Pure Home Water's Social Business
Tamale, Ghana

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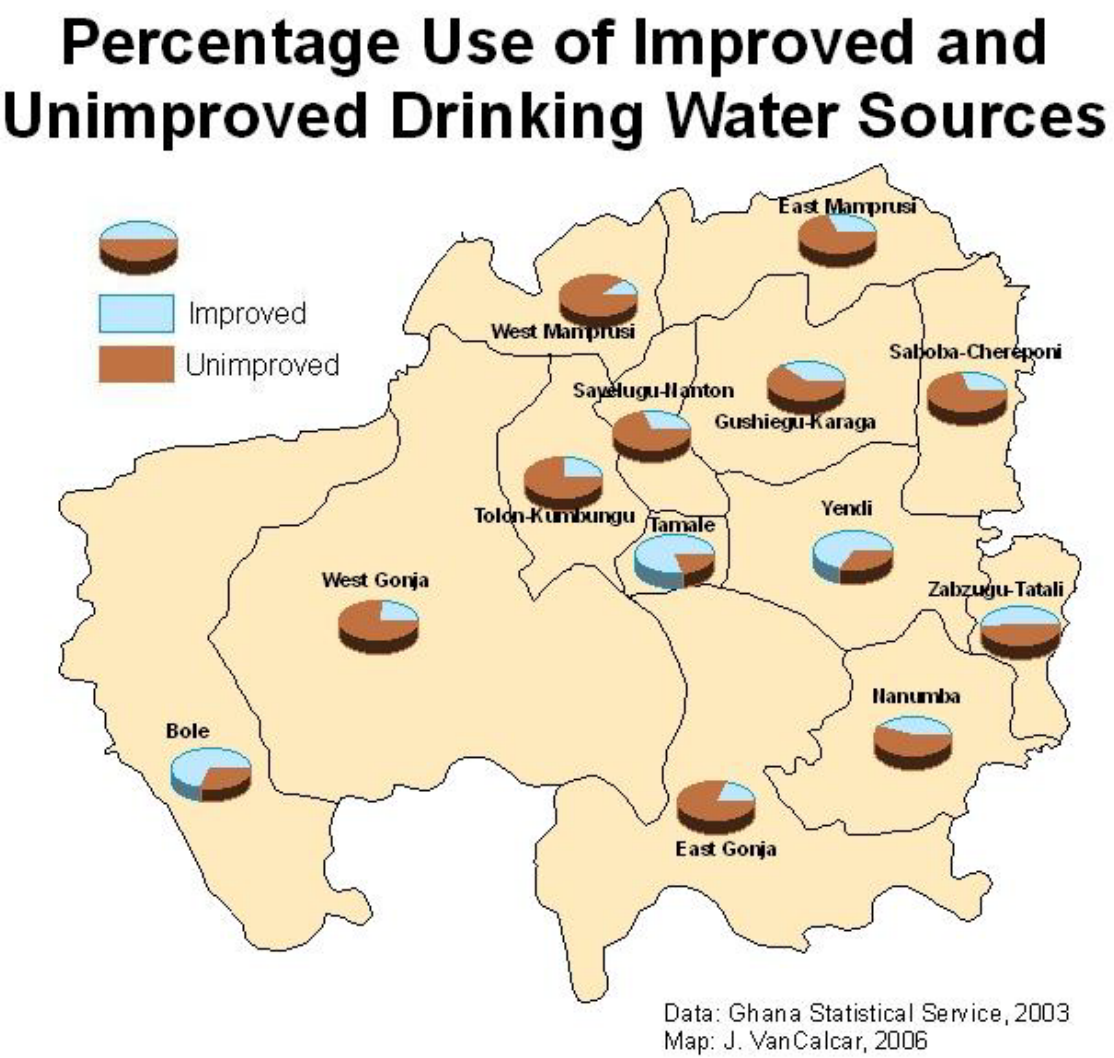
Master of Engineering Project Introduction
September 9, 2011

Credit: A.Dia

Ghana has big drinking water problems!

50 % (0.9 million out of 1.8 million people) in Northern Region, Ghana currently use unimproved sources

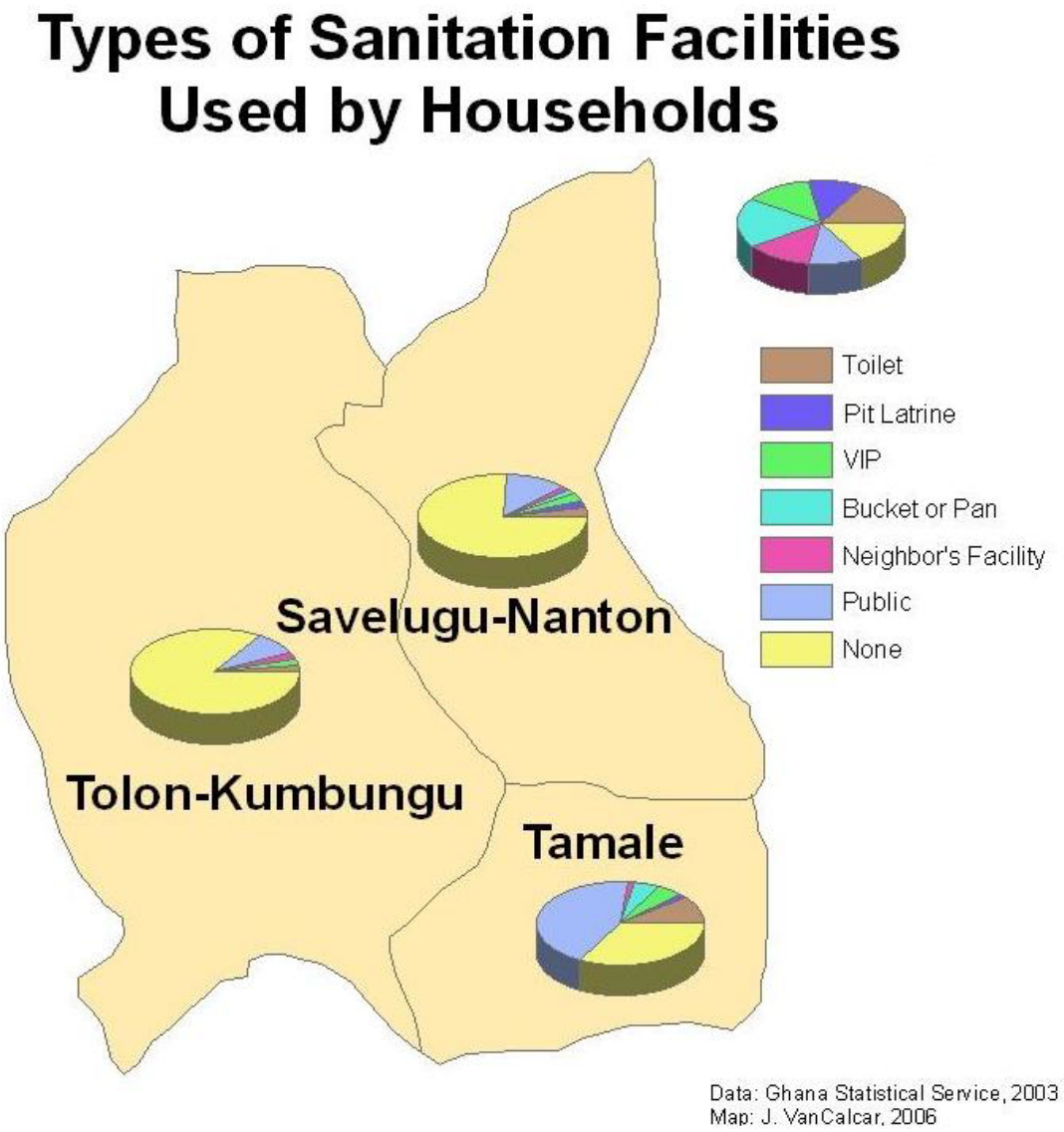


- Improved Sources
  - Boreholes
  - Household connection
  - Public standpipe
  - Rainwater harvesting
  - Protected springs and dug wells

- Unimproved Sources
  - All surface water sources
  - Unprotected springs and dug wells
  - Tanker trucks
  - Vendor water

SANITATION is even worse

- Ghana has the 4th lowest rate of sanitation coverage globally.*
- Many have no sanitation facilities (i.e. practice open defecation), including in the school and village bordering the Pure Home Water factory.



* (UNICEF/WHO, Progress Report on Sanitation and Water, 2010).

Typical Surface Water Source
Ghanasco Dugout, Tamale, Ghana

Ghanasco Dugout, Tamale

Credit: S.Murcott

Ghanasco Dugout, Tamale

Credit: Tamar Losleben

Ghanasco Dugout, Tamale

Credit: Tamar Losleben

Example of Water Quality Data for selected Tamale District Dugouts

Location	**Date (2006)**	***E. coli*** **(CFU per 100 mL)**	**Total Coliforms (CFU per 100 mL)**	**Turbidity (TU)**
Ghanasco Muali Dam, TD	20-Jun	169	6,621	~1,600
Kaleriga Dam, TD	22-Jun	754	13,475	> 2,000
Bipelar Dam, TD	27-Jun	100	21,667	38
St. Mary's Dam, TD	29-Jun	1,650	52,110	>2,000
Dungu Dam, TD	4-Jul	133	4,540	400
Libga Dam, SD	6-Jul	0	500	75
Bunglung Dam, SD	11-Jul	200	5117	300
Diare Dam, SD	13-Jul	0	3,417	23
Libga Dam, SD	17-Jul	50	1,408	50
Gbanyami Dam, TD	19-Jul	367	19,150	~1,000
Vitting Dam, TD	25-Jul	1,400	12,767	~125
Average		**438**	**12,797**	**690**

By any standard, this water should be considered unacceptable for drinking!

On the bright side, Ghana has successfully eradicated guinea worm in 2011!!!

Photo: Braimah Apambire, World Vision

Guinea Worm Eradication Campaign: Working with the Ghana Ministry of Health over a period of several decades, the Carter Center, headed in Ghana by Jim Niquette (below), points out the districts with remaining cases of guinea worm in Northern Ghana

Success!!! It was through a successful partnership (Ghana Ministry of Health and the Carter Center), through meticulous data collection and village- by-village and house-by-house surveillance, and through a focused 5-point campaign that the team has been able to eradicate guinea worm from Ghana!

Pure Home Water

- Pure Home Water (PHW): a social enterprise founded in 2005 to provide safe drinking water in Northern Ghana.

PHW has 2 goals:

1. Reach people most in need of safe drinking water in Northern Ghana, the poorest part of Ghana, esp. by applying household drinking water treatment and safe storage solutions.
2. Become financially and locally self-sustaining

What are Household Drinking Water Treatment and Safe Storage Technologies?

Traditional unsafe storage

Kosim Ceramic Filter
Pure Home Water, Ghana

Post-tap filter for "luxury water"

A cluster of innovative technologies invented and disseminated only within the last few to 15 years that are explicitly designed to address the safe water needs of more than one billion people at the bottom of the economic pyramid.

They are distinct from 1st World post-tap devices that give "luxury water" to the rich, or to traditional water management practices, that may or may not give safe water.

Where is Pure Home Water?

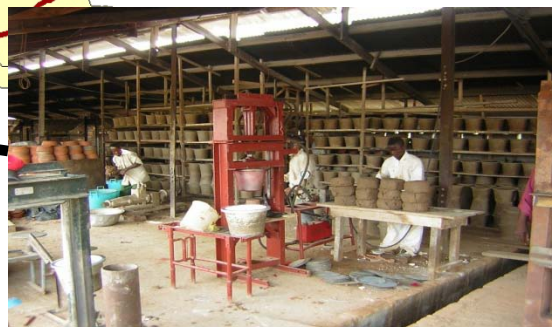
Bad Roads,

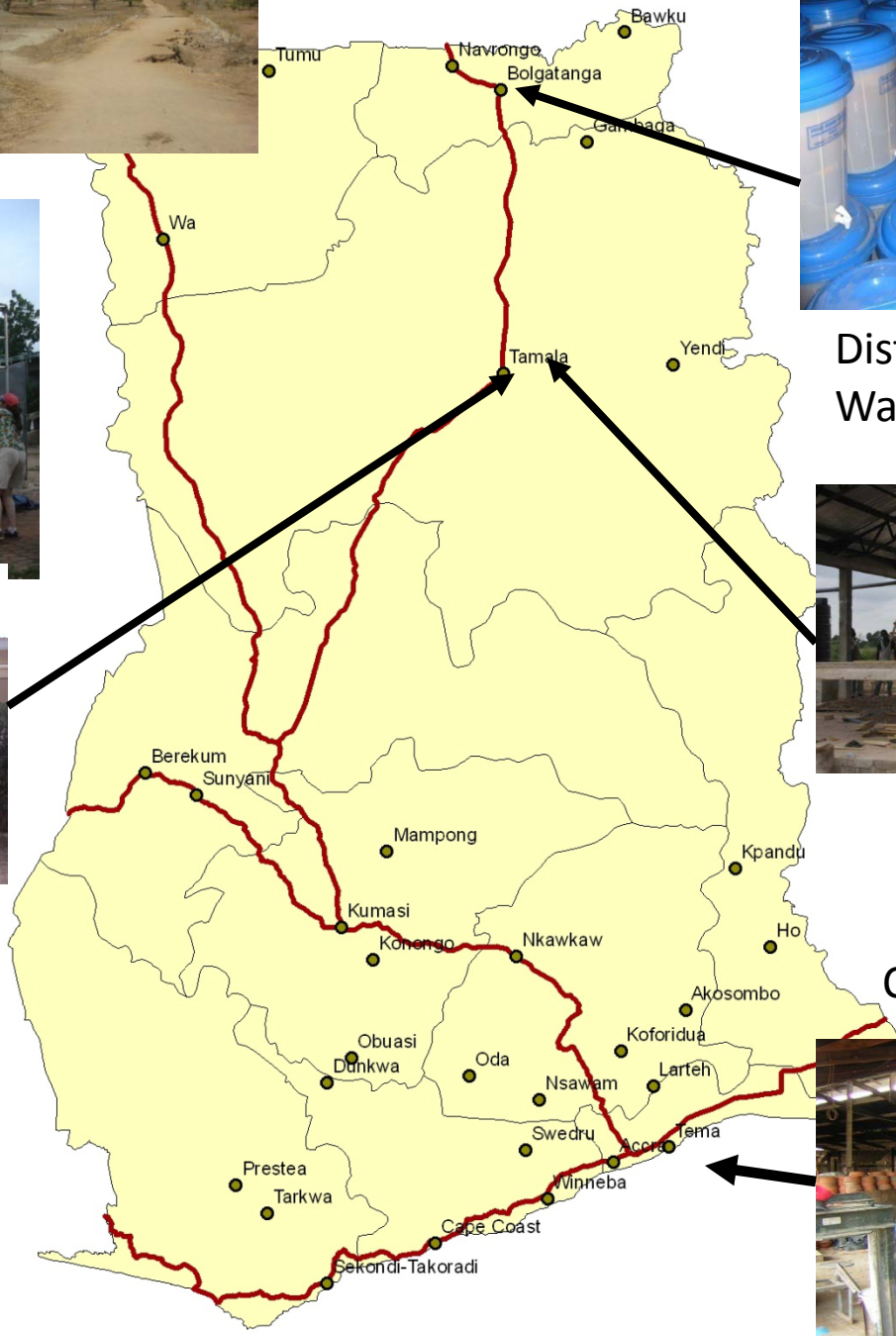
Pure Home Water Office/House

District Gov't Warehouses

Pure Home Water Factory

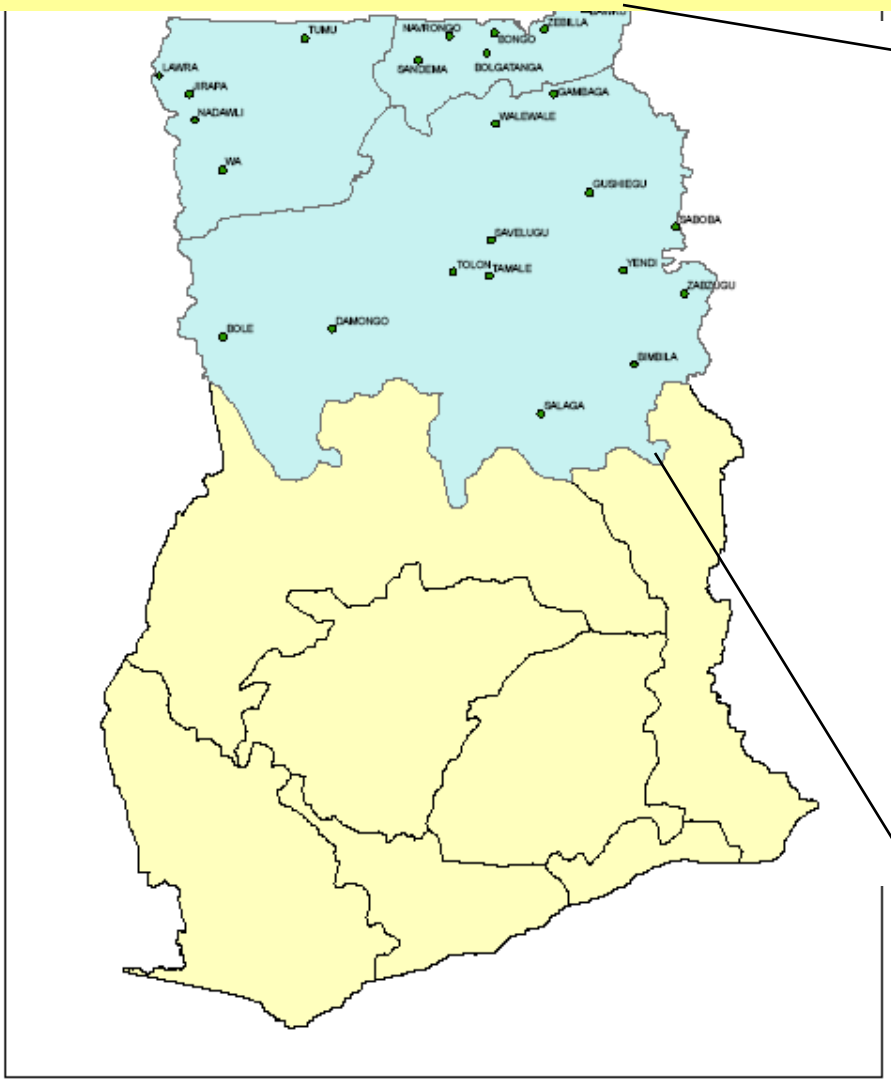
Ceramica Tamakloe

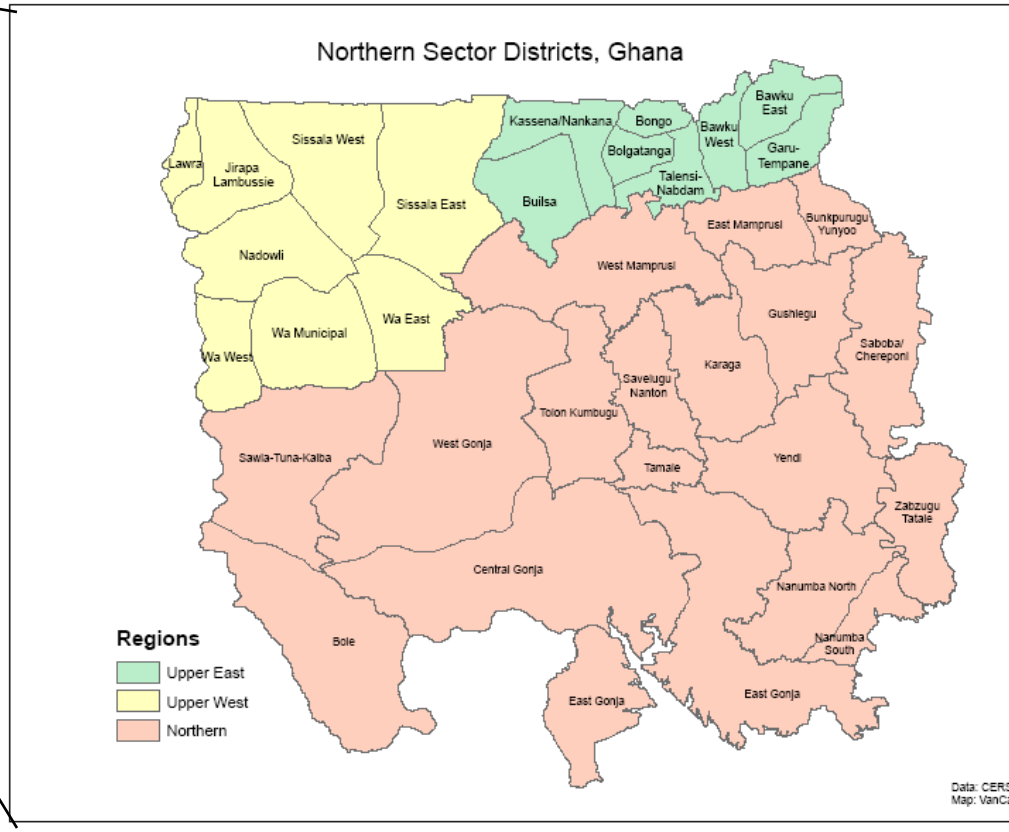




Northern Sector - Target Area of Pure Home Water

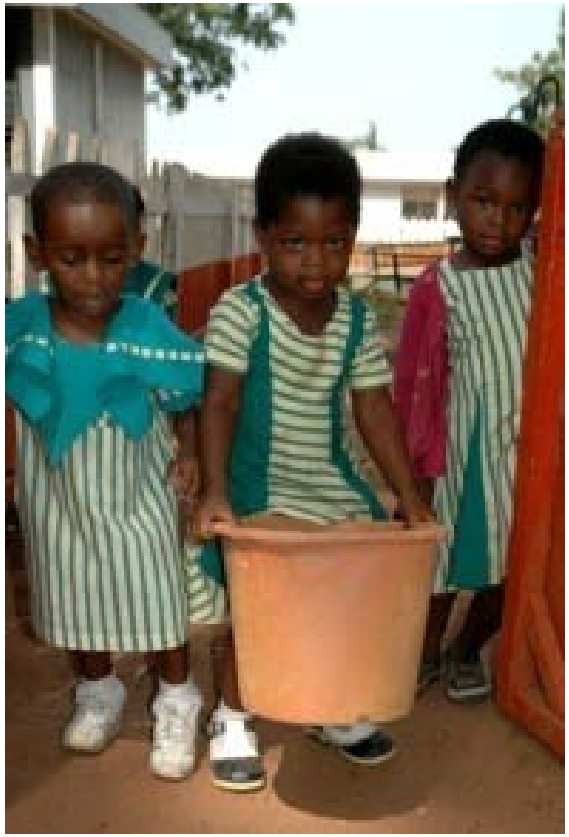
Sales & Distribution





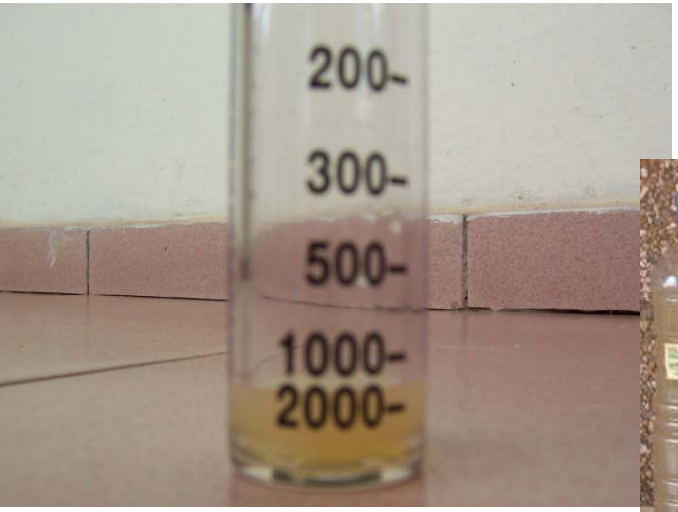
MIT and Ghanaian students and professionals have been assisting Pure Home Water in building a social business in Northern Ghana since 2005

Our 1st Product*: Kosim* Ceramic Pot Filter



Why did we choose a ceramic pot filter?

- Extremely high turbidity, even in dry season, in the widely used surface water supplies



Turbidty Test (NTU)

Why did we choose a ceramic pot filter?

- Culturally compatible – rural water in Ghana is universally stored in large clay vessels

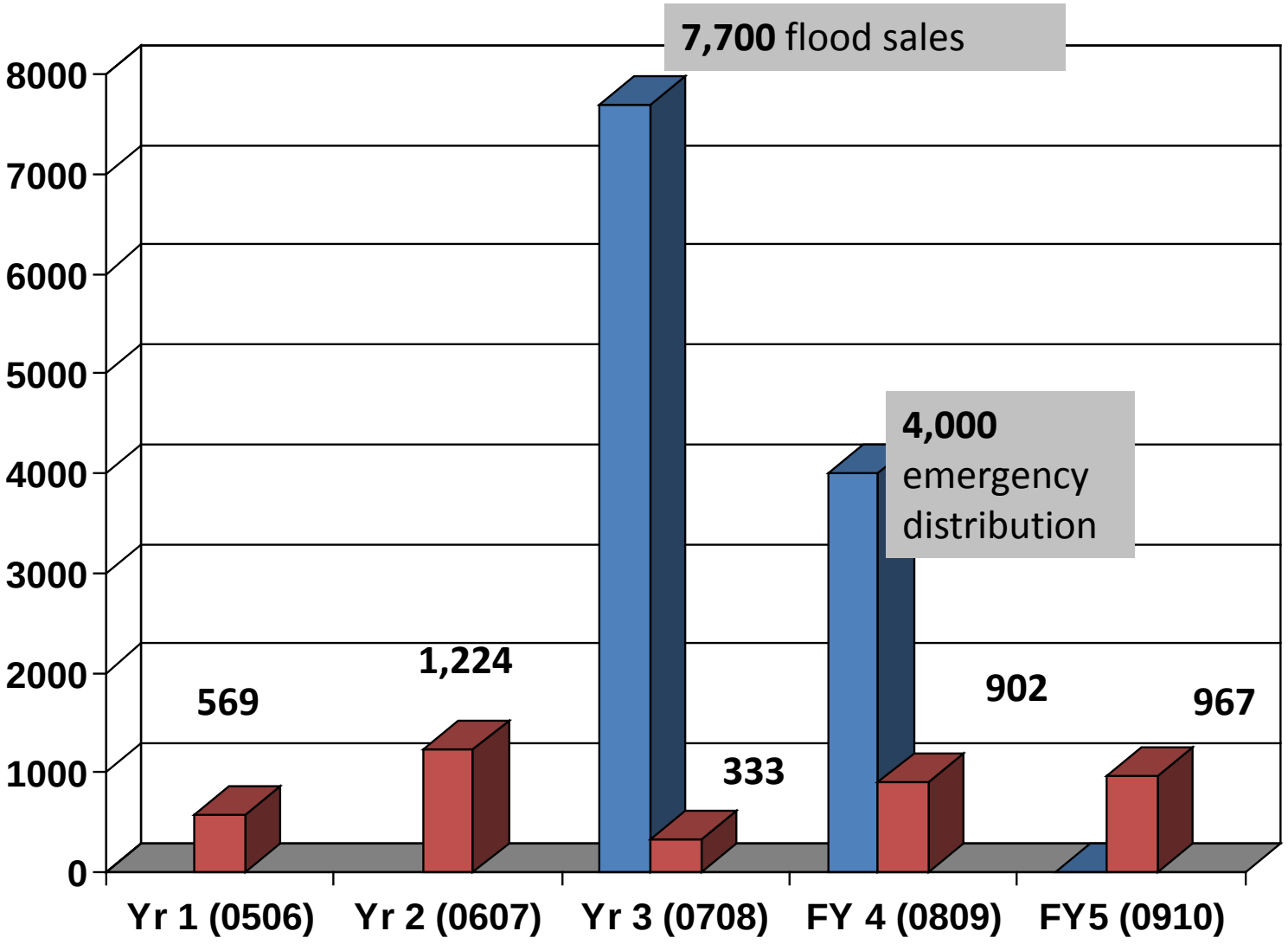
Credit: Rachel Peletz

Because it works!
Before and After

Credit: Alexandr Nishichenko

Accomplishments: Pure Home Water Filter Sales (2005 – 2010)

We have reached over 100,000 people to date!



of People Reached

(July ‘05 to Dec. ‘10)

	Units Sold	People per HH	# People Reached
Urban/Retail	4,108	6	24,648
Emergency (free)	11,820	6	70,920
Schools & Clinics (free)	115	40	4,600
Intern’l-Burkina Faso	200	6	1,200
TOTAL	16,243		***101,368***

2008 Flood Distribution

- 5,500 filters sold by PHW to UNICEF and Oxfam in Nov. 2007
- 2000 Distributed to end user by PHW, remainder by NGO or Government (Jan. – April, 2008)
- Free of charge
- PHW has monitored > 1,000 filters in households (June – Aug, 2008)

(Credit: M.Stevenson)

2009 Guinea Worm Distribution - 4000 Filters Training, Dissemination, Monitoring

Woman from Yesapi, Central Gonja, with bandage covering guinea worm- infected foot

Pure Home Water's Present & Future Plans (2011 – 2015)

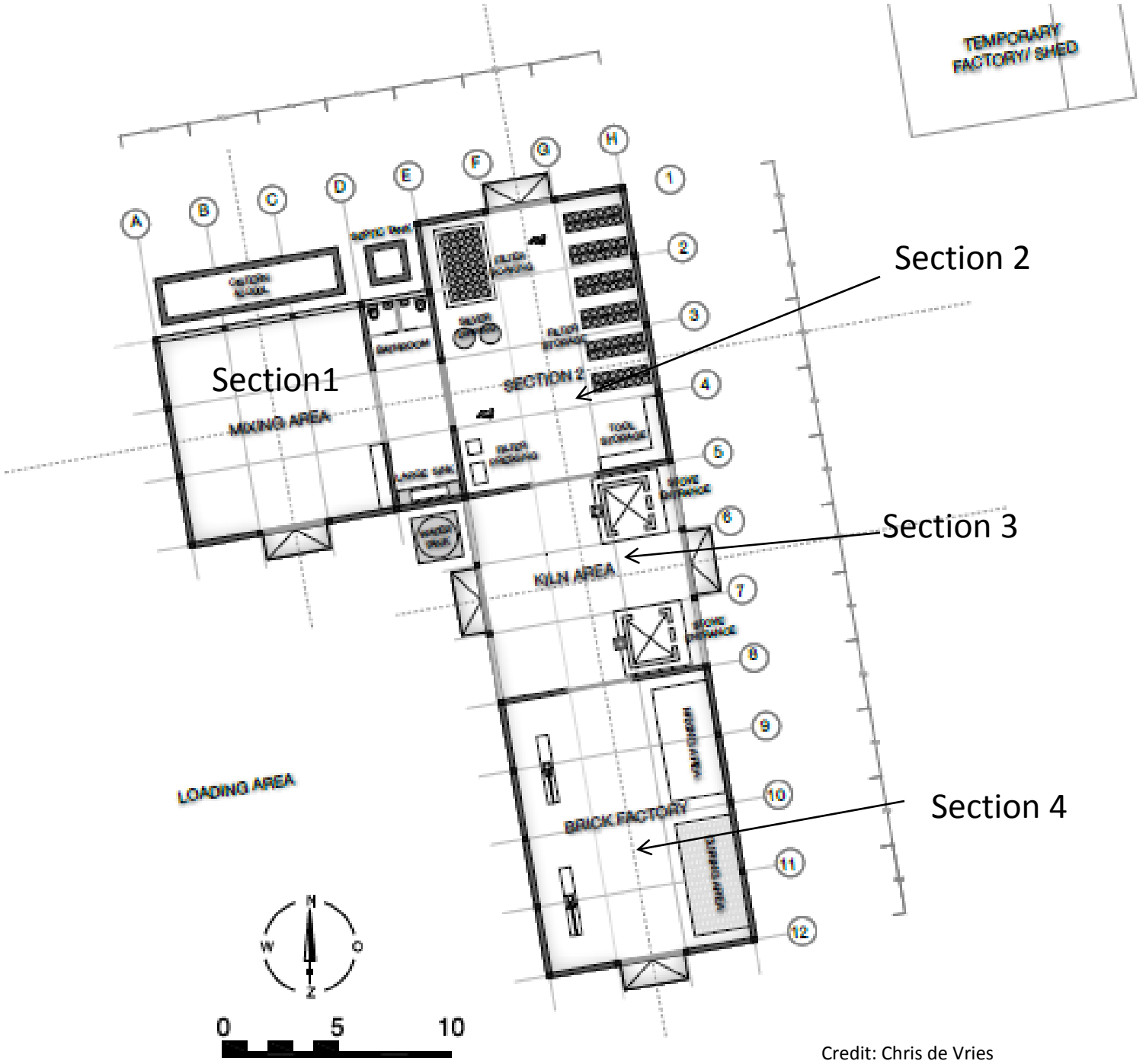
- Complete filter factory in 2011
- Produce quality filters
- Focus on building markets and distribution channels
  - Kiosks/retail outlets
  - Business capacity development
- Extend reach in urban Ghana with new products , including sanitation and hygiene products

Our factory is on the map!

Close-up of Factory Land from Google Earth

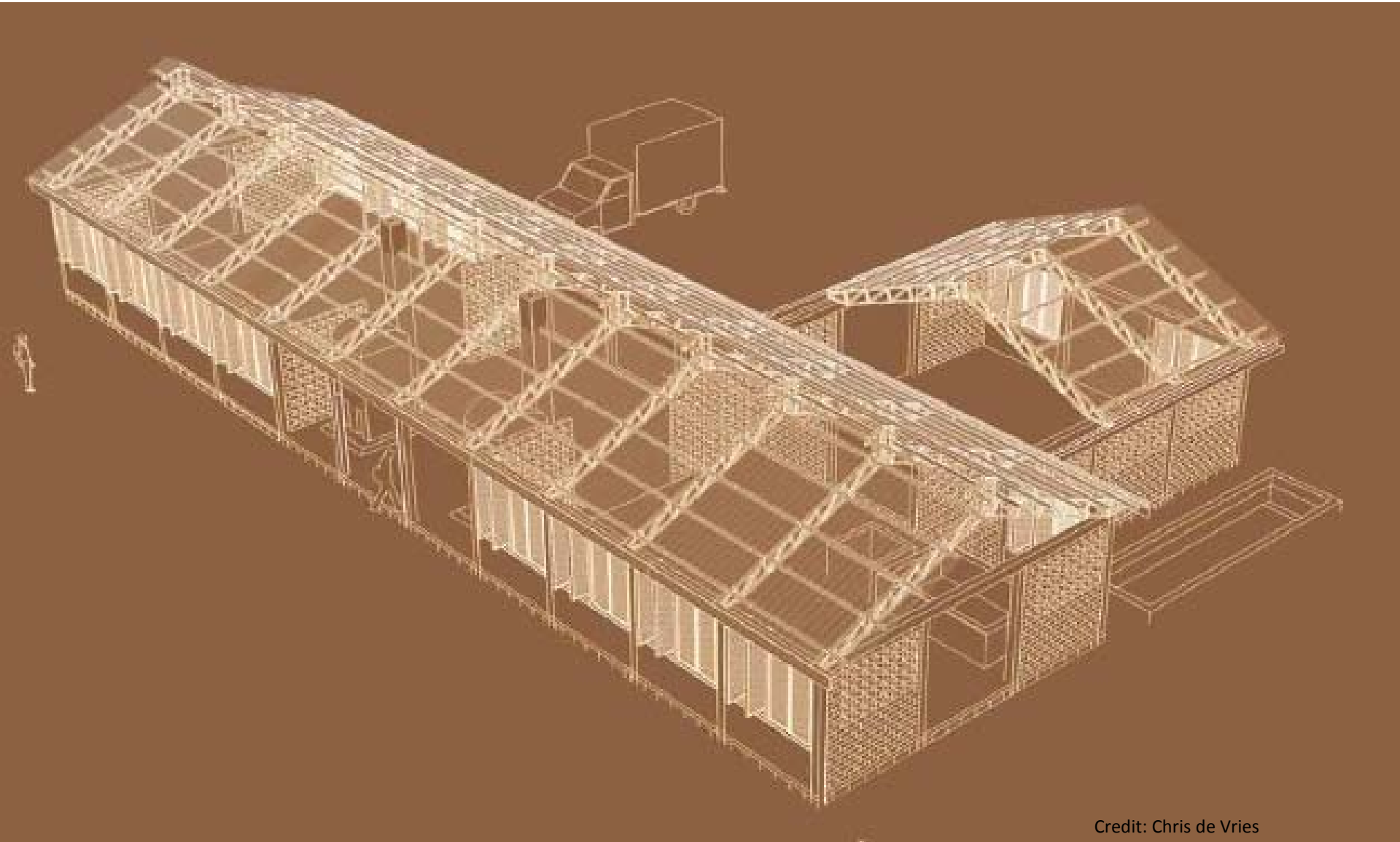
Plan Layout

August 2010



Credit: Chris de Vries

Factory Architectural Design Plan



Credit: Chris de Vries

Status of factory construction – July 2010

Credit: Chris de Vries

Factory Construction – August 2010

Credit: C. DeVries

Pure Home Water & MIT Team Jan. 2011

During Jan. 2011 we made progress on completing our big kiln, filter drying racks, soaking tank, laying the foundation for the big rainwater harvesting tank and constructing an EcoSan latrine

Factory - January 2011

Showing rammed earth blocks produced on site for construction & sale

As of summer 2011, we have completed the factory windows and doors and the rainwater tank

We received our first orders and began full-scale production in March 2011

But, we were confronted by various challenges that forced us to slow down and address each problem step-by- step

Uneven stacking

Cracked Lip

Carbon staining

And more challenges with the press and kiln!

Uneven pressing

Incomplete firing

Goals for MIT-M.Eng. Ghana – Pure Home Water Collaboration (2011-2012)

- Assist PHW in achieving good quality control procedures
- Evaluate household drinking water treatment and safe storage (HWTS) products to be marketed in new water/sanitation/hygiene (WASH) distribution center(s)
- Determine, through surveys, sustained filter use and behavior change
- Identify low-cost sanitation technologies

Potential M.Eng. Ghana Projects with Pure Home Water (2011 – 2012)

1. Hemispheric Filter Evaluation
2. Flow and Surface Loading Rate Analysis
3. Bacterial Monitoring Method for PHW Factory/Lab
4. Survey of Sustained Filter Use & Behavior Change
5. Redesign of Ceramic Filters for Fluoride and/or Arsenic Removal
6. Comparison of Selected Household Drinking Water Treatment and Safe Storage Options for Marketing & Sales in Ghana
7. Low-Cost Sanitation Technology Options for Ghana

Project # 1: Hemisphere filter evaluation

Credit: Curt & Cathy Bradner

Paraboloid & flower pot design currently produced at Pure Home Water factory

Credit: Steve Buchele

Existing Presses & Molds & New Press/Mold

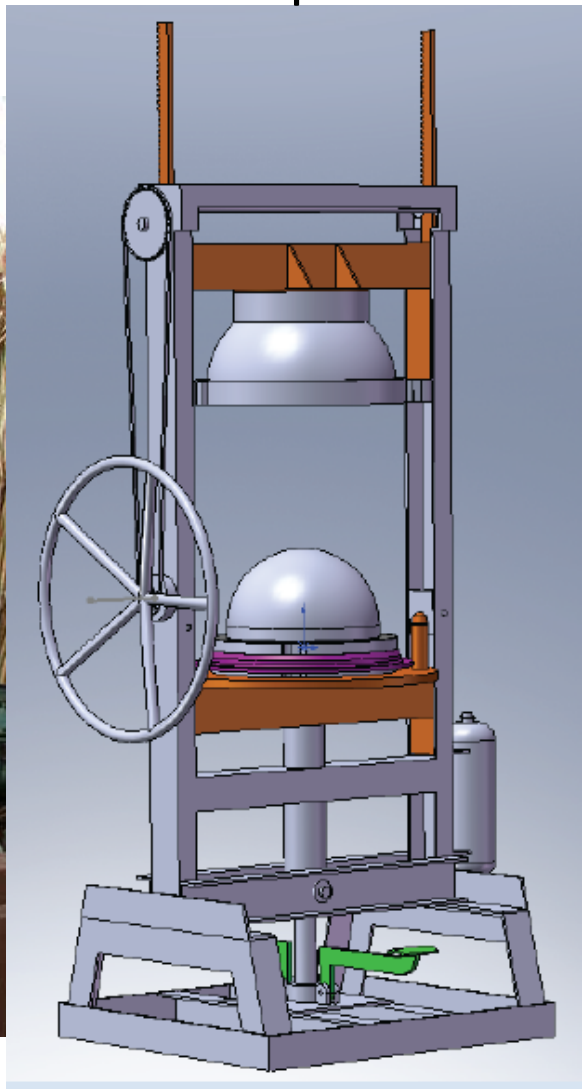
Flower pot

Credit: Leah Nation

Paraboloid

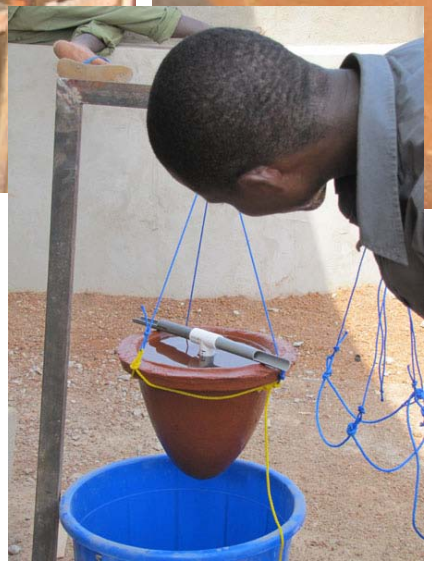
Credit: Steve Buchele

Hemisphere



Credit: Reed and Blair Miller

Project # 2: Flow & Surface Loading Rate Analysis



Credit: Curt & Cathy Bradner

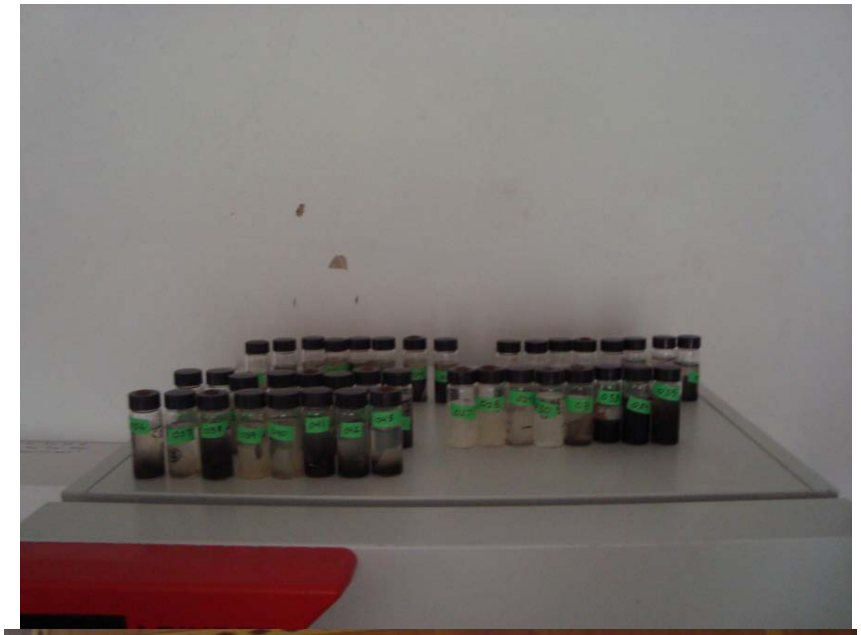
Results in M.Eng 2011 Group Report

Comparison of Filter Design Variables

Shape	Bucket, ID (in)	r_T (cm)	r_B (cm)	H (cm)	V (L)	t (cm)	Q (L/hr)	SLR (L/hr/m^2)
Flower Pot: Current Design	11.7	10.90	7.35	19.7	5.2	1.5	2.14	16.28
Paraboloid: Current Design	12.8	12.30	-	21.0	5.0	1.5	1.65	13.78
Flower Pot: New Design	14.6	16.24	12.64	20.0	13.2	1.67	3.84	16.38
Paraboloid: New Design	14.6	16.24	-	36.6	15.1	1.67	5.61	21.19
Hemispheric: New Design	14.6	16.24	-	16.2	9.0	1.67	5.65	34.13

Flow Rate Testing Set-up

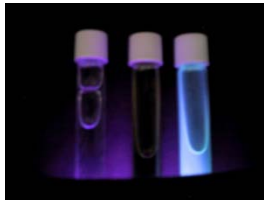
#3. Bacterial Water Quality Testing for Filter Evaluation



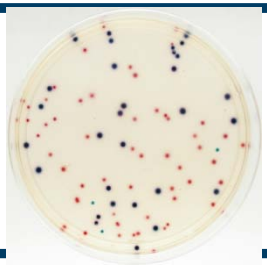
Bacterial testing at Pure Home Water lab during January 2011.

Bacterial Methods Evaluated So Far…

Colilert – 10 ml P/A + 3M PetriFilm



EasyGel



QuantiTray - MPN –

H2S

Membrane Filtration

We seek a new project to establish the best bacterial water quality test method(s) for the Pure Home Water factory and others.

#4 Sustained Filter Use and Behavior Change

Community Demonstration of Ceramic Filter

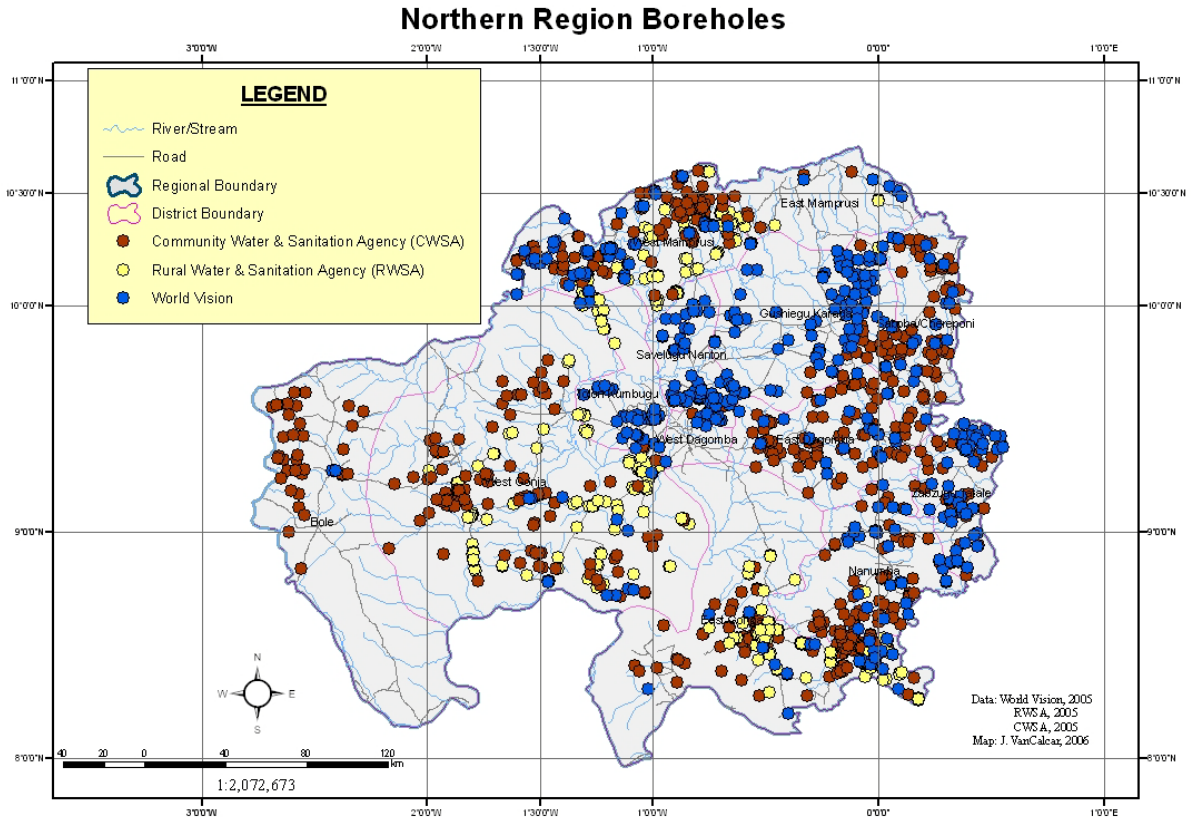
#5 Ceramic Pot Modification for Fluoride or/or Arsenic Removal

Skeletal Fluorosis

Arsenicosis

Dental Fluorosis

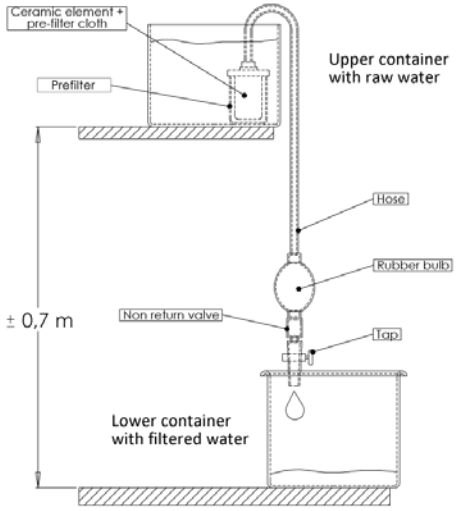
In addition to micobial contaminants in drinking water, some borehole wells in Ghana have high fluoride or arsenic



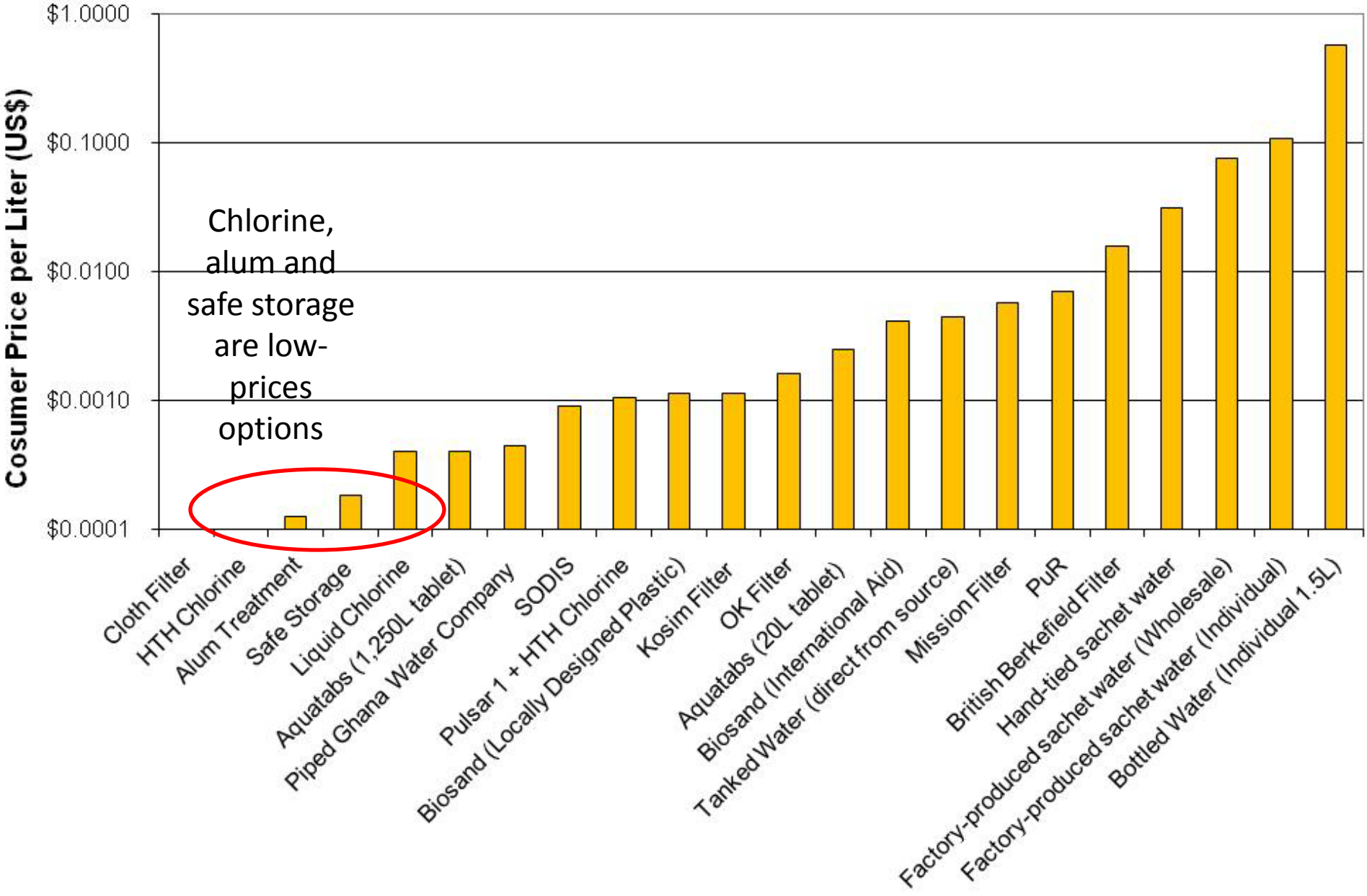
Some Possible Fluoride or Arsenic Adsorption Media (low cost, locally available in Ghana)

- Laterite: acidic red clay soil abundant in the tropics, with typical pH of 4-5; comprised of hydrous oxides of iron and aluminum, with minor proportions of manganese and titanium;
- Bauxite tailings
- Bone char

#6. Performance Comparison and Recommendation of Household Drinking Water Treatment Products for Regional Distribution Center



Comparison of Water Option Costs



#7 Low-cost, Marketable Sanitation Technology Options

SanPlat – standard model

EcoSan toilet ranged in price from $380 - $680!

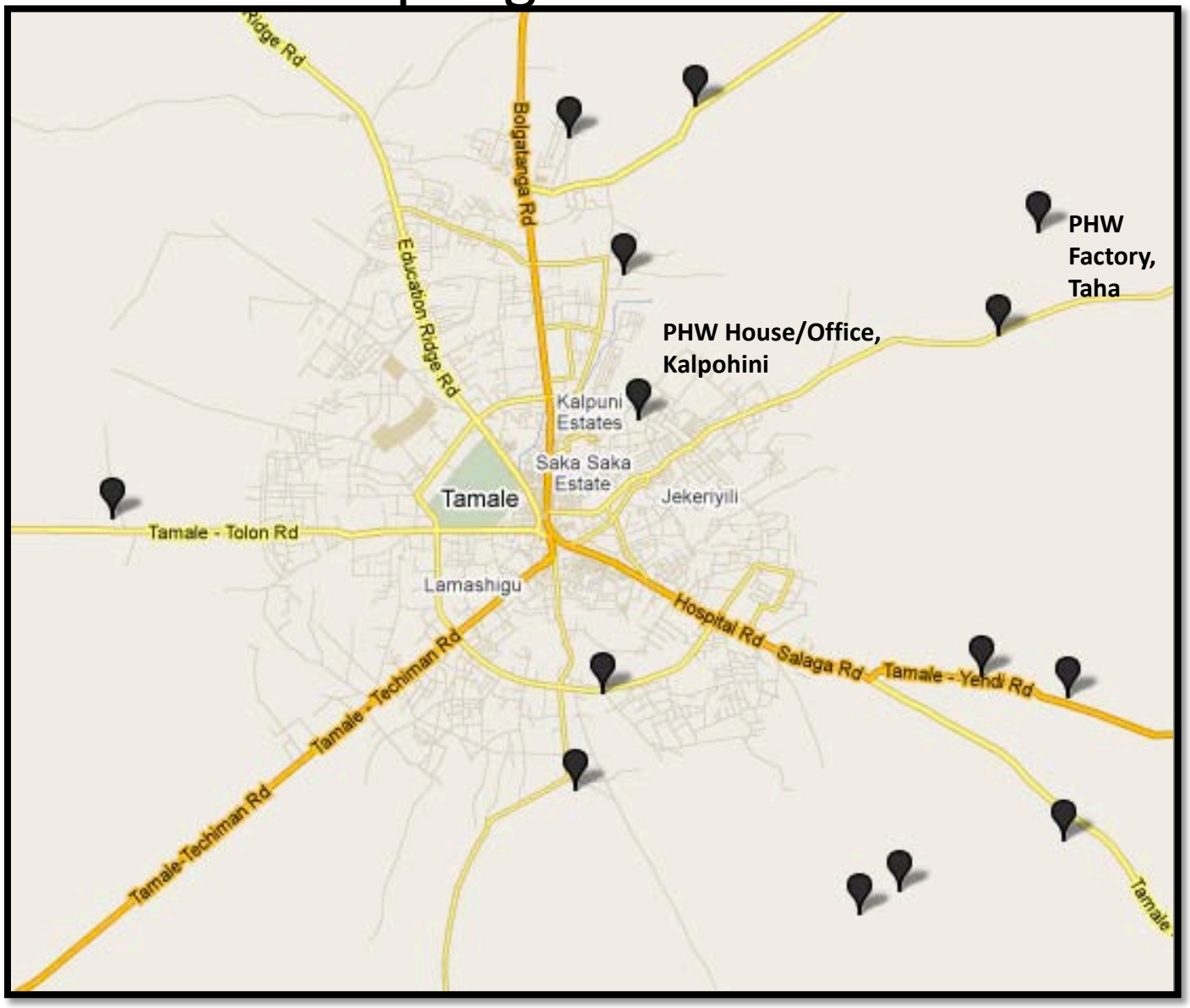
?

Pre-fab “Sanergy” model?

Other potential M.Eng Ghana Projects…

8. Health impact study
9. Solid waste management plan
10. Tippy tap hand-washing station survey and recommendations
11. Mechanical equipment construction – mixer, hammer mill, pug mill,
12. Design and build new kiln
13. Your ideas?

Pure Home Water House/Office & Factory and some Water Sampling Locations



Living accommodations while in Ghana: Pure Home Water has a house for office, sales, residence, lab, stock, and a small shop

Summer 2010 Construction

Credit: Chris de Vries

Taha Women fetching water

Credit: Josh Hester

For More Information

http://web.mit.edu/watsan/meng_ghana.html

http://www.purehomeh2o.com

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