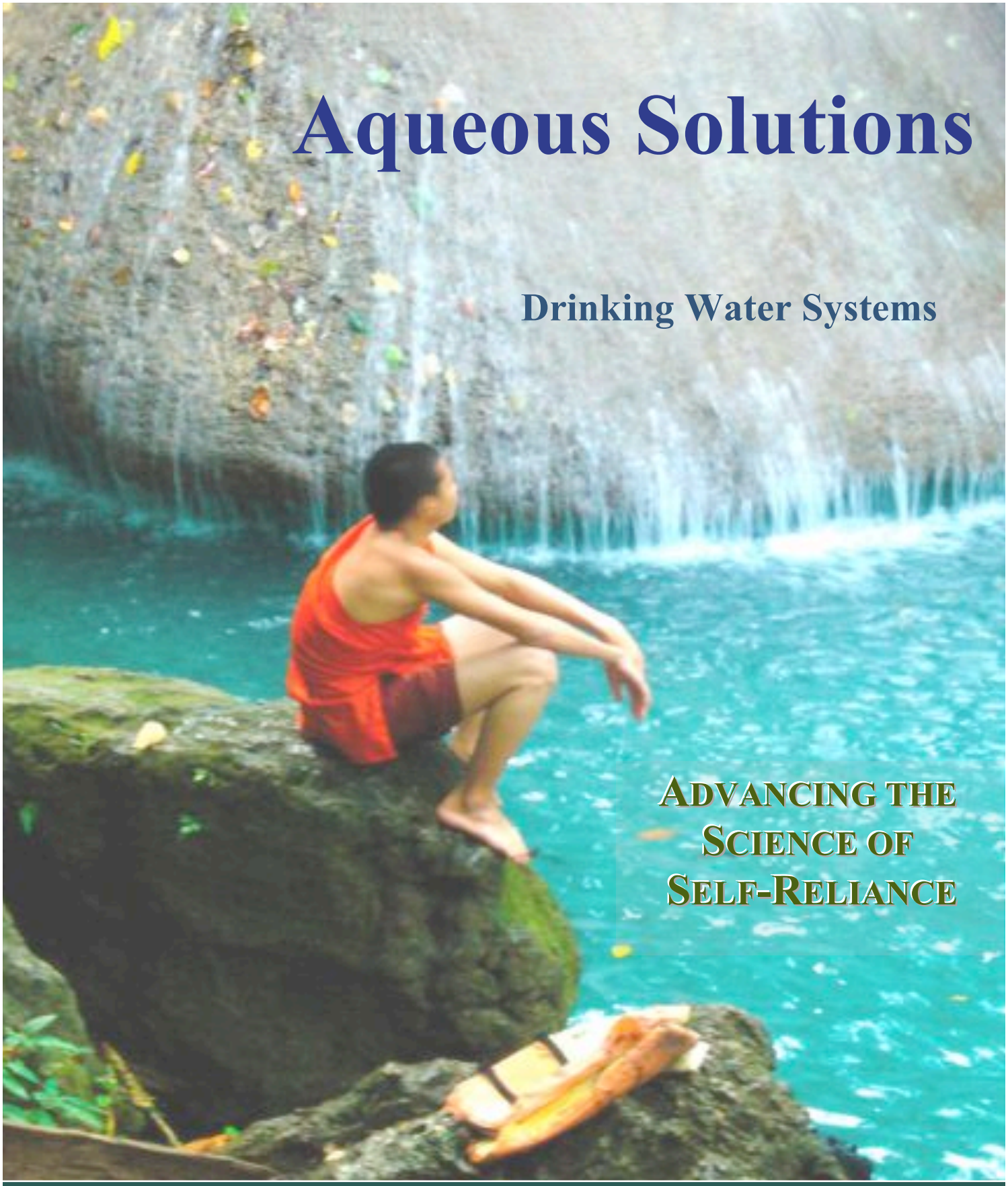


Aqueous Solutions

Drinking Water Systems

ADVANCING THE SCIENCE OF SELF-RELIANCE

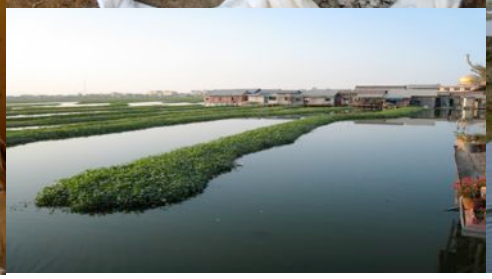
ANNUAL REPORT 2008-2009

Mission

Each year, hundreds of millions of tons of pesticides are applied widely and intensively in agricultural zones around the globe.

Many of these chemicals exhibit toxic effects in humans and have been linked to a variety of diseases including cancer. One of our most vital resources – clean drinking water – is under the increasing threat of contamination by these substances.

At Aqueous Solutions, our mission is to enable households and communities to ensure the safety of their drinking water in a sustainable and self-reliant manner. Our researchers and engineers are developing low-cost, robust water purification systems that can be constructed using locally sourced labor and materials, anywhere in the world, to remove pesticides and other agrichemical contaminants from drinking water supplies.



Our website – www.aqsolutions.org – is a resource and information hub providing scientific data, design specifications and other how-to information for construction of small scale self-reliant water treatment systems.

Aqueous Solutions

Annual Report 2008-2009

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Acknowledgements

The following institutions and individuals provide crucial support for the activities and programs of Aqueous Solutions:

Organizations

Appropriate Technology Collaborative

Biochar Fund

Engineers Without Borders, North Carolina State University Chapter

Foundation for Global Community

International Society for Ecology and Culture (ISEC)

Charles A. and Anne Morrow Lindbergh Foundation

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Safe Water Development Program

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Outreach, fundraising

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Lauren Wellborn
Research

Letter from the President

Joshua Kearns is the President of Aqueous Solutions and also serves as the director of science.

This past year, Aqueous Solutions gained exposure far and wide through our field projects, research activities, and educational outreach programs, as well as our written publications and presentations to audiences ranging from indigenous farmers in rural Asia, to international conference attendees, directors of philanthropic organizations, civically engaged citizens, and university researchers.

In February '08 we installed a prototype water filtration system using local charcoal to remove pesticides and other agrichemical contaminants from the drinking water supply at the Pun Pun Organic Farm community in northern Thailand. With the implementation of this system, we also initiated a monitoring regime with the help of collaborators at Kasetsart University in Bangkok. Researchers at Kasetsart help us to assess the prototype's performance *in situ*, allowing us to evaluate our designs for robust and effective water filtration systems.

In May, we were awarded a prestigious grant from the Charles A. and Anne Morrow Lindbergh Foundation. Receipt of this award has been an honor and has enabled advancement in our research and field projects.

May also marked my return to the laboratory. Working with collaborators at North Carolina State University, I began to elucidate the molecular scale chemical and physical processes that govern interactions between pesticide water contaminants and charcoal filter materials. These laboratory investigations are providing the foundational scientific understanding to support proof-of-concept and full confidence in the design and operation of our water filter systems in the field.

In June, Aqueous engineer Nathan Reents led a group of US and Bolivian engineering students in developing community-scale ecological sanitation systems in a tropical region of Bolivia. At the same time, I began to mentor a group of Engineers Without Borders students at NCSU working on potable water systems serving Andean highland communities, also in Bolivia.

In July, environmental engineer Lauren Wellborn – a Master's student at NCSU – joined our team, and has since been carrying forth additional laboratory investigations in charcoal filtration as part of her thesis work.

In September, Aqueous began a collaboration with the Belgian NGO Biochar Fund to explore possibilities for simple water filtration systems using charcoal serving the rural communities of Cameroon. This unique collaboration seeks to alleviate hunger through improved agricultural soils, mitigate the effects of

global climate change, reduce the pressure of deforestation, and provide safe drinking water – simultaneously.

In October, Nate and I returned to Thailand to continue our research and development of the water filtration system serving Pun Pun Farm. We also created and implemented an educational curriculum in appropriate technologies for the farm's winter internship program.

Also in October, Aqueous Solutions was joined by Jessica Geheran, our new executive director. Jessica comes to us with incredible experience working in developing countries (including Thailand), and in building capacity for small NGOs. We're thrilled to have her as the leader of our team, and indeed she has already opened up a host of exciting new opportunities for our organization.

I will now be devoting myself to areas where I can make the greatest impact – science, research, and field operations. In an effort to better understand and advance the scientific basis of our work, I will be engaging in doctoral studies in the program of Environmental Engineering for Developing Communities at the University of Colorado at Boulder beginning this Fall.

Aqueous Solutions rang in the new year with the notification that our field projects and research in 2009 will be supported in part by a grant from the Foundation for Global Community – a tremendous honor and indicator that exciting times are ahead as we continue to advance the science of self-reliance in providing safe drinking water!

These are just some of the highlights from a landmark year in the development of our organization – more details, photographs and anecdotes follow in this report telling the story of Aqueous as has unfolded over the past year.

Thank you for your enduring support and best wishes in 2009!

Josh Kearns
January 2009

Letter from the Director

As we look forward to the year ahead, Aqueous Solutions has many opportunities and challenges on the horizon. Several exciting new efforts are underway in areas relating to education and humanitarian assistance, as well as expanding our organizational capacity. We will also continue to reflect on how to best leverage the results of these efforts so that they may add up to more than the sum of their parts.

Inspiring new leaders in the field of appropriate technology and sustainable development is an imperative legacy. This year, Aqueous Solutions will be partnering with the Prem Center International School in northern Thailand to develop an education site for our projects. It is our hope that participants at the site will continue to apply their collective experience and knowledge to real-world challenges and go on to generate new research that will help address the complexity of socio-environmental challenges faced by communities worldwide.

This year, Aqueous Solutions will also develop water purification systems specifically designed to meet the needs of refugees and displaced persons along the Thai/Burma border areas. These systems will be designed for use in the refugee camps, which currently serve as home to more than 50,000 individuals, and for mobile medical units operating on the other side of the border.

Aqueous team members will continue to maintain a presence with the Pun Pun Organic Farm community in northern Thailand. Here we hope to expand our purview of water related appropriate technology systems through experimenting with an aquaponics installation for the farm. Aquaponics combines water treatment with food production (for example, connecting effluent from a tank of fish with a series of constructed wetlands where vegetables are grown using the fish manure as fertilizer).

We will continue to provide trainings in the region for local farmers in self-reliant water purification. Farm interns and workshop attendees from around the world will also benefit from practical experiential educational programs in appropriate technologies provided by Aqueous Solutions team members.

Furthermore, Aqueous has been asked by the Pun Pun community to consult on the design of a delivery system to bring water from a nearby reservoir for irrigation of a newly acquired tract of land dedicated to the farm's vegetable seed saving and agro-biodiversity conservation program.

In the laboratory, Aqueous engineer Lauren Wellborn will be completing her Master's thesis this spring and with it a regimen of path breaking experiments examining the molecular interactions between pesticide chemicals and charcoal filter media. She, along with Aqueous director of science Josh Kearns and project advisor Professor Detlef Knappe expect to publish these researches in the scientific literature as well as in popular topical journals.

These experiments will also provide a segue for more in-depth laboratory explorations to be assumed by Josh in the context of the University of Colorado-Boulder's doctoral program in environmental engineering for developing communities. In this community of scholars Josh hopes to advance the fundamental science and research relevant to Aqueous' field projects.

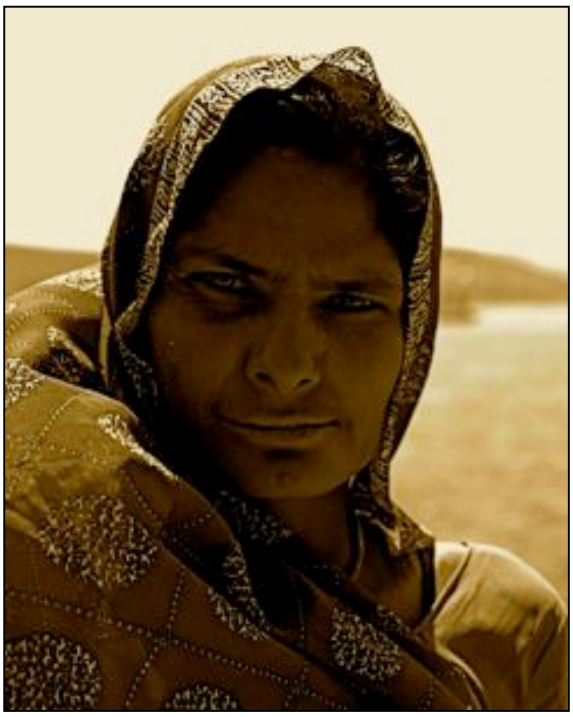
Aqueous Solutions' work would not be possible without the investments that several funding agencies have made in our vision. In January of 2009, Aqueous Solutions received significant new funding from the Foundation for Global Community to support our efforts in deploying appropriate technology for safe drinking water. With their support we will be able to expand the scope of our projects and solidify our own course of development as an organization. With the support of our friends and colleagues, we look forward to serving more communities, developing new collaborations, and deepening our current associations, as we continue to advance the science of self-reliance in water systems.

Jessica Geheran
January 2009

THE PROJECTS

INDIA

Our current project in India serves the rice farming villages of West Bengal. We have partnered with the Kolkata-based Centre for Interdisciplinary Studies to set up a water filtration demonstration at the Centre's agricultural biodiversity research station *(Basudha* – Bengali for "Earth-Mother") in *Bankura* district. *Basudha* aims to conserve Bengal's vanishing rice varieties, in addition to demonstrating and encouraging organic and traditional multi-cropping techniques and promoting local knowledge of biodiversity. *Basudha* conducts workshops for farmers and villagers from throughout the region on topics in agriculture and ecology and runs a seed bank and distribution center. The water filtration demonstration will supplement *Basudha*'s teaching curriculum on the dangers of pesticide use, and will give villagers the tools and information they need to ensure the safety of their drinking water.



THAILAND

Our current projects in Thailand serve three proximally located communities sixty kilometers north of Chiang Mai city in the northern region of the country. They are called the *Pun Pun Organic Farm, Seed Center and Sustainable Living-Learning Center*, the *Panya Sustainable Living Project*, and the *You Sabai Organic Thai Cooking School*. The communities have a combined year-round average population of about fifty people, about one half Thais and the remainder internationals. They are

committed to practicing a variety of sustainable and self-reliant living techniques including organic farming, seed saving, and earthen building. The community teaches these techniques during workshops, internships, trainings and permaculture courses to a diverse audience of four- to five-hundred people each year who visit the farm from all over Thailand and around the world. The *Pun Pun Organic Farm* community considers that "only by living in a sustainable way ourselves is it possible for us to create a model from which others can learn and live. Through natural cultivation on our organic farm we display ways of transitioning to, and living more sustainably. Through the living and learning center we experiment with appropriate technologies, organic farming, and natural building techniques. Through our seed-saving operation we seek to bring back indigenous and rare species of all kinds of vegetables, fruits, and medicinal herbs. We propagate them at the farm and then exchange them for greater use amongst farmers and other interested people, thus empowering and improving the health of the general public." The *Panya Sustainable Living Project* "aims to be a thriving example of sustainable living in northern Thailand, while simultaneously providing a vehicle for growth and expansion for all those involved." *Panya* conducts year-round research and teaching exercises in permaculture, agroecology and natural building. The *You Sabai Organic Thai Cooking School* hosts multi-day traditional Thai cooking courses including tours of the organic farm and local markets, yoga and meditation, and accommodations in bamboo and earthen guest houses. In order to meet their drinking water needs in a self-reliant manner, the *Pun Pun*, *Panya*, and *You Sabai* communities capture rainwater from roofs of the farm buildings. However, it is not possible to capture and save enough drinking water to last through the long annual dry season from October to June. During these months, the community must purchase bottled water, which is expensive and must be trucked over great distances incurring a significant expenditure of fossil energy and the resultant pollution. This situation denotes a critical dependence the community has on outside energy and resources to meet this vital need. A network of irrigation canals fed by a nearby reservoir provides a steady source of freshwater to the farm. However, this water is contaminated by biological and chemical agents due to agricultural runoff from the non-organic farms in the region, pesticides being a significant concern. (See our Resources page on the Aqueous Solutions website, www.aqsolutions.org, for detailed studies about pesticide use in Thailand.) Thus the purpose of our project is to develop and deploy a simple, robust and inexpensive technology to provide the three communities with a stable, year-round source of safe drinking water using locally sourced labor and materials.




BOLIVIA

Asanquiri

Aqueous Solutions has partnered with the North Carolina State University Chapter of Engineers Without Borders and Save the Children-Canada to develop and implement various techniques for potable water systems in the highlands of Bolivia.

The village of Asanquiri is a high Andean community in the Potosi region of Bolivia. The region is one of the poorest in Bolivia, where large portion of the population in the area does not have basic services such as water, electricity, sanitary services or telecommunications. Nutrition is often poor, and clothing is sometimes insufficient for the cold weather in the area. People in the area suffer from a variety of water borne diseases, with children experiencing the most severe effects. Currently, the community drinks untreated spring water stored in concrete tanks that is at risk of contamination by coliform bacteria from livestock grazing in the area.

Together with Engineers Without Borders and Save the Children-Canada, Aqueous Solutions is developing and testing a variety of techniques to provide the community with safe drinking water. This project will serve up to 150 people in the vicinity of the village of Asanquiri, and will employ a suite of techniques for drinking water solutions including solar disinfection (SODIS), rainwater harvesting, and potentially a combination of sand and charcoal filtration.

Alto Beni

Getting to the Alto Beni is an adventure in itself. The drive from the city of La Paz ascends a 14,000 ft pass on a windy and precarious road that drops down into a majestic sea of clouds making the bright green peaks look like islands in the sky. Eight hours and several passes later, one arrives in a lush tropical valley known as the Alto Beni. Since the 1960´s this area has provided hope for poor families fleeing the harsh conditions and unstable economy of the Altiplano, a high plane on the dry eastern side of the Andes. With the help of the government and international aid these new "colonists" have come a long way in the last six decades. Towns have since been established with decent roads, electricity, potable water and sewer systems and organized agricultural cooperatives centered around the organic production of cocoa, banana and citrus fruits.

Despite these various forms of progress, only about one-half of families in Alto Beni have access to potable water systems. In larger towns local springs no longer provide enough water to fulfill the needs of a growing population. Presently there is a need for the implementation of appropriate technologies to treat surface water and improve the taste of groundwater pumped during the dry season in the municipality of Palos Blancos. Aqueous Solutions is currently working with communities in Palos Blancos and throughout the Alto Beni region to initiate programs to address these public health concerns relating to safe drinking water.

CAMEROON

Aqueous Solutions has partnered with the Belgian NGO *Biochar Fund* to explore the applicability of simple water filter systems for rural communities in Cameroon. Biochar Fund works with *Key Farmers Cameroon*, an NGO promoting sustainable agriculture in 25 villages and in cooperation with 50 autonomous farmers' groups throughout the region to address issues of food insecurity, soil depletion, and small-scale energy generation.

The communities served by the collaboration between Aqueous and Biochar Fund are among the poorest in the world: community members often experience periods of hunger and insufficient nutrition, their livelihoods depend on less than $0.75 per day, and they have no access to safe drinking water sources or adequate sanitation facilities.

In this collaboration, Biochar Fund will introduce simple and efficient techniques for converting waste agricultural and forestry biomass to charcoal or "biochar." Farmers will be instructed in the use of this material as a soil amendment. Adding biochar to agricultural soils enhances fertilizer and nutrient retention within the soil, increases water-holding capacity, promotes the growth of beneficial microorganisms,

and greatly enhances accumulation of organic matter and humic substances in the soil – and thereby improves crop yields while obviating the need for heavy (and expensive) chemical inputs to maintain soil fertility.

The char itself is relatively stable in the soil – it has a residence time of hundreds- to a few thousand- years. Thus creating biochar from waste biomass and using it as a soil amendment has the net effect of removing atmospheric CO_2 and sequestering it soils and thereby mitigating the effects of CO_2-induced climate change and global warming.

Aqueous Solutions' role in the collaboration with Biochar Fund will be to develop simple household water purification units utilizing the biochar as a filtration medium to remove pesticides and other harmful organic contaminants. The locals will create their own biochar from agricultural waste materials, incorporate it into home-built water filter systems, then utilize the spent filter material as a soil amendment.

This exciting, one-of-its-kind collaboration between Aqueous Solutions and Biochar fund will promote sustainability and local self-reliance for agrarian communities in Cameroon, and will help to provide locals with food security, better nutrition and safe drinking water, while benefiting agricultural soil quality and exhibiting a net-positive effect on climate change.

More information about Biochar Fund's work in Cameroon is available at biocharcameroon.org.

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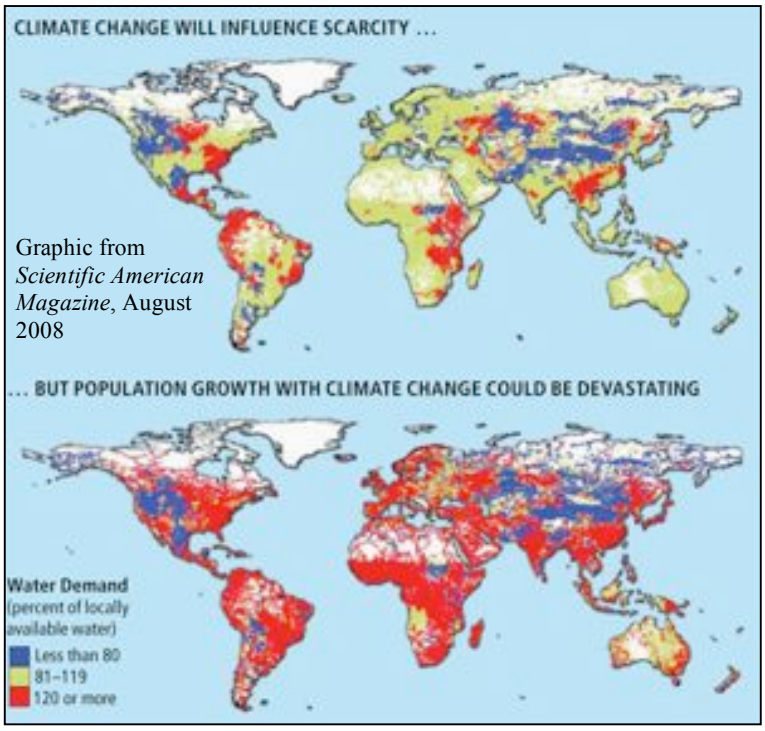
THE GLOBAL WATER CHALLENGE: Providing Safe Drinking Water for the 21st Century

One of the greatest challenges to providing households and communities around the world with clean, safe drinking water is contamination by toxic agricultural chemicals such as pesticides. For the past two years, Aqueous Solutions has been working with rural communities around the world to develop low-cost, robust drinking water filter systems using local materials.

THE GLOBAL WATER CHALLENGE

A now-classic paper in the journal *Science* on human domination of Earth's ecosystems concluded: "Conflicts arising from the global use of water will be exacerbated in the years ahead, with a growing human population and with the stresses that global changes will impose on water quality and availability. *Of all of the environmental security issues facing nations, an adequate supply of clean water will be the most important.*" (emphasis added)

More recently, an article from Scientific American magazine reported that "By 2025…the freshwater resources of more than half the countries across the globe will undergo either stress—for example, when people increasingly demand more water than is available or safe for use—or outright shortages. By mid-century as much as three quarters of the earth's population could face scarcities of freshwater."



Graphic from *Scientific American Magazine*, August 2008

A wide array of human enterprises appropriate the global supply of freshwater, with irrigated agriculture taking the lion's share. But perhaps no human demand is more immediate and critical than the requirement for clean drinking water. Yet as the Harper's Magazine noted in December of 2008, 1 in 6 people worldwide "lack adequate drinking water due to socioeconomic conditions."

The World Health Organization (WHO) has reported that at least 1.1 billion people lack access to safe drinking water. More precisely, at least 1.1 billion are without access to "improved water supply" –

although systems that fall under this rubric (including household connections, public standpipes, wells, springs, and rainwater collection) stand significant odds of contamination because of malfunctioning water distribution systems, inadequate household handling and storage, and a number of other circumstances. Thus the number of people worldwide consuming unsafe drinking water is probably far in excess of 1.1 billion.

In sub-Saharan Africa, 42% of the population is still lacking basic water and sanitation amenities. In Asia, nearly two-thirds of the population uses water from unsafe sources. The number of people without improved water sources in China alone is equal to the number of unserved in all of Africa. These conditions lead to an estimated 4 billion cases of diarrhea and 2.2 million deaths annually, mostly in children under five years of age.

In recognition of this global pandemic of waterborne disease, the United Nations has set as a Millennium Development Goal to halve, by 2015, the number of people worldwide without access to safe drinking water.

A PARTICULAR CHALLENGE FOR PROVIDING SAFE WATER IN THE TWENTY-FIRST CENTURY: PESTICIDE CONTAMINATION

Moreover, the figures above refer only to the contamination of drinking water by biological pathogens – an additional and perhaps even more widespread concern is contamination by toxic synthetic chemicals such as pesticides.

Annually, several hundred million tons of chemical pesticides are applied widely and intensively in agricultural zones around the globe. Many of these chemicals are known or suspected to cause childhood and adult cancers, diseases of the developmental and reproductive systems, neurological dysfunctions, endocrine disruption, and a variety of other chronic and acute toxic effects. WHO has estimated that worldwide, exposure to pesticides results in three million cases of acute and chronic poisoning, 750,000 new cases of disease, and 20,000 deaths each year.

In the United States, about one billion pounds of conventional pesticides are used each year to control weeds, insects, and other pests. This has led to widespread contamination of groundwater and surface waters. By the late 1980's, one-half of the groundwater and well water in the US was or had the potential to be contaminated by pesticides.

AN ADDITIONAL, AND PERHAPS EVEN MORE WIDESPREAD, CONCERN IS CONTAMINATION BY TOXIC SYNTHETIC CHEMICALS SUCH AS PESTICIDES

The National Water Quality Assessment Program by EPA surveyed 51 major hydrologic systems throughout the US over the decade 1992-2001, and represents the most comprehensive national-scale analysis to-date of pesticide occurrence and concentrations in streams and ground water. This study reported that pesticides or their degradates were detected in one or more water samples from every stream sampled, and that one or more pesticides or degradates were detected in water more than 90 percent of the time throughout the years of survey in agricultural, urban, and mix-land-use areas. Furthermore, more than half of the shallow wells sampled in agricultural and urban areas, and 33 percent of the deeper wells that tap major aquifers, contained one or more pesticides or their degradates. A 2008 survey of 19 US drinking water utilities across the nation detected the herbicide and suspected endocrine disruptor atrazine in more than half of the samples collected from tap water distributed to homes and businesses.

The infiltration of pesticides into drinking water sources constitutes a major human exposure route. A recent study by the Centers for Disease Control (CDC) of nearly 10,000 people found that the average US

adult carries a body burden of hundreds of industrial chemicals including dozens of pesticides. One-hundred percent of subjects tested positive for pesticides and/or breakdown products, with the average adult carrying at least 13 different pesticides. Children, women, and Hispanic-American farm workers were found to bear the heaviest pesticide body burdens. A 2005 study by the Environmental Working Group in collaboration with Commonweal detected 21 out of 28 different organochlorine pesticides tested for (including, for example such long-banned chemicals as DDT, chlordane, and dieldrin) in 100% of umbilical cord blood samples. Seven of these 21 pesticides are currently in active use in the US and 14 are banned or severely restricted.

The situation is even more calamitous among communities in the developing world such as those where Aqueous Solutions has been working over the past two years. In developing countries such as Thailand and India, lax, un-enforced, or non-existent regulations permit the heavy use of many agrichemicals deemed too hazardous to ecosystems and human health for use in developed countries such as the US. Nearly three-quarters of the pesticides used in Thailand and India are banned or severely restricted in the West due to deleterious ecological and/or human health effects. Seventy-three percent of the agrichemical imports into Thailand are classified by WHO as category Ia (extremely hazardous), or Ib (highly hazardous). Moreover, numerous studies have reported the detection of pesticide residues in soils and groundwater. Recent surveys by the Thai National Environment Board found residues in 100% of soil samples, 86% of environmental water samples, and city tap water.

Alarmingly high levels of pesticides banned in the West have been detected in the breastmilk of mothers throughout the developing world. For example, high concentrations of DDT and hexachlorocyclohexane residues in mothers' milk were detected in samples from Punjab, India, an area associated with intensive cotton cultivation. Similarly high concentrations of DDT residues were also detected in the milk of mothers living in KwaZulu, South Africa and the Kariba Valley in Zimbabwe, owing to the use of DDT in vector control programs.

A 2001 study of *Hmong* tribal women living in *Mae Sa Mai* village in northern Thailand reported detection of DDT in 100% of mothers' milk samples; heptachlor and hexachlorobenzene were also frequently detected in mothers' milk. The estimated daily intakes of DDT, heptachlor, and heptachlor-epoxide (a heptachlor metabolite) by the infants exceeded up to 20 times the acceptable daily intakes as recommended by FAO and WHO. The amounts of DDT in the breast milk and estimated daily intakes by the infants were, according to the study, "one of the highest reported in the 1990s."

Mae Sa Mai village is about 20 km from one of the communities Aqueous Solutions has been working with over the past two years – the Pun Pun Organic Farm and Seed Center in a remote part of Chiang Mai Province. Over the 2006-07 and 2007-08 winters, Aqueous conducted informal surveys of pesticide use in the vicinity (~ 10 km radius) of Pun Pun Farm. Of 58 pesticide products found to be commonly used throughout the region, 33 are moderately to acutely toxic to humans, 15 are cholinesterase inhibitors (neurotoxins), 19 are suspected endocrine disruptors, 8 are reproductive or developmental toxins, 14 are possible carcinogens and 9 are known carcinogens, 31 are classified by the Pesticide Action Network as "Bad Actors," and 20 are known or potential groundwater contaminants.




These disturbing discoveries motivate us at Aqueous to develop the potential of endogenous charcoal materials as low-cost analogs to industrial activated carbon for adsorption of pesticides in robust home-constructed water filtration systems. US EPA, WHO, and numerous academic studies identify granular activated carbon (GAC) as the best available technology for the control of many agrochemicals and synthetic organic chemicals in drinking water. Although it is not possible to produce fully "activated" carbon adsorbents without an industrial process involving very high temperatures, pressures, steam and/or caustic reagents and finely controlled atmospheric conditions, graphitic carbonaceous materials with appreciable molecular surface areas, porosity development and surface reactivities can be obtained using traditional charcoal production techniques.

Charcoal has been used in drinking water filtration for millennia. Ancient Hindus in India as long ago as 2000 BCE were purifying water by filtering it through charcoal and then exposing it to sunlight. Egyptian papyri from around 1,500 BCE describe the use of charcoal as a medical adsorbent and purifying agent, and there is a Biblical Old Testament reference (Numbers 19:9) to the ritual purification of water using the charred remains of a heifer.

Filtering water through charcoal is an ancient technique, substantiated by millennia of practice in cultures that span the globe. The question that motivates our research and fieldwork at Aqueous Solutions is: Can this ancient technique be adapted to solve a modern problem? Specifically, we are asking:

> *Can endogenous charcoals perform as low-cost, widely available, sustainably-derived analogs for GAC (industrially produced activated carbon) for removal of pesticides in simple, robust, home-constructed water purification systems serving "the other 80%" of humanity without access to the capital-intensive water treatment facilities in developed countries?*

If this question can be answered in the affirmative, then Aqueous Solutions will be helping to meet and surpass the United Nations Millennium Development Goal of ensuring communities around the world with a stable supply of safe drinking water.

THE RESEARCH

With the support and partnership of individuals and organizations around the world, Aqueous Solutions is carrying out laboratory investigations and field observations to quantitatively determine critical parameters for the design of simple water filtration systems that rural communities around the world, and especially in developing countries, can use to ensure the safety of their drinking water.

Underway are a series of laboratory analyses of various charcoal materials (some collected in the field and some synthesized in the lab under controlled conditions) to quantitatively assess charcoal's capacity for pesticide adsorption and subsequent removal from drinking water. This work is taking place in collaboration with researchers at North Carolina State University.

So far, our research suggests that drinking water can be made safe from pesticide contamination using filtration through endogenous charcoal materials, but that the feedstock (the material from which the charcoal is made), and the temperature and atmospheric conditions of the charcoal making process each plays an important role in the quality of the resultant charcoal, influencing its effectiveness as a water filtration medium.

In accordance with these findings, field experiments and observations are currently underway to test different methods of charcoal production in order to identify key parameters in charcoal kiln design and manufacturing processes to identify optimal production conditions for high-quality water filtration charcoal.

In general, we have found that organic materials such as straw and rice hulls that have high silica and mineral content do not make effective filter charcoals. Other materials such as bamboo, coconut husks, and various woods (e.g. pine chips, fruit tree prunings) potentially can be used as filter charcoals if their pyrolysis is hot enough (i.e. < 500 ^{o}C). Our laboratory researches are helping to identify materials and conditions that produce the best charcoals so that others, in the construction of similar systems serving other communities, can select effective locally sourced materials.

Having determined effective feedstock and pyrolysis parameters in the lab it is important to assess whether such pyrolysis conditions can be attained in the field. With community aid, Aqueous has constructed an earthen kiln at Pun Pun Farm in northern Thailand and we have been monitoring charcoal production in this kiln *in situ*.

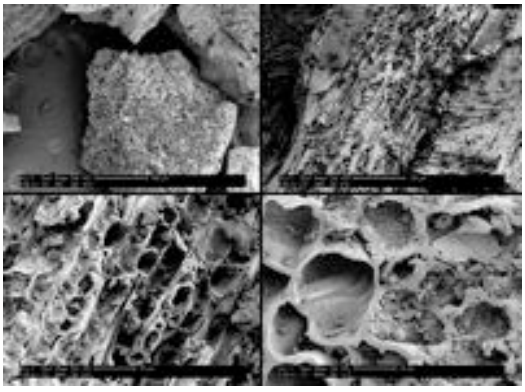
Our observations have determined that it is possible to achieve temperatures in excess of 650 $^{\circ}$C with this simple kiln design. Inspiration for the kiln design was influenced by local traditional methods and in consultation with local farmers – thus we expect that locally produced charcoals are of similar quality to those produced in our experimental kiln.

Assessment of the performance of our prototype charcoal filtration system in use at Pun Pun Farm is ongoing. A sampling regime of local source-water and filtered water is currently underway in collaboration with colleagues at Kasetsart University, Bangkok. Professor Pakawadee Sutthivaiyakit's research group specializes in trace analysis of pesticide chemicals in environmental waters – Dr.

Sutthivaiyakit and her team are currently testing our samples for a few dozen of the most common and problematic compounds. These analyses in progress have assured us that the filtered water poses no risk to the community. More detailed expositions will be possible as additional data are collected.

BIOCHAR…ALLEVIATING HUNGER THROUGH IMPROVED AGRICULTURAL SOILS, MITIGATING GLOBAL CLIMATE CHANGE, REDUCING DEFORESTATION, AND PROVIDING SAFE DRINKING WATER - SIMULTANEOUSLY

An interesting 'twist' in our research and project work has come about regarding the question of what to do with spent filter charcoal at the end of the filter's design lifetime (i.e. when charcoal in the filter is replaced). Spent filter charcoal must be regarded as a potentially hazardous material since it may contain residual small quantities of pesticides and other toxic adsorbates. A strategy has been sought to at least render this material innocuous, if not find a positive use for it.



The scanning electron microscope images above show charcoal made from longan wood – a common fruit tree species in SE Asia. The grain in the upper left image is about 1 mm across. (Images courtesy of Dr. Carl Saquing, NC State Univ.)

Much interest has arisen over the past two to three years with the recognition of the *terra preta* ("dark earth") soils of Amazonia. Since ancient times, pre-Columbian Amazonians amended their agricultural soils with charcoal. Traces of charcoal centuries to a few thousand years old remain today, along with a rich organic layer built up as a result of the enhanced physical and bio-chemical properties of the soil endowed by charcoal addition. Such soils are highly sought-after by locals because of the much greater agricultural productivity than the surrounding typically poor tropical soils.

Study and consideration of the problem of what to do with spent water filtration charcoal suggests the best practice may be to amend it into local farm soils. This would presumably benefit soil quality and increase crop yields as has been demonstrated elsewhere, and provide a long-term sink for charcoal-carbon and thus be preferable to burning spent filter material (which would re-introduce the carbon to the atmosphere as CO_2). Moreover, the most effective strategy for the rapid destruction of any hazardous chemicals adsorbed to the charcoal is probably to expose the material to the activity of soil microorganisms, which can catalyze their degradation.

In consideration of this, we are now recommending communities to bury spent filter charcoal in garden soils and/or use in it composting of organic wastes. Also, we have connected with various groups of researchers at universities and in the field promoting the use of charcoal as an agricultural amendment, and are in discussion with these groups about the potential for collaborations wherein charcoal materials produced for this purpose could also be used in simple drinking water purification systems in areas where pesticide contamination is a threat to water safety.

BREAKTHROUGHS IN SOLAR WATER DISINFECTION

One of our primary research focuses at Aqueous has been the development of filtration systems using endogenous charcoal to chemically decontaminate drinking water, i.e. to remove pesticides. However, biological contamination is also an ineluctable concern when the end product is safe drinking water for households and communities, especially considering that charcoal is known to provide an excellent habitat for the development of microbial colonies.

We have explored and demonstrated a variety of methods for disinfecting drinking water, including biological slow-sand filtration, and ultraviolet lamp units installed at the point-of-use. Recognizing the limitations of various systems under differing conditions (e.g. the need for an electrical power source in the case of UV lamp units), at one of our field sites we have contrived to design and implement a simpler, less costly and more robust system that depends only upon sunlight.

The germicidal properties of sunlight have been recognized for millennia. In recent decades, solar disinfection (SODIS) by simply placing

plastic bottles full of water in direct, intense sunlight for several hours has been recommended in crisis situations such as refugee camps and natural disaster areas where other methods are unavailable.

The limitations of the SODIS method are that water is treated in relatively small batches and thus treating large quantities of water is impractical. Furthermore, with concerns over leaching of toxins from plastic containers into water it is not a long-term solution. At our field site in northern Thailand we have created and are testing a design for a flow-through solar disinfection reactor that overcomes these limitations.

Briefly, we have used concrete roofing tiles, scrap lumber, glass, and discarded insulating materials to construct a corrugated panel over which water slowly flows. Positioning the panel southward and at a slight angle allows for maximal insolation and the attainment of synergistic conditions of aeration of the water, exposure to the sun's natural UV rays, and solar heating for a pasteurizing effect.

We are currently optimizing the design and evaluating its effectiveness with a battery of field microbiological testing supplies (for *E. coli*, total coliforms, and other indicator organisms). Similar systems have been constructed and tested by university researchers with promising results; however, these systems have been fabricated in laboratories using sophisticated means and specialized materials. If our system tests well, it will be (to the best of our knowledge) the only example of an effective system made from ordinary, widely available, inexpensive and scrap materials. Hence we are very excited about this development and possibilities for proliferation of the technique of eliminating biological threats to drinking water safety!

AQ ED (EDUCATIONAL PROGRAMS IN APPROPRIATE TECHNOLOGY)

Aqueous Solutions is committed to the development of appropriate technologies that empower households and communities to meet their basic needs – such as that of safe drinking water – using materials that are ecologically apposite and naturally abundant. We strongly advocate techniques that engender local self-reliance and decentralized, democratic control in their creation and operation, and moreover, are conscientious of the local culture and traditions and thereby operate as means of harnessing and celebrating local wisdom and labor skills.

In accordance with these principles, Aqueous Solutions is promoting the science of self-reliance through educational programs in appropriate technologies. Our programs serve members of developing communities, as well as science and engineering students and members of the general public interested in pursuing sustainable living techniques. Our aim is to provide fundamental scientific theory and engineering design principles along with ecological and social context in a holistic approach to appropriate technologies design and implementation.

ENGINEERING STUDENTS IN BOLIVIA

For the third consecutive year, in 2009, Aqueous engineer Nathan Reents will work with engineering students from Michigan Tech University, the University of Southern Florida, and the Bolivian Technological University, to monitor the effectiveness of three different rural wastewater treatment systems in the Palos Blancos area, Bolivia.

In collaboration with a university laboratory in La Paz, these systems will be evaluated according to a number of parameters including solids content, biochemical oxygen demand, and dissolved oxygen content to determine the efficiency of each design and the feasibility of the systems in a rural context. Through collaboration with each community, improved maintenance procedures are being developed each year of this ongoing program.

Presently there is a need for the implementation of appropriate technologies to treat surface water and improve the taste of groundwater pumped during the dry season in the municipality of Palos Blancos. Aqueous Solutions is currently researching the possibility of working with various communities to solve relevant water based issues.

APPROPRIATE TECHNOLOGY SMALL GROUPS AT PUN PUN

Over winter 2008/09, Aqueous engineer Nate Reents and director of science Josh Kearns led a course comprising one-third lectures and two-thirds small-group practica in various appropriate technologies projects for the internship program at Pun Pun Organic Farm in northern Thailand. Lecture topics included: environmental biogeochemistry for organic farmers, DIY drinking water filtration and disinfection, water delivery systems such gravity flow and pumps, and design of ecological wastewater and sanitation systems. Small-group projects included: synthesis, characterization and gardening with charcoal and biochar materials; design and construction of solar water heating systems; developing simple flow-through solar water disinfection systems using scrap materials; and rainwater harvesting systems design and implementation.

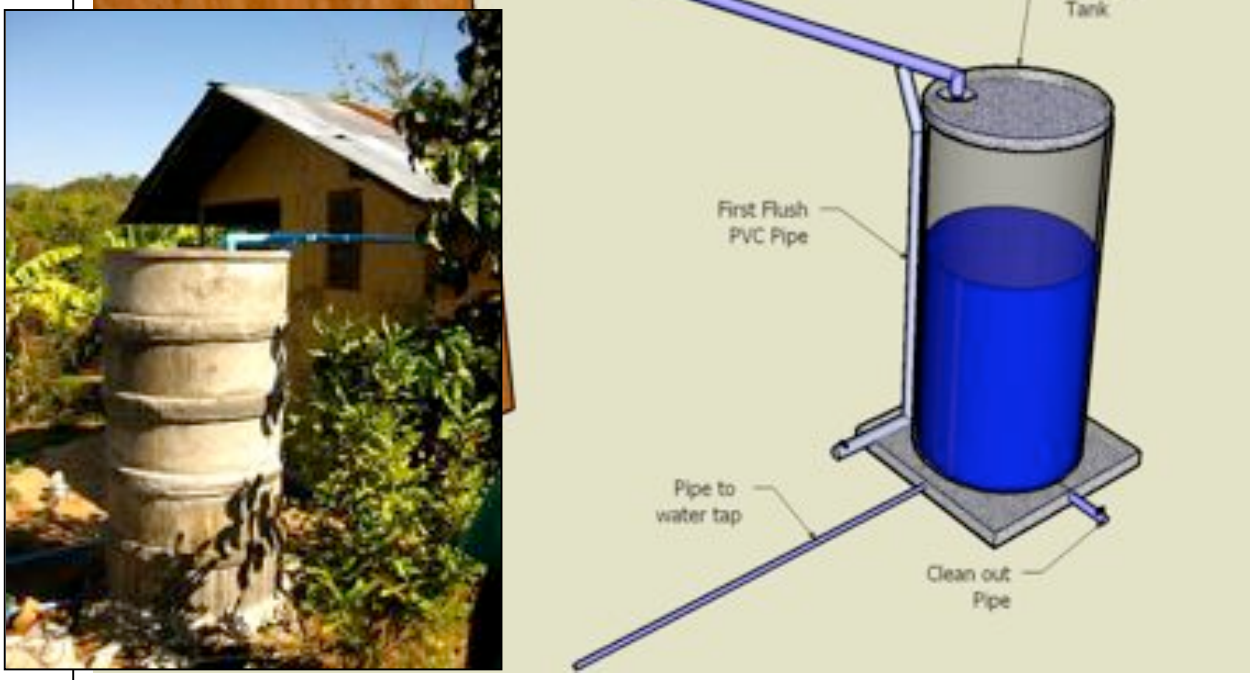
PROJECTS:

Solar water heater

In this solar water heater, water is heated in the panel and thus rises to the top of the upper tank. Colder water flows down from the lower part of the tank and enters the bottom of the solar panel where it is heated by the sun. Water cycles through this system throughout the day, continually heated by the energy of the sun and without the need for any pump or electricity. When the shower is turned on, cold sourcewater forces the hot water out of the upper tank and into the showers.

Aqueous engineer Nate Reents led construction of a low-cost passive solar water heater for Pun Pun organic farm sourcing materials from local hardware stores.. This hands-on project was completed with the help of four interns and was designed to heat water using sunlight and without utilizing any electricity or pumps This gravity-fed system can provide about twenty warm ten-minute showers. In order to achieve higher temperatures an additional panel may be added to the system. This water heater is an appropriate technology for rural areas and can decrease dependency on the use of fossil fuels since energy costs in production of materials are low compared to the energy saved by using the sun to heat the water, and maintenance costs are low due to absence of pumps or any moving parts in the design.

Rainwater harvesting



In this rainwater catchment system, dirty water from the first few minutes of a rain event fills the vertical pipe, allowing subsequent clean water to overflow into the storage tank.

Rainwater harvesting systems are a simple way to supplement drinking water supplies for rural communities. In order to provide potable water for the intern-housing complex at Pun Pun Farm, Reents led a group of four interns to construct a simple rain collection system that will fill during the rainy season and can provide water during the dry season. A gutter was installed on the intern dormitory. The gutter was PVC first-flush system to separate the dirty water that runs off the roof during the first few minutes of a rain event. Five concrete rings were connected with a cement and sand mortar and sealed with cement putty to form the storage tank. The age-old technology of rainwater harvesting is one of the simplest, most cost-effective, low-maintenance methods of improving health conditions and access to drinking water in rural areas. In dry climates roof runoff can also be used to irrigate garden beds once drinking water needs are met.

Lectures

Biogeochemistry
Aqueous director of science Josh Kearns led a lecture and discussion course in environmental biogeochemistry and global systems science tailored to the needs and interests of organic farmers. The course covered the geological history of Earth and the evolution of life, biogeochemical cycling of water and key elements such as carbon and nitrogen, soil microbiology, and a survey of large-scale human impacts on ecosystems and global processes (e.g. land use change, biodiversity loss, global warming).

The Ecology of Globalization
Aqueous director of science Josh Kearns led a study of the historical trends that have led to globalization and their implications for human well-being and environmental sustainability. The course provided a social, economic, and historical context for Aqueous Solutions work promoting sustainability, self-reliance and appropriate technologies. It began with a critical view of modern economics, surveyed the major breakdowns of industrial agriculture and examined the influence of Western "developmentality" on ecosystems, communities, and traditional cultures worldwide. It progressively evinced an alternative course of authentic development for the future of human society, arising from an agrarian philosophical outlook that incorporates economic re-localization, local self-reliance, folk wisdom and traditional cultures, appropriate technologies, and ecological sustainability.

Gravity Flow Water Systems
Aqueous engineer Nate Reents lectured on the transport of water using only the force of gravity. This type of system is by far the most simple, low-cost, virtually maintenance-free system of water transportation. Interns learned how to determine the size of pipe needed to transport a given flow-rate of water, how to maintain water pressure within the capacity of the pipe material being used and where to locate clean-out valves and air purge valves in order to avoid blockages at critical points in the pipeline.

Eco - Sanitation
Aqueous engineer Nate Reents led a practicum on environmentally- and health-safe care of sanitation needs on site. The inefficiency of conventional wastewater treatment systems using potable water and pumps to transport human and industrial waste to energy intensive treatment plants was discussed. As an alternative to conventional systems, interns were taught how to build their own composting toilet. Designs for alternate climates were reviewed including moldering and tropophilic composting techniques.

ENGINEERS WITHOUT BORDERS IN BOLIVIA

Aqueous Solutions has partnered with the North Carolina State University Chapter of Engineers Without Borders (EWB) and Save the Children-Canada to develop and implement various techniques for potable water systems in the highlands of Bolivia. Aqueous director of science Josh Kearns is mentoring a group of EWB science and engineering students in the design and implementation of a potable water system serving the village of Asanquiri.

Aqueous Solutions will provide the expertise necessary to design and implement a water purification and filtration system that can be entirely maintained by the town. Also, EWB-NCSU will assist in the formation of a town committee to be responsible for the system during and after the installation, a crucial step in the long-term sustainability of the project. Currently, we are looking into a slow sand filtration system as a means of achieving the required level of sanitation. Slow sand filtration appears to be best suited to fit the needs of the community and EWB because the design is cost efficient, is easily maintained, and is constructible from resources available in the area. As a more reproducible method, SODIS (solar disinfection) will be taught to the locals as an alternate method. A rainwater catchment system along with a storage tank is to be designed to provide additional water availability during the dry season.

Read more about this project at the website of the EWB-NCSU Bolivia Water and Sanitation Committee (http://ewb.ncsu.bolivia.googlepages.com/).

PUBLICATIONS AND PRESENTATIONS

Our website (www.aqsolutions.org) is a continually-updated repository for our research and papers. The following titles are currently downloadable in PDF format from our Resources page:

RESEARCH AND PAPERS

Charcoals: An Electron Microscopy Study, August 2008

A Five-Gallon Bucket Filter for Rooftop Harvested Rainwater, April 2008

Pun Pun Farm Water System Construction Manual, April 2008

Pesticide Use in Thailand and the US: Ecological and Human Health Effects, April 2008

Simple Field Tests for Water Quality, January 2008

Agrichemicals of Concern in Northern Thailand, December 2007

Agrichemicals of Concern in West Bengal, India, Fall 2007

Charcoal Filtration Basics, Fall 2007

Constructing an Adobe Kiln for Making Charcoal, Fall 2007

DIY (Do-It-Yourself) Water Purification: Basic System Design, Fall 2007

PUBLICATIONS

Five-Gallon Bucket Filter for Drinking Rooftop Rainwater. Josh Kearns, Permaculture Activist Magazine, Issue #69, Autumn 2008.

Self-reliance in water treatment: Providing safe drinking water to communities using charcoal filtration to remove pesticides. Judith Flanagan and Josh Kearns, technical paper in Proceedings of The Third International Conference on Gross National Happiness, November 2007.

Drinking water purification using homemade charcoal: possibilities for self-reliance in water treatment. Josh Kearns, Permaculture Activist Magazine, Issue #65, Autumn 2007.

PRESENTATIONS (DURING 2008)

The global water challenge: providing safe drinking water for the twenty-first century. Presentation to Pun Pun Organic Farm community, November 2008, Chiang Mai Province, Thailand.

Sustainability and Self-Reliance in Drinking Water Purification. Transcript of presentation given at Town of Apex Conservation Days, May 31, 2008, Apex, North Carolina, USA.

Providing Safe Drinking Water to Rural Communities in Thailand Using Charcoal Filtration to Remove Pesticides. Presentation to Lindbergh Foundation, May 17, 2008, Atlanta, Georgia, USA.

Sustainability and self-reliance in drinking water purification: Using ordinary charcoal to remove pesticides. Academic seminar for the Department of Environmental Engineering and Earth Sciences, Clemson University, April 25, 2008.

A Five-Gallon Bucket Filter for Rooftop Harvested Rainwater. Demonstration and workshop, The Ashevillage Institute, Asheville, North Carolina, USA, April 24, 2008.

Sustainability and self-reliance in drinking water purification: Using ordinary charcoal to remove pesticides. Presentation to Engineers Without Borders, North Carolina State University Chapter, April 16, 2008.

IN THE MEDIA

This past year Aqueous Solutions was featured in numerous publications and media sources:

The Charles A. and Anne Morrow Lindbergh Foundation Newsletter. Novermber/December 2008.

The Charles A. and Anne Morrow Lindbergh Foundation Newsletter. August 2008.

Earnest – the magazine of the College of Engineering and Science at Clemson University, fall 2008

Huntington man awarded Lindbergh Foundation grant. Herald Dispatch newspaper, Huntington, WV. October 17, 2008.

NGOs team up to offer climate solutions, enhanced sustainable agriculture, and clean drinking water. Global Climate Solutions website, October 25, 2008. (http://globalclimatesolutions.org)

Partnership between Biochar Fund and Aqueous Solutions. Biochar Fund website. November 12, 2008. (http://biocharfund.com)

Biochar and drinking water in Cameroon – a partnership between Aqueous Solutions and Biochar Fund (http://biocharcameroon.org)

Aqueous Solutions @ Lindbergh. Sustainable Design Update website. May 17, 2008. (http://sustainabledesignupdate.com)

2008 Annual Report of the Department of Earth and Planetary Sciences at the University of California-Berkeley.

"*Natural Farming*" Article featuring the water filter system at Pun Pun Farm in a Thai-language magazine about self-reliance, sustainable farming, and appropriate technologies. Fall 2008.

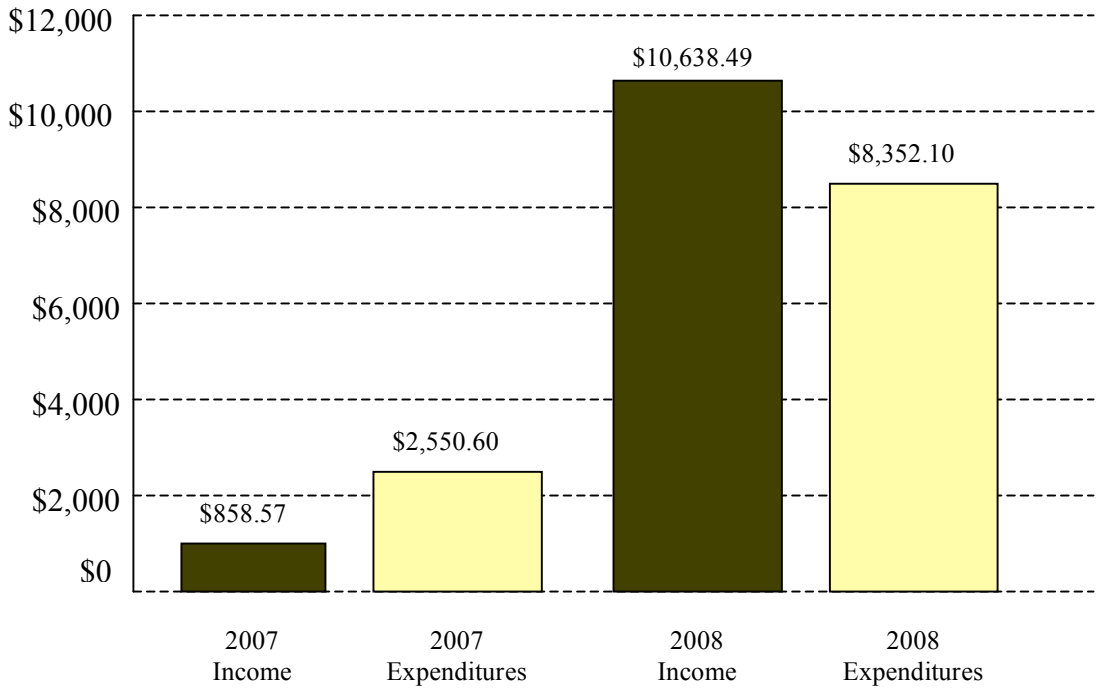
THE FINANCIAL REPORT

2008

CATEGORY	
education and technology transfer	$ 118.71
travel and transport	$ 4,651.15
tools, materials, and research equipment	$ 1,759.04
outreach and communications	$ 426.66
living expenses	$ 1,396.53
total	$ 8,352.10
income	$ 10,638.49

2007

CATEGORY	
fundraising	$ 51.00
tools, parts and supplies	$ 438.55
outreach	$ 198.65
research	$ 94.41
travel and transport	$ 1,767.99
total	$ 2,550.60
income	$ 858.57



MEET THE STAFF

Darwin Bond-Graham
Outreach and media

Darwin is a doctoral candidate in Sociology at UC Santa Barbara. His research involves issues of equity, environmental racism and disaster recovery. He is currently working in post-Katrina New Orleans with several community groups on issues of public housing, health and education. In Santa Barbara Darwin helps run the SB Infoshop and is involved with multiple ecological projects. He is also currently co-authoring a book on the University of California's nuclear weapons laboratory contracts.

Judith Flanagan
Research and fundraising

Judith received her bachelor's degree from University of Sydney, Australia and after spending 3 years working on the Human Genome Project, (LBNL, California) returned to Australia to complete a PhD in Medicine from the University of New South Wales. From medicine and public health, Judith segued into environmental science during her postdoctoral studies as a molecular biologist at UC Berkeley to study the genetics of a microbial acid mine drainage community. It was through this experience that Judith developed an interest in bioremediation and water contamination issues.

Combining her medical research background and ecology led to an appointment at UCSF to study "ecology" of patients suffering from asthma, cystic fibrosis and chronic suppurative otitis media (CSOM) a disease leading to hearing loss in children in marginalized communities. Upon returning to Australia she took up a position as scientific writer for a non-profit medical research institute that delivers eye care to indigenous and marginalized communities in Australia, Sri Lanka, Africa and Vietnam.

Judith's diverse background in the life sciences and her unparalleled skills communicating scientific and technical matters to a lay audience have prepared her well to head up grant-writing and fundraising activities for Aqueous.

Joshua Kearns
President and Director of Science

Joshua Kearns holds bachelor's degrees in chemistry and environmental engineering from Clemson University and a master's degree in environmental biogeochemistry from the University of California-Berkeley. He has worked as a researcher and activist in the fields of ecological economics and sustainability science both in academia and in the non-profit NGO sector. Josh is certified in permaculture design, and has studied and practiced a variety of sustainable and self-reliant living techniques throughout the US and Asia including natural building and ecological agriculture.

Josh is also a prolific writer, developing themes in topics as diverse as agrariansim, ecology, social responsibility in science, Buddhism, Taoism and Eastern philosophy, criticism of economics, globalization and 'development,' local self-reliance, and adventure and eco-travel. His articles and essays have been widely published both on-line and in print media.

Josh enjoys long-distance trail running, road and mountain cycling and bicycle touring, and open-water swimming. Josh is a homebrewed-beer enthusiast and also a bluegrass musician – he plays mandolin and guitar, sings lead, and on occasion attempts to sing harmony. Among his professional aspirations are to build a log cabin in the mountains using only hand tools and to farm using power from draft animals.

Sue Ann Kearns
Office manager

Sue keeps the books for Aqueous, manages correspondence with the donor-base and Aqueous' fiscal sponsor, and provides the central contact point for administrative operations. She also keeps Aqueous Solutions fiscally sound, and ensures that operations are on the up-and-up with the IRS.

Sue performed accounting and bookkeeping operations for her father's food processing and distribution business during high school. She's managed the Kearns family household economy for thirty-five years, doing double-duty during much of this time as a special education teacher in the West Virginia public school system.

Sue is involved in a wide variety of folk arts and crafts using various media; she produces a range of high quality, aesthetic and useful hand-made goods including quilts and religious items. She's an avid reader and gardener and loves to take frequent nature walks.

Tim Patterson
Director of outreach

Tim holds a bachelors degree in political science from Williams College (Massachusetts), but when his classmates applied to law school and took jobs with investment banks, he bought a one-way ticket to Asia and hasn't looked back since.

Tim recently returned from northern Burma, where he reported on the ethnic Kachin people's struggle for autonomy, a project supported by the Pulitzer Center for Crisis Reporting. He also leads educational travel programs for Where There Be Dragons, and is currently designing a new Dragons semester program that will follow the Mekong River from Tibetan headwaters to the delta in Vietnam, examining issues of cultural ecology and development.

Tim helps direct outreach for Aqueous, tapping the magic of the web to spread the word about our projects and research, and to leverage this publicity into financial support.

Nick Rahaim
Web development

Nick is a freelance writer, photographer, and web/print designer. In the past few years he has work as a city hall reporter for a daily newspaper in Salinas, California and has been a legal assistant and web editor at the California First Amendment Coalition where he helped journalists and concerned individuals hassle the government for information. He received a BA in Economics and English Studies from the University of Vermont, where he also minored in Philosophy and Film. His work has been published by USAToday.com, San Francisco Bay Guardian, JANE Magazine, New America Media, and in other print and internet publications. In his spare time Nick climbs and surfs the rocks and waves of the Bay Area, struggles with languages like French, Spanish, Arabic and Farsi, and annoys his neighbors honking on his sax.

Lauren Wellborn
Research

Lauren is a MS student in environmental engineering at North Carolina State University. This spring she will be completing a regime of ground-breaking experiments examining the molecular interactions between pesticide chemicals and charcoal filter media. The results of her work will be published in the scientific literature as well as in popular topical journals.

In her free time, Lauren enjoys adventuring, contra dancing, biking, pottery, and well-told stories.

Jessica Geheran
Executive Director

Jessica joins Aqueous Solutions with extensive experience in sustainable development initiatives in Southeast Asia. Most recently, she spent three years based in Thailand working with NGOs and international organizations focusing on watershed conservation, refugees, and appropriate technology applications.

With a background in applied anthropology and international development, she is interested in human-environment relations in developing regions. Her work has focused on the relationship between environmental conditions and human security, and the related effects of renewable energy initiatives on human rights, conflict, and migration.

She can often be found negotiating, puppy rearing, fermenting, and enjoying stinky exotic fruit.

Nathan Reents
Project management and research

Nathan holds a bachelor's degree in mechanical engineering and a master's degree in environmental engineering. As a researcher and project manger for Aqueous Solutions, Nate draws on his considerable expertise in community scale water systems in the development of creative ways for using inexpensive and locally abundant materials to improve water quality. Currently Nate is developing a protocol for monitoring and evaluating the performance of the prototype treatment system at Pun Pun Farm, and using these data to make future designs easier and more affordable to build.

He worked three years with Peace Corps in Honduras on the design and construction of potable water systems. While on a bike trip in Bolivia he was offered a job as an environmental engineer with a non-profit organization and survived four years working in villages along Andean mountain roads. His main activities included watershed mapping, protection and reforestation; environmental licensing; and designing coffee wastewater treatment systems, constructing wetlands and compost latrines. In the fall of 2007 he organized the first phase of a three-year National Science Foundation research project with students from Bolivia and the United States to evaluate the sustainability of several wastewater treatment systems in the tropical regions of Bolivia. This June, a third year of data will be taken and further efforts will be made to improve maintenance procedures and overall performance of each treatment system.

Nate is currently working at Pun Pun Organic Farm in Thailand, teaching and learning a variety of techniques for building with natural materials. Nate's first year at Pun Pun he worked on building a low cost water treatment system. This year he has been focusing his efforts on building and experimenting with a low maintanence solar water heater and rainwater catchment system.

When he's not on-site at the farm in Thailand, Nate splits his time between Bolivia and his family home in Colorado, USA. Working with his partners in Bolivia, Nate recently acquired land for developing a sustainable, organic cocoa tree agroforestry system. And during the past several summers in the northern hemisphere he has helped to build strawbale and rammed-earth-and-recycled-tire (earthship) homes with his family in the mountains of Colorado. He also loves to travel, dance and hike.

WAYS TO CONTRIBUTE

There are two ways to make tax-deductible donations in support of Aqueous' work:

Give online through our fiscal sponsor, the International Society for Ecology and Culture (ISEC). ***Be sure to specify Aqueous Solutions in the "Designation" field***. To make a secure online contribution click on the Network for Good icon on the Aqueous Solutions website.

Or, you may send a check made out to "ISEC/Aqueous Solutions" to:
ISEC PO Box 9475
Berkeley, CA 94709 USA

If you are not concerned that your donation be tax-deductible, then you can send a check made out to "Aqueous Solutions" directly to:
Aqueous Solutions
329 Wilson Ct
Huntington, WV 25701 USA

Aqueous is now also using ChipIn for quick, secure online donations that go directly for our most pressing needs – for example, key pieces of scientific field equipment. Use the widgets on the Aqueous website to make an easy, targeted contribution. Thanks so much for your support!

Opportunities to Work and Learn With Aqueous Solutions

Aqueous Solutions is 100% run by volunteers! As such, we can always use a hand with our various projects. In the laboratory, performing various types of research using the web, conducting field surveys, working on-site with our projects, and helping out with the development of our organization are some of the ways you can plug in, support our work, learn a lot, and have fun!

Contact us through our website or via email at info@aqsolutions.org to find out how you can team up with Aqueous Solutions to make the possibility of safe drinking water a reality for communities around the world!

Link Up With Aqueous Solutions on MySpace and Facebook

The Causes application on Facebook and MySpace allows people to support their favorite organizations, through tax-deductible contributions, or simply through joining the Cause. Let your online friends and colleagues know that you support the science of self-reliance on Facebook and MySpace.

www.aqsolutions.org