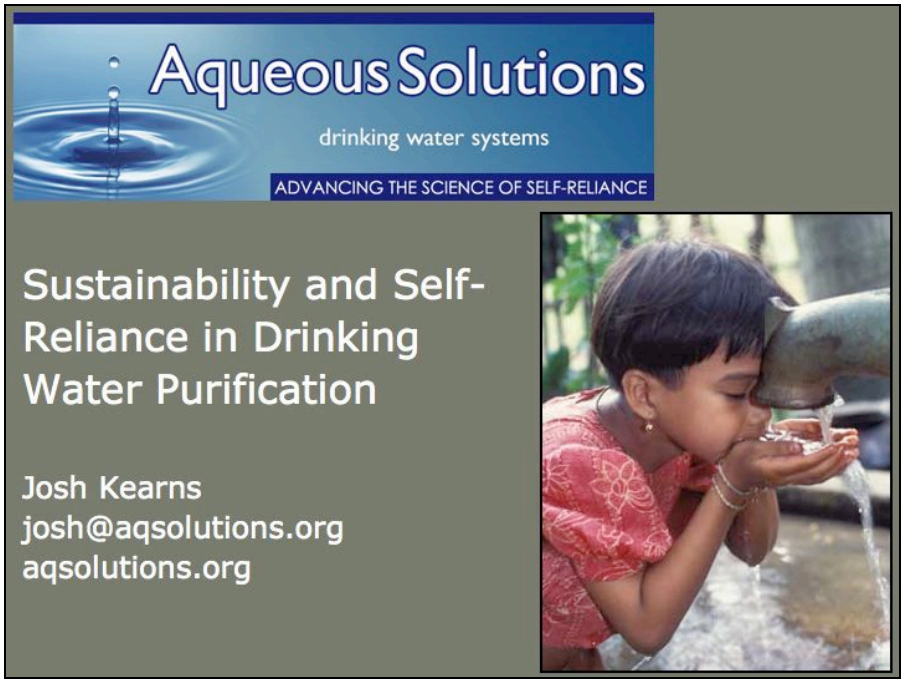
Sustainability and Self-Reliance in Drinking Water Purification

Transcript of presentation given at Town of Apex Conservation Days, May 31, 2008



Good afternoon everyone, my name is Josh Kearns. I work for a non-profit called Aqueous Solutions. Our mission at Aqueous Solutions is to develop very inexpensive, low-tech, small-scale (household to small community scale) drinking water purification systems that can be constructed using locally sourced labor and materials by just about anyone, just about anywhere in the world, in order to provide themselves, their households and communities, with a stable source of safe drinking water in a sustainable and self-reliant manner.

Basically, we're designing potable water systems for "the other half," for people who live on less than $2 a day. About half the global population – almost 3 billion people live on less than $2 a day. Around 1.1 billion people lack access to safe drinking water – over twice that number lack access to basic sanitation services. (Meanwhile here in the US we use the bathroom in drinking water – weird, huh?)

So at Aqueous, we're designing systems with these folks in mind.

So today I'm going to talk a little bit about one of our projects to design a drinking water filtration system for a farming community in northern Thailand. Also, my colleague Akeem Robinson is here – he's the president of the local NC State chapter of Engineers Without Borders. Our organizations have partnered up

to work on various projects, and later this summer we're taking a trip to Bolivia to work with a rural community in the highlands there to develop some potable water systems. Akeem is going to show some slides and talk about that trip.

So this workshop session is going to be a kind of two-part thing. First we'll have our slide show – a kind of dog-and-pony show to show pictures and talk about various international projects. Then we'll do a more hands-on, how-to demonstration for how you can make your own 5-gallon bucket filter for rooftop harvested rainwater. With the drought going on here in the southeast, a lot of folks are becoming very interested in harvesting rainwater for flushing toilets, showering, irrigating vegetable gardens, drinking as well. After the slide show we'll do a demonstration for how to can construct your own simple water filter using household materials to remove pollutants – from air pollution, and from roofing materials like asphalt shingles – from rainwater to make it safe for drinking.

I should also mention our website: aqsolutions.org…there you'll find all sorts of information about our international projects, ways that you can get involved, lots of downloadable documents detailing our research as well as how-to-do-it-yourself information, plus a very detailed instruction set for constructing the bucket filter we're making today. So don't worry if you don't get it all in this one go – the document on our website has detailed instructions with photos, plus parts and tools lists for everything you'll need and approximate prices for all the bits if you need to go to the local hardware store for supplies, etc.

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So, regarding some of Aqueous Solutions' international projects…I've spent most of the past two years living and working and traveling around Asia. A good portion of that time I've spent with this small farming community in the northern part of Thailand.

To give a brief biographical sketch of the community – it's about 1/3 Thais, about 1/3 hill tribe people (indigenous people), and about 1/3 Westerners from various countries, for a total of about 50 or so people, fluctuating with the seasons. So it's pretty diverse; a lot of cultural cross-fertilization going on there.

Recognizing the manifold challenges facing human society today: pollution, climate change and global warming, ecological degradation and damage to the biosphere, the un-sustainability of the global economy, destructive agricultural practices, biodiversity loss, and social ills such as poverty, stress, disease, and various things that make people's living conditions difficult – their strategy for addressing these challenges and moving in a positive direction has been to develop and teach various techniques in sustainable and self-reliant living.

They consider that, to the extent that individuals, households and small communities can meet a great portion of their basic needs through their own efforts and skills, using locally available resources, and in ways that make sense given the local ecological context, people can be free and happy and healthy, enjoy a great deal of independence and self-sufficiency, and have plenty of space and time to pursue spiritual and philosophical development and so forth. In this way people can have nice lives – do good work, eat good food, be part of a healthy community, live in relative comfort and abundance – and not wreck the planet in the process.

For several years now, this community has been developing and practicing all sorts of sustainable and self-reliant living techniques – small-scale, biologically diverse organic agriculture; seed saving and biodiversity conservation (*Pun Pun* is Thai for "thousand varieties"); natural building using mostly earthen and organic materials; all sorts of stuff – and they have become quite successful and a bit famous and so now are giving workshops and programs for people from all over Thailand and around the world, which is how I got connected with them.

The impetus for the water filtration project came up about a year and a half ago, in the middle of the dry season. You see Thailand has a monsoon climate with a long dry season from October-or-so until June, which is by the way predicted to get longer and hotter and drier under climate change. Anyway, we ran out of drinking water in mid-January.

In Thailand, as in many places around the world, people harvest rainwater off of roofs for drinking. Even with a big cistern, it's not possible for most households to save enough water during the rainy season to last the whole dry season, certainly not possible for this community especially with all the guests, interns, workshops participants, etc. coming through.

When our water ran out, the farm had to start purchasing bottled drinking water, which is expensive, is trucked over long distances to get to the farm, which is fairly remote implying all the fossil energy expenditure, pollution, contributions to global warming that go along with that, and points up a critical

dependence on an unsustainable flow of energy and resources of this community that's meant to be all about balance and sustainability and local self-reliance.

There's plenty of water around, but it's either pumped from shallow wells, or surface water: ponds, irrigation canals, a couple perennial streams. Thailand's a big agricultural country so there are irrigational canals everywhere. But the water isn't potable, largely because of agricultural runoff – pesticides in other words.

This farming community of course uses all organic methods, but this is very much not the case for the majority of farming in Thailand at the moment. It turns out Thailand is one of the heaviest-pesticide-using countries in Asia. And about three-fourths of the pesticides used there are banned or heavily restricted in the West due to their ecological and human health effects.

This is pattern, incidentally, is very common in so-called developing countries, where agrichemical corporations sell huge quantities of pesticides that are outlawed here. It's certainly true in India and most other places I've traveled in South Asia.

Anyway, this issue of pesticide contamination of drinking water supplies is really a worldwide concern. Every year, hundreds of millions of tons of chemical pesticides are applied widely and intensively in agricultural zones throughout the globe. Many of these chemicals are known or suspected to cause a variety

of cancers, developmental and reproductive diseases, neurological dysfunction, endocrine disruption and wide variety of other toxic effects.

According to the US Center for Disease Control, based right here in Atlanta, we all carry a toxic body burden of dozens of pesticides. Pesticides have been widely detected in human breast milk and umbilical cord blood.

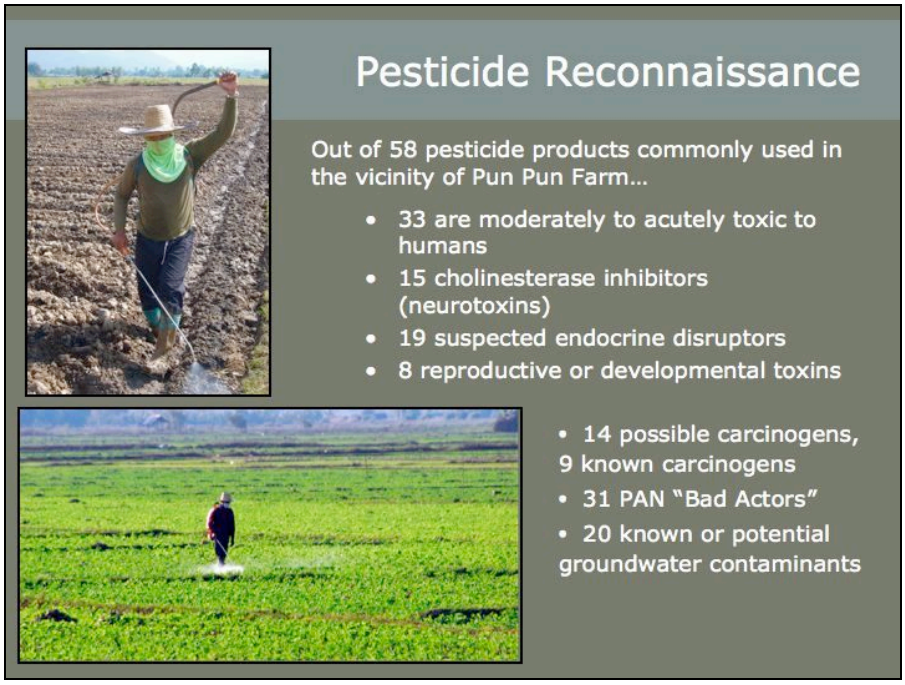
In fact, one study I came across recently from a few years back where they surveyed several women from a local hilltribe, from a village that's just down the road from our farm. 100% of the women tested positive for DDT in their breastmilk. Findings like this aren't uncommon – there are many, many similar studies from other parts of Thailand, India, Africa, Latin America, even the US and other developed countries. This particular study just stood out because it hit so close to home.

Anyway, many surveys have been conducted from around Thailand of soils, groundwater, river sediment, surface waters, and so on have indicated widespread contamination by an array of chemical pesticides and their breakdown products.

Similar is true also here in the US, by the way. A recent study by the USGS indicated contamination by pesticides or their breakdown products in shallow groundwater in about 60% of aquifers in urban and agricultural areas around the country, and in well over 90% of streams and surface waters.

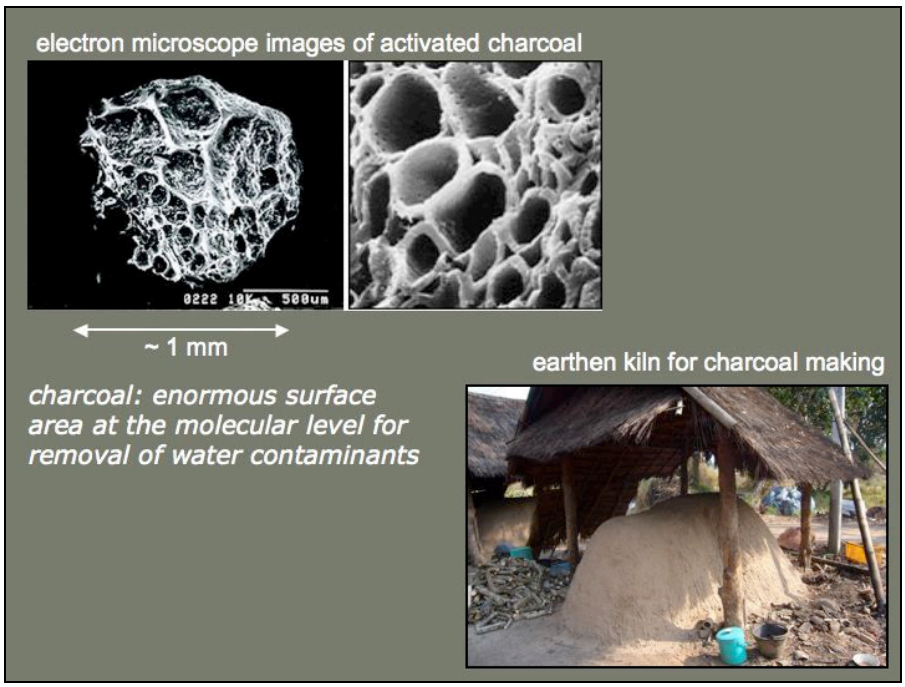
So to design a drinking water filtration system to remove pesticides for this farming community in Thailand, I first needed to do some reconnaissance to find out what we were up against – to identify the agrichemicals commonly used in our region that might be getting into local water sources.

I spent a lot of time over the past two winters talking to farmers in our area, checking out the feedshops in every neighboring village within a 20-mile radius to see what they were selling, and skulking around fields identifying discarded pesticide containers.



Anyway, my pesticide detective work turned up the following: that chemicals used in our area included numerous substances that are acutely toxic, several carcinogens, toxins of the nervous system, reproductive system, endocrine disruptors, and so forth.

So that's the bad news. But I don't want you to be bummed out, so this talk has a happy ending.



I recalled from my training in environmental chemistry that charcoal makes an excellent water filtration medium. In fact, a substance called activated carbon that is derived from charcoal is what's used in most municipal drinking water treatment facilities in the US and other developed countries. This material has been identified by the US EPA, the WHO, and numerous academic studies as the Best Available Technology for the control of hazardous synthetic organic contaminants such as pesticides in drinking water.

Actually water filtration using charcoal is nothing even remotely new. People have been using charcoal water filtration since the societies of ancient Egypt and India. So it's a technology, if you will, with a several-millenia-long proven track record.

So in a sense, charcoal water filtration is old-hat. But here's why it's actually really exciting:

Charcoal is cheap and ubiquitous. People have been making charcoal for 10,000 years, so it's not like this is some weird, gimmicky, high-tech, space-age material we're talking about.

Simple charcoal water filtration systems can be configured and used by just about anyone, just about anywhere in the world, regardless of economic status or level of formal education.

Charcoal water filtration systems can be constructed by folks using the skills of their own hands, which is empowering at the personal level, making them more independent and self-reliant, and using materials that are locally sourced, abundant, inexpensive or freely available, and sustainable.

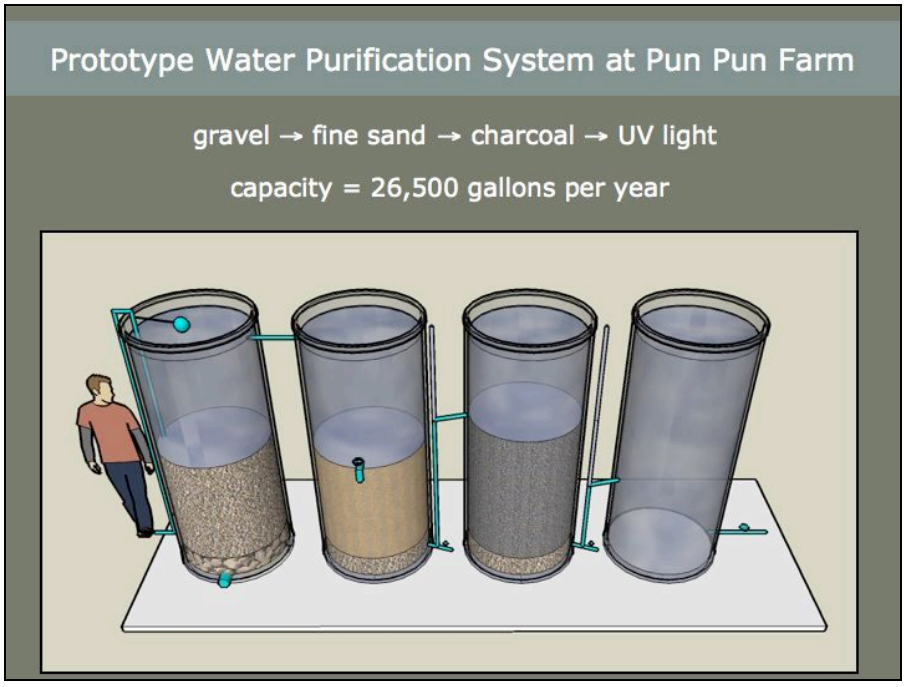
What all this means is that we're talking about a truly appropriate technology, accessible to millions of people worldwide, that they might provide for themselves, their households and communities a stable year-round source of safe drinking water in a sustainable and self-reliant manner.

In other words, this technology meets the criteria of "design for the other half," for folks who live on less than $2 per day. So it's very exciting for that reason.

So how do we make this work?

The short answer is: try it and see.

#1 We're building a prototype system for the farming community in Thailand We've already begun some of the design work and construction, and later this year we'll bring the prototype system fully online.



Here's an illustration done by my colleague of how the system will be configured, with gravel and sand filters to remove turbidity and microorganisms, and an optional germicidal UV unit for further disinfection

at the point-of-use.

We've established a collaboration with an analytical chemistry lab at a university in Bangkok – they have agreed to receive water samples from the prototype system over about an 18-month period in order to monitor the system's performance and evaluate its effectiveness specifically for removing pesticides. If anything gets through the filter that could harm members of the community – which includes me, by the way, since I'll be drinking this water same as everyone else – we'll know about it.

#2 Laboratory research. Charcoal can be made from a variety of materials – but how well do these different materials work as water filtration media?

Charcoal can be made out of just about any kind of organic matter, including all sorts of agricultural and forestry waste materials – prunings from fruit trees, straw, rice husks, nut hulls, coconut coir and shells, corn cobs, saw dust, etc., bamboo, which grows very fast, even bamboo construction waste.

We knocked down an old dilapidated bamboo hut on the farm last winter to make room to build a new guesthouse for farm interns. So we had a big pile of kind of useless bamboo and I said, "let's make it into charcoal!" So we built an earthen kiln on site at the farm and started making our own charcoal.

So I came back from Asia this spring with a duffle bag full of charcoal samples collected from all the

communities I visited for laboratory analysis. A review of the relevant scientific literature suggests that locally produced charcoals will make a very effective medium for removing pesticides from drinking water. But this needs to be confirmed by direct experimentation with various charcoals and a suite of pesticide water contaminants.

So for this, we're working with researchers at the University of California-Berkeley and at North Carolina State University to complete a suite of rigorous laboratory analyses to allow us considerable precision in our designs for charcoal filtration systems in the field.

So we have research in the lab going on, and also development and testing of the prototype in the field, all kind of simultaneously.

And that's kind of it in a nutshell. I want to end there and turn it over to my colleague Akeem. I'm happy to take questions after the workshop….Here again is our contact information, and we can always use volunteers….actually we're an all-volunteer organization…please go to our website, download our materials, tell your friends….Thanks for listening!