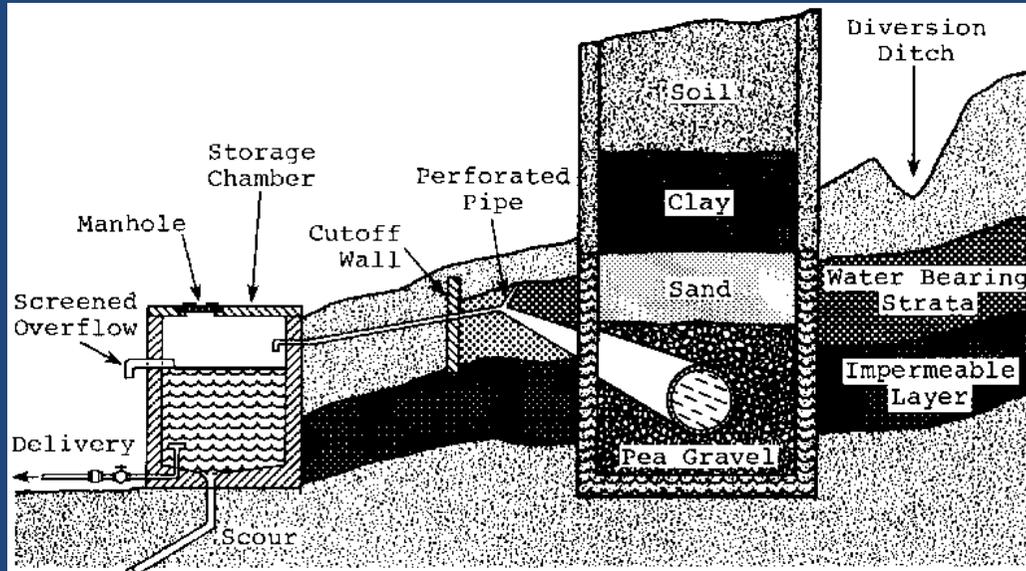
Pilot technology under study in the field: iron matrix filter

Pour in water from
well

Layers of iron filings,
sand, broken brick,
and fabric filter
arsenic from the
water

Collection
basin for
filtered water





Infiltration gallery

In local geo-chemical environments where filters won't work, alternate schemes under study by UC-Berkeley Engineers without Borders



Alum sedimentation



Rainwater harvesting

Assessment of project performance

Successes: Data contributes to two cleanups so far, including capping of leaking oil wells north of the lake and a safe cistern system on the Peninsula of Chucuito

Bragging point: 59 monitors trained to date and continuous monitoring in 14 monitoring stations ; strong partnership with local NGO and government health agency

Bright spots: data shows that the more people monitor, the better they can explain basic cause-and-effect on water pollution, basic water science (even holds steady when controlling for science background of respondents)

Hopeful signs: innovation in water monitoring by UNA biology students, who are working on developing biological monitoring utilizing phytoplankton and zooplankton as biomarkers for pollution

Room for improvement: community mapping, outreach, creative civic use of data to get response from local authorities

Conclusions

- The assertion that environmentalism is a post-material value that corresponds mostly with concerns of citizens of wealthy, industrialized nations is highly questionable.
- Models of CBMW utilized in U.S. settings are applicable in developing world settings, but with some substantial revisions of curriculum and firmer grasp on the logistics of monitoring and sample preservation.
- Widespread skepticism about the inclination and ability of governments to stop powerful polluters may dampen people's enthusiasm for monitoring.
- CBMW training appears to enhance people's understanding of cause and effect in watersheds and their ability to explain indicator variables
- Active involvement matters: the more you monitor, the more you know.

How the Chijnaya Foundation supports the Suma Quta Project

- Human resources: honorarium for 1-2 ground level coordinators
- Office: rent, utilities, computer and printing
- Training and outreach: transport, overnight housing, food
- Field kits and equipment: new kits for expansion to new communities, maintenance of reagents and glassware, calibration equipment, replacement parts for probes
- Partnerships and cross-national networks: Global Water Watch, Engineers without Borders, Peruvian American Dental Association, Lions Club
- Laboratory expenses: sampling equipment and lab fees for toxics and metal screens, testing of soil and solids
- (future goals) zodiac and motor for rapid lake and river delta sampling, portable spectrophotometer or voltmeter, drying oven and equipment for total suspended solids testing; capitalization for small assembly plant for household ceramic filters

52 people interviewed: 23 non-monitors, 29 monitor-trained

Monitors:

16 women, 13 men; mean age = 29 years

86 percent had at least some college

72 percent had science, agronomy or engineering background

76 percent were professionals or pre-professional

52 percent were urbanites

17 percent rural

31 percent between country and city

Non-monitors (control group)

15 men, 8 women; mean age = 27 years

83 percent had at least some college

22 percent had science, agronomy, or engineering background (**)

72 percent were professionals or pre-professional

26 percent were urbanites

8 percent were rural

65 percent between country and city (this was a more heavily f/t student group)

GAUGING CONCERNS OF RESPONDENTS

1 = "Doesn't concern me at all"

2 = "It worries me a little, but I rarely think about this"

3 = "I'm moderately worried about this"

1

2

3

4

5

4 = "I am pretty worried about this— I think it's important and it affects my morale and/or my finances"

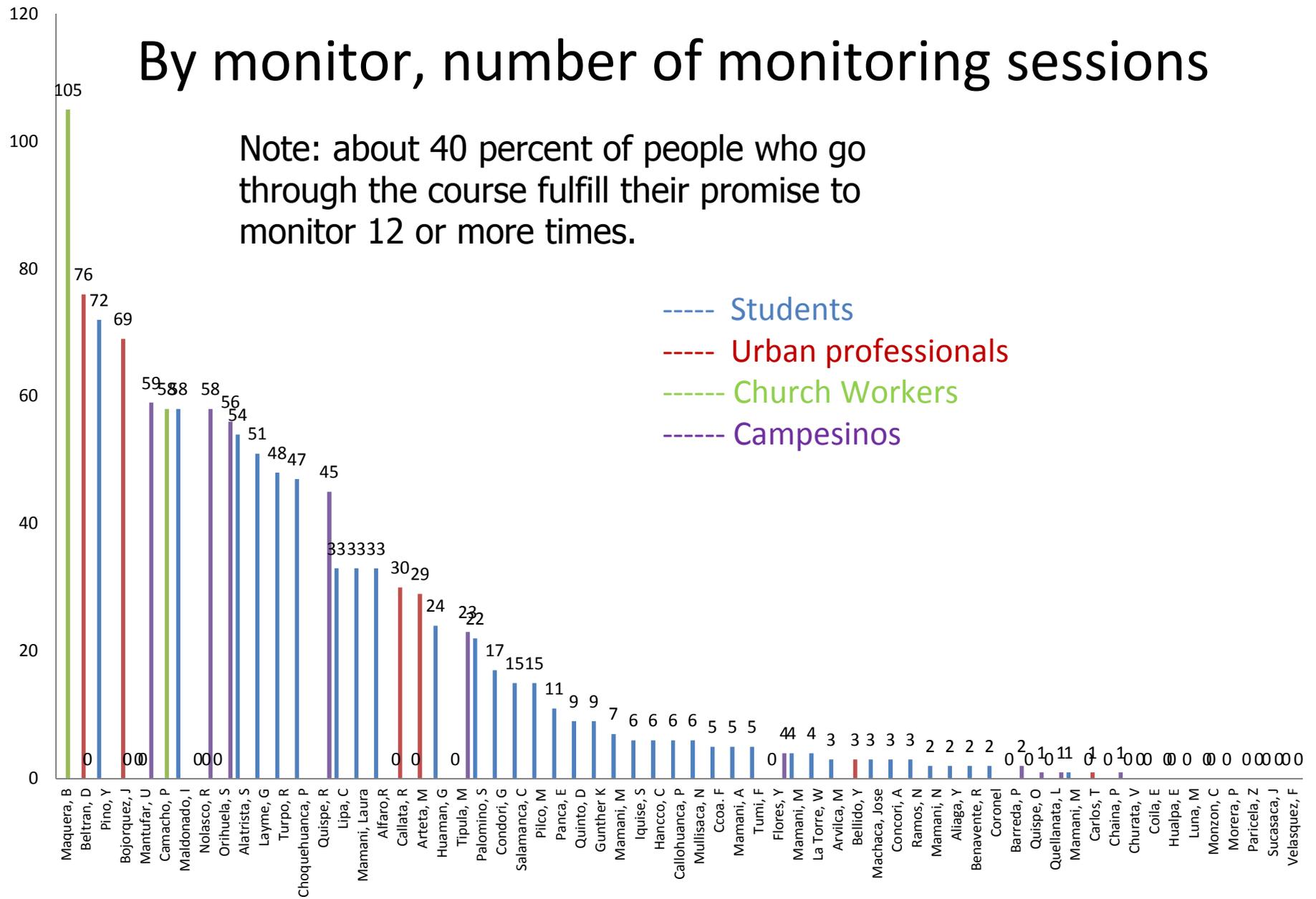
5 = "I am extremely worried about this— it affects me so much that I think about it on a daily basis"

What is your opinion on the environment in general?	4.115
What is your opinion about the environment in Puno?	4.260
Air quality	3.462
Soil conservation and profitability of land	3.846
Quantity and quality of water in rural wells	3.962
Quantity and quality of water in urban systems	4.000
Toxins in food	3.462
Biodiversity and wild species	3.904
Climate change	4.250
River flow	3.692
Level of the lake	3.981

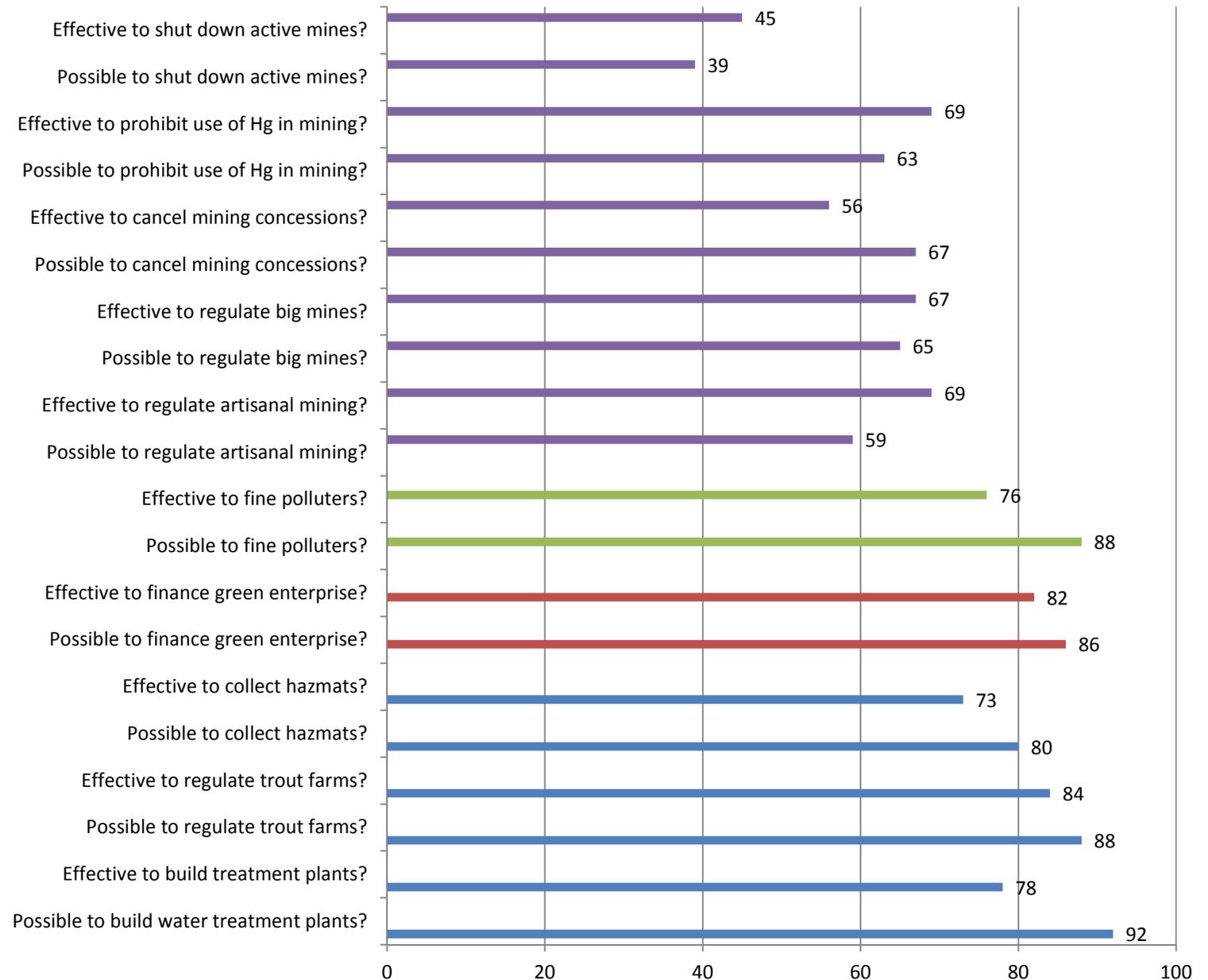
Note: means testing of summed scored showed no significant difference in level of concerns between those who were trained monitors and those who were not.

By monitor, number of monitoring sessions

Note: about 40 percent of people who go through the course fulfill their promise to monitor 12 or more times.



Measured in yes/no answers to specific questions, respondents seemed moderately optimistic about the viability of anti-pollution measures...



However, when asked to explain their views about who/what is responsible for stopping pollution, and whether government can or should respond to pollution, many expressed skepticism about the state's ability or inclination to regulate effectively.

Questions on civil society, collective action, the role of state and society

How do you view problems of pollution in the lake basin? Do you think that pollution is the inevitable/unavoidable price we must pay for prosperity?

Once Puno is more prosperous, will there be more attention at that point paid to cleaning up the environment?

What specific measures would make the most difference in combating pollution in the lake and the rivers feeding it?

What role should government have in cleaning up pollution or preventing it?

What role should civil society have in cleaning up pollution or preventing it? (if any role specified, then who are most likely actors? NGOs? The Catholic Church? Students? Mesas de concertacion? Chambers of commerce?)

What role should universities have in cleaning up pollution or preventing it?

What role should media have in cleaning up pollution or preventing it?

Do you think civil society can make government and/or political parties more responsive to pollution?

Families of responses

- “Modernizationist”— pollution comes with increasing income and consumption, but prosperity and functioning markets will lead to the adaptation of cleaner technologies
- “Accountability-seeker”— pollution is not the price of progress, but instead a process of deterioration; authorities can and should be held to account for pollution
- “Bottom-upper” – pollution is not the price of progress, but instead a process of deterioration. Government, however, is unlikely to respond to demands for a cleaner environment; instead, action should focus on neighborhood/community self-organization to stop pollution and promote green micro-enterprise

Does training in community-based water monitoring make a difference?

CAUSE/EFFECT QUIZ

Can you tell us some possible explanations for the following environmental and health problems? (stating "pollution" as a cause is not sufficient—please state what type of pollution and from what kind of activity)

Green scum and lentejas in bays and river mouths

Water that is opaque and grey

Mercury in fish

Stomach aches and diarrhea

No fish or very small fish yields

Rashes on skin after contact with water

Sick animals

Did those who took the monitoring course score better than those who did not? (One-way analysis of variance)

aggcauseeffect (course takers averaged 8.4 of 14 points; non-course takers averaged 6.2 of 12)

	Sum of Squares	Mean Square	F	Sig.
Between Groups	59.341	59.341	6.297	.015
Within Groups	471.179	9.424		
Total	530.519			

sum of science terminology score (course takers averaged 7.1 of 14 points; non-course takers averaged 2.83)

	Sum of Squares	Mean Square	F	Sig.
Between Groups	236.046	236.046	17.255	>.001
Within Groups	684.012	13.680		
Total	920.058			

Correlations: Did those who monitored more score better on watershed science questions? Did those who were more concerned about the environment score better on these questions?

	Aggregate cause/effect score	Aggregate basic science score
Number of times monitoring		
Pearson Correlation	.459 ***	.653***
Sig (2-tailed)	.001	.001
N	52	
Sum of Concerns		
Pearson Correlation	.225	.213
Sig (2-tailed)	.109	.659
N	52	52

*** Correlation is significant at the 0.01 level (2-tailed).

Did prior science training matter? (N=26)

ANOVA

Aggcauseeffect (science students scored average 8.4 of 14; nonscience scored 6.3)

	Sum of Squares	Mean Square	F	Sig.
Between Groups	58.173	58.173	6.158	.016
Within Groups	472.346	9.447		
Total	530.519			

Sum of science score (science students scored average 7.9 of 14; nonscience scored 2.9 of 12)

	Sum of Squares	Mean Square	F	Sig.
Between Groups	254.327	254.327	19.101	<.001
Within Groups	665.731	13.315		
Total	920.058	51		

For non-science background people, was there a correlation between the number of times people monitored and their performance on cause/effect and basic science terminology questions?

		number of times monitoring	aggcauseeffect	sum of science terminology score
number of times monitoring	Pearson Correlation	1	.395	.657**
	Sig. (2-tailed)		.051	.000
	N	25	25	25
aggcauseeffect	Pearson Correlation	.395	1	.549**
	Sig. (2-tailed)	.051		.005
	N	25	25	25
sum of science terminology score	Pearson Correlation	.657**	.549**	1
	Sig. (2-tailed)	.000	.005	
	N	25	25	25

** . Correlation is significant at the 0.01 level (2-tailed).

For science background people, was there a correlation between the number of times people monitored and their performance on cause/effect and basic science terminology questions? (N=26)

Correlations

		number of times monitoring	aggcauseeffect	sum of science terminology score
number of times monitoring	Pearson Correlation	1	.579**	.607**
	Sig. (2-tailed)		.002	.001
	N	26	26	26
aggcauseeffect	Pearson Correlation	.579**	1	.753**
	Sig. (2-tailed)	.002		.000
	N	26	26	26
sum of science terminology score	Pearson Correlation	.607**	.753**	1
	Sig. (2-tailed)	.001	.000	
	N	26	26	26

** . Correlation is significant at the 0.01 level (2-tailed).