



# Solutions Benefiting Life Institute Ltd.

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# Mission Statement

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Solutions Benefiting Life researches and develops sustainable household water systems that meet WHO standards on harmful bacteria. SBL filter systems are sustainable, low cost, efficient, and are designed to be produced and sold by local manufacturers in developing countries.



# 1<sup>st</sup> Generation Clay Water Filter

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*SBL Water Filter System*

- Simple to use
- Sustainable, clay system
- Bacteria count is Zero
- Flow rate 1.5 to 2 LPH
- Based on antibacterial action of colloidal silver



# SBL Facility

Water Analysis lab, Clay filter manufacturing lab and offices in new 5000 square foot facility in Sudbury, MA, USA.



*David and Arlene analyzing a pot shaped filter in the SBL Clay Lab*



*Hem looking through a Stereoscope in the SBL Water Lab*



# SBL Organization

**DR. KAMAL BAWA** is a Distinguished Professor of Biology at the University of Massachusetts, and Founder and Trustee and President of ATREE.



**JAMES CRISP** is a conservation biologist with 25 years experience working in the US, Central, and South America. As director of the Monteverde Conservation League in Costa Rica, he facilitated the purchase of over 60,000 acres of rain forest to create the first international children's rain forest. Mr. Crisp brings experience and understanding of environmental and socio-political issues impacting rural and developing communities and governments.

**CHRIS WALTER** is Founder and President of Yayla Tribal Rugs Inc., a carpet producer and distributor, and founder of Barakat Inc. Mr. Walter is Founder and Coordinator of Cultural Survival's special projects for the benefit of Ersari Turkmen refugees from northern Afghanistan and Tibetan refugees living in Nepal and India.



# SBL Organization

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**HEM K. POKHAREL** has B.S. in geography and a certificate in environmental studies from UMass, Boston. He also holds a B.S. in environmental science from Kathmandu University, Nepal. Hem is the project manager.

**ARLENE MACK Mc LAREN** is a volunteer at SBL. She is working on a field research and funding

**CHERI ARMSTRONG** currently works for both UVTech and Solutions Benefiting Life as an administrative manager.

**DAVID ELLIOTT** is the founder and president of SBL.

**LELIA ORRELL ELLISTON** is a Ph.D. candidate in the Environmental Biology Program at UMass Boston.

**MARTIN GAVIN** is a Registered Investment Advisor representative and is also licensed in Massachusetts as a broker in Insurance and Real Estate.

**EDWARD SCRIBNER** is the majority owner of Edward A. Scribner P.C., a certified public accounting firm.

**ELEANOR MURTAGH** is a student at MinuteMan Tech. She is helping SBL with water testing and analysis.



# Colloidal Silver Ceramic Filters for Household Water Treatment

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Preliminary Test Data By  
Hem K. Pokharel  
&  
David J. Elliott



# Clay Preparation

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Dry clay and sieved additives, like sawdust or rice husk, are mixed together with water.



*Dry clay and Sawdust being mixed.*



*Sawdust and clay mixed with water.*



# Filter Manufacturing

Molding, Drying, Firing, and Silvering

The clay and additive mix is pressed into a pot-shaped filter, dried for 4 days, fired, and then silvered.



*Hem Pressing filter in SBL Clay Lab*



*Kiln used to fire filters at SBL*

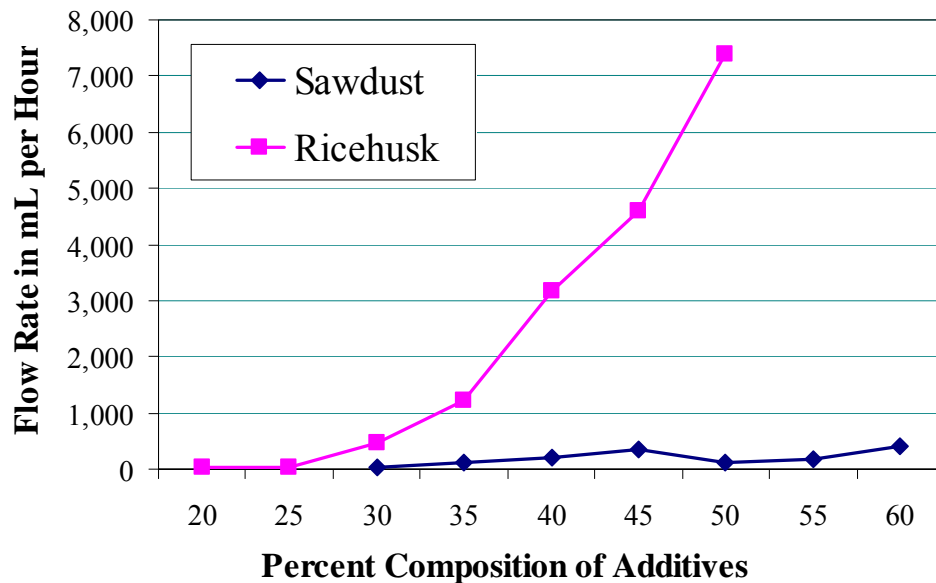


*Filter drying in SBL Clay Lab*



# Flow Rate Measurement

**Flow Rate vs. Percent Composition**



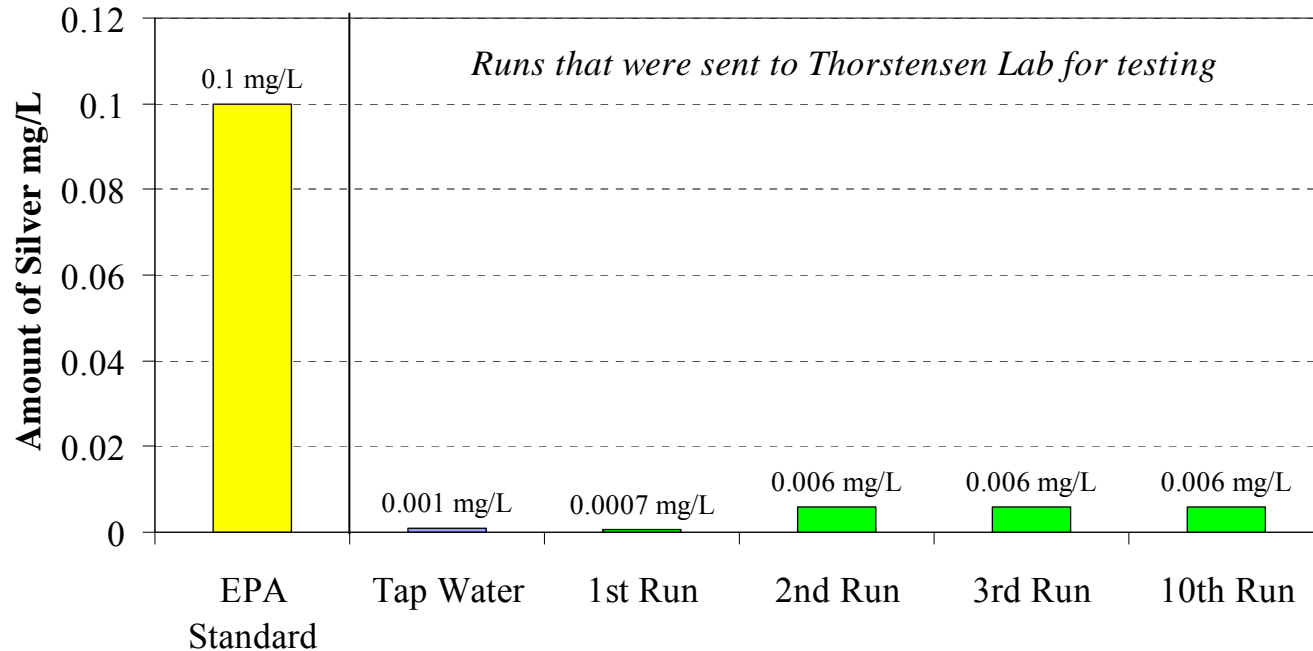
Percentage of Additives	Sawdust mL per Hour	Rice Husk mL per Hour
20%	NA	20
25%	NA	20
30%	15	460
35%	102.5	1215
40%	200	3183
45%	345	4600
50%	120	7400
55%	175	NA
60%	400	NA

Fired pots were tested for flow rate. The first generation filter was comprised of ground rice husk and clay – maximum flow rate was 7.4LPH.



# Silver Concentration in Filtered Water

at 2mL of 3.2% Colloidal Silver per 300mL of Water



The amount of silver found in the filtered water was well below the EPA standard. Colloidal silver concentrations in the filter could be increased 3x and the silver level in the filtered water would remain below the 0.1 mg/L maximum allowable level.



# Presence/Absence Test



Water samples collected from the Sudbury River were poured into a clay water filter, and then the filtered water was tested using the Presence/Absence test. Test results were negative, i.e. no colonies of bacteria were found.



# Test for E. Coli, Total Coliform, and H<sub>2</sub>S



- The Sudbury River water is passed through the filter and the filtered water is collected for testing.
- Filters were tested for E. coli, Fecal Coliform and H<sub>2</sub>S. Test results were negative for the presence of bacteria.

	<b>H<sub>2</sub>S Bacteria Test</b>	<b>Florescence Test for the presence/absence of E. coli</b>	<b>P/A Test results for E. coli and Total Coliform</b>
<b>Positive</b>	Black	Fluorescence	Murky Yellow
<b>Negative</b>	Yellow	No Fluorescence	Purple



# Membrane Filtration Test



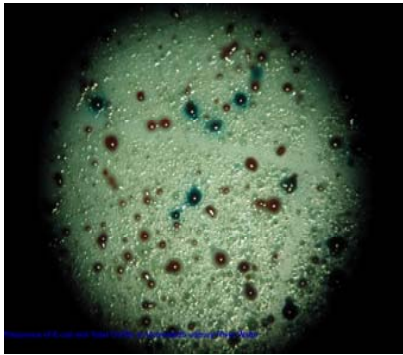
Membrane filtration test allows us to count the colonies of *E. coli* and Fecal coliform. SBL filtered water indicated no colonies of bacteria.

*Millipore Membrane Filtration Setup*



# Total Coliform and E. Coli Test

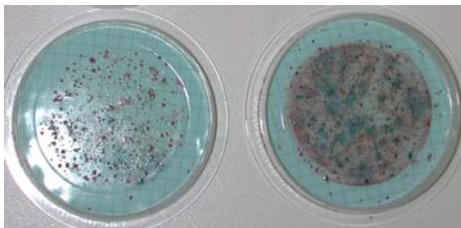
## 1<sup>st</sup> Generation Filter



*Colonies of total coliform bacteria obtained from the Sudbury River water 5 ml sample*

8140 colonies of bacteria were found in a 100mL sample of Sudbury River water. The number of colonies found in filtered water was zero.

Percent Composition	Sample Volume	Blue Colonies	Red Colonies	Total Colonies	% Efficiency of Filter
30% Rice Husk, 70% Clay	100mL	None	None	None	99.98%
30% Rice Husk, 70% Clay	100mL	None	None	None	99.98%
35% Rice Husk, 65% Clay	100mL	None	None	None	99.98%
35% Rice Husk, 65% Clay	100mL	None	None	None	99.98%
40% Rice Husk, 60% Clay	100mL	1	1	2	99.97%
40% Rice Husk, 60% Clay	100mL	1	2	3	99.96%
45% Rice Husk, 55% Clay	100mL	None	None	None	99.98%
45% Rice Husk, 55% Clay	100mL	None	3	3	99.96%
50% Rice Husk, 50% Clay	100mL	1	5	6	99.92%
Untreated Sudbury River Water	100mL	—	—	8140	N/A
Untreated Sudbury River Water	5mL	—	—	407	N/A



*Colonies obtained from 5ml and 100 ml of the Sudbury River water sample*

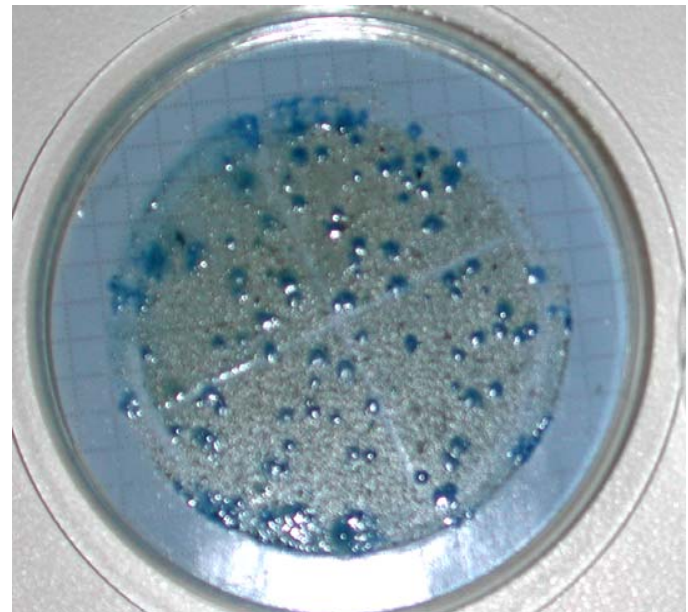
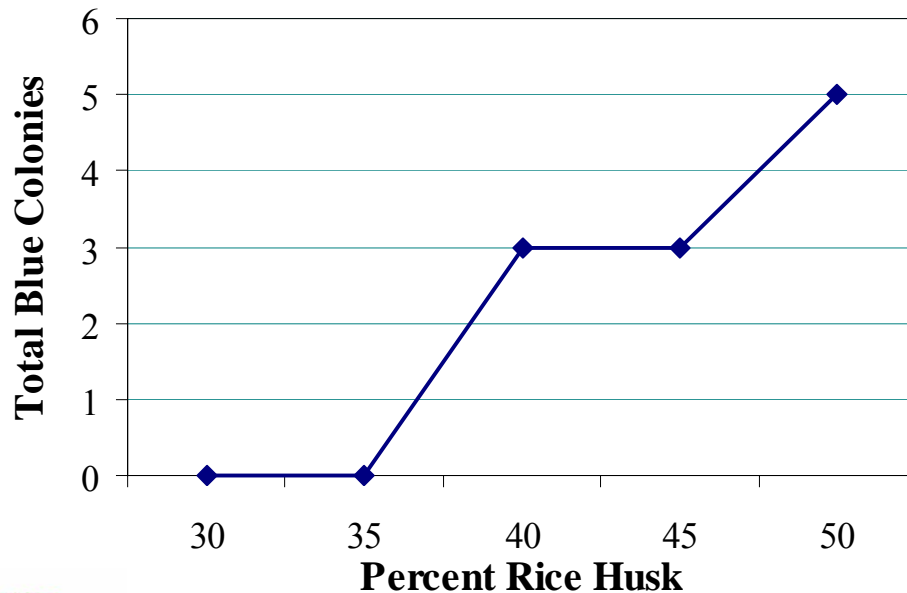


# Fecal Coliform Test

## 1<sup>st</sup> Generation Filter

Fecal coliform colonies are blue. Zero colonies were found until the filter composition reached 35% rice husk.

**Percent Composition of Rice Husk vs. Total Blue Colonies**



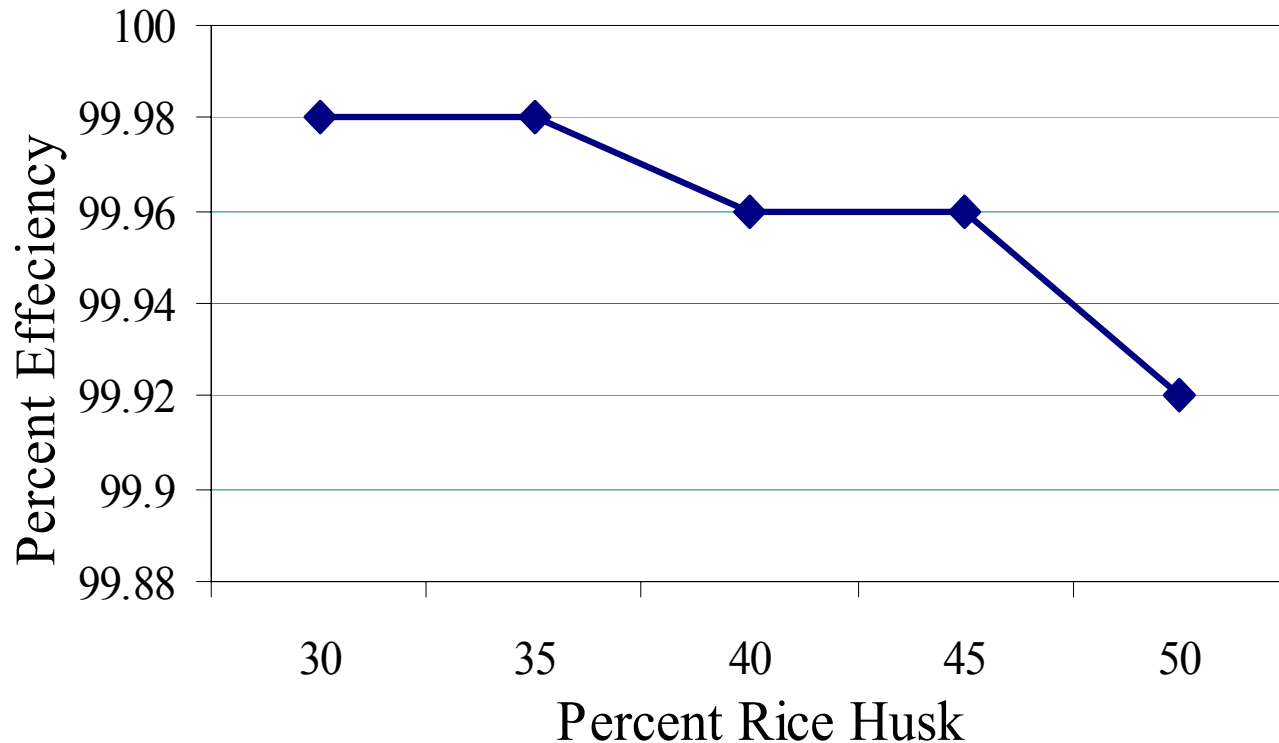
*Results of the fecal coliform test on the Sudbury River water.*



# Percent Efficiency of 1<sup>st</sup> Generation Clay Filter

at 2mL of 3.2% Colloidal Silver per 300mL of Water

The efficiency of filters at killing bacteria decreases with the increase in percentage of rice husk.



# Comparison of the Two Filter Designs

**First Generation**



**Second Generation**



Categories	1 <sup>st</sup> Generation Filter	2 <sup>nd</sup> Generation Filter
Filter Design	Pot Shaped Filter	Disk Filter Glazed or cemented into the Bottom of a Ceramic Cylinder
Filter Volume	1 Liter	2.5 Liters
Area of Filtration	Entire Pot	A Disk 4.7 inches in Diameter, & 0.5 inches Thick
Flow Rate	1.5-2 Liters per Hour	3-4.5 Liters per Hour
Composition	35% Rice Husk, 65% Red Clay	75% Sawdust, 25% Red Clay
Silver Solution Concentration	2mL of Ag per 300mL of Tap Water	10mL of Ag per 300mL of Tap Water
Fired Cone	Cone 08	Cone 04
Strength	Weak Lip on Pot	Very Strong
Bacteria Count	Zero Colonies Found	Zero Colonies Found



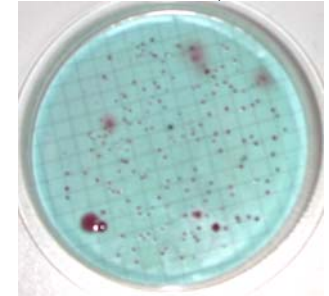
# Preliminary Test Results of 2<sup>nd</sup> Generation Clay Filter

at 10mL of 3.2% Colloidal Silver per 300mL of Water; Filter Composition: 75% Sawdust, 25% Red Clay

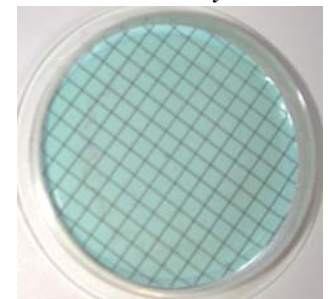
## Total Coliform Analysis

5/5/05	Thorstensen Laboratory	Sample Size	Number of Colonies
	Sudbury River Water	100mL	Too Numerous to Count
	1 <sup>st</sup> Run	100mL	0
	2 <sup>nd</sup> Run	100mL	0
5/9/05	SBL Laboratory	Sample Size	Number of Colonies
	Sudbury River Water	5mL	181
	Scaled to 100mL	100mL	3620
	3 <sup>rd</sup> Run	100mL	0
5/10/05	Thorstensen Laboratory	Sample Size	Number of Colonies
	Sudbury River Water	100mL	300
	4 <sup>th</sup> Run	100mL	25 <sup>1</sup>

Sudbury River Water  
SBL Laboratory

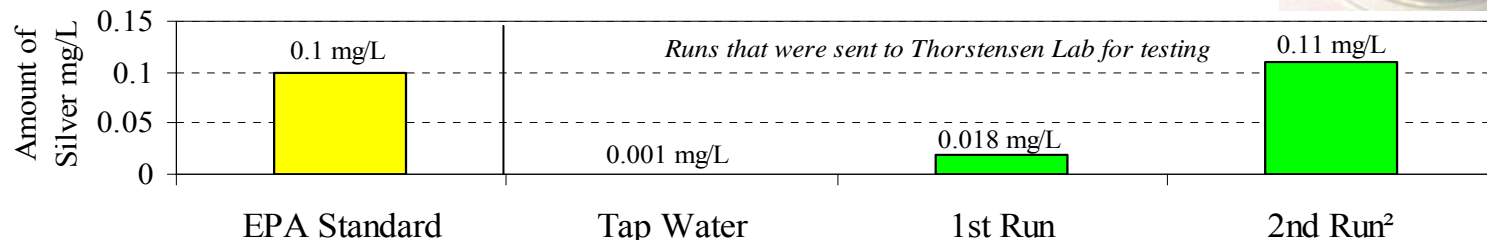


3<sup>rd</sup> Run of the Filter  
SBL Laboratory



<sup>1</sup> Improperly glazed causing incomplete seal, 1<sup>st</sup> batch

## Results of Silver Analysis



<sup>2</sup> Need data from more runs, silver concentration expected to decrease



# Summary

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- 1<sup>st</sup> Generation pot filter gave 1 liter volume with 1.5-2.0 LPH with 100% bacteria kill – all clay system
- 2<sup>nd</sup> Generation disc filter gives 2+ liter volume with 3.0-4.5 LPH flow and 100% bacteria kill – all clay system
- Cost of both systems is  $\approx$ \$4.00
  - SBL 2<sup>nd</sup> generation water system is manufactured on a potters wheel – no press



# Future Work

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- Increased number of filters in the field
- Conduct research on increased flow rate
- Scale design for larger volume
- Initiate and support local manufacturing of filters and receptacles



# Field Sites in India and Nepal

Nagadesh, Nepal  
Quazipur and Harijan Basti, India

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# India



*Hem testing water at Quazipur.*



*Local villagers drinking water out of a SBL filter.*

- Partner with Barakat\* Inc. and Mehabob Ali Barakat School.
- Continued distribution of filters in houses and schools
- Field Trip every 90 days
- Establish local office and storage at the work site



*Children at Memhabob Ali Barakat School at Quazipur.*



# India



*Local potter near Bhadohi.*



*Children in Bhadohi, a warm welcome.*

- Micro-business model used
- Local potter making SBL filter.
- Water testing in Harijan Basti and Quazipur.
- Women involved in manufacturing as well as distribution.



*Hem with Teachers at Mehabob Ali Barakat School.*

# Nepal

- SBL is a partner with Adarsha Youth Club, Madhyapur clay craft, Shree Ganesh Secondary school, Co-operative Saving and Community service and Nepal Ceramics Society.
- Establish local office and storage at the work site.
- Test water at work site.



*David and Hem with members of Adarsha Youth Club, president of Cooperative Savings, Thimi.*



*Teachers and students at Shree Ganesh Secondary school looking at SBL user manual.*



# Nepal



*Women attending SBL water filter workshop. They are ready to make clay water filters as a micro business.*



*David handing SBL filter system to Hari Govinda, SBL partner in Nepal.*



*David, with President of Nepal Ceramics Society, Hari and local villager.*



# Acknowledgements

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- **Ron Rivera** – Potters for Peace
- **Wally Owens** – Silver Shell Studio
- **Cheri Armstrong** – Solutions Benefiting Life
- **Arlene Mc.Laren** – Research Support SBL
- **Eleanor Murtagh** – Volunteer SBL
- **Jody Foster** – The Potter Shop and School Needham
- **Hari Govinda & Noor Alum** – Contacts in Nepal and India
- **Ron Millman Jr.** – UVTech Systems
- **Victoria Chaplick** – UVTech Systems

