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Paper for *Bottom-up Approaches to Global Poverty: Appropriate Technology, Social Entrepreneurship, and the Church*

Dr. Robin Klay, Economist, Hope College, Holland, Michigan

Dr. Robert McDonald, Physicist/Businessman, Holland, Michigan

Vision, trust, and good business models: Essentials for introducing appropriate technology

I. Introduction

The concept of *social entrepreneurship* is relatively new, but the practice is as old as the first person who pursued a vision to improve a community. Indeed, Alexis de Tocqueville wrote admiringly in the 1830s about the habits of small town Americans who instinctively organized themselves to deal with community needs and seize on local opportunities, rather than turning to government.

In many different ways throughout the centuries, Christians have responded to Gods' call to assist people in need. Remarkable individuals inspired efforts by founding organizations like orphanages, youth programs (e.g., YMCA), feeding programs (e.g., Second Harvest), schools, and care for the dying (e.g., Hospice). In most cases, funding these private-sector efforts first relied on donations. The exceptions include Christian hospitals and retirement homes that cover expenses with charges for their services.

Over the last two decades a new vision has developed for meeting the needs of people in Third World countries, for which the term *social entrepreneurship* fits better

than *mission*—although the two are not as different as one might imagine. It has become obvious that the capacity for meeting needs can be greatly expanded only if programs are designed to generate sustainability in the form of revenues beyond charity.

In the 21st century, the most publicized form of social entrepreneurship is micro-lending. Micro-lending has been an especially effective form of lending to women in Third World countries. Typically, each woman in a group receives a small loan to start or expand her own small business. Each borrower pays interest, but together the entire group ensures that the lending organization receives weekly payments of principal and interest. Borrowers may begin with loans as small as $100 and gradually qualify for loans as large as $5,000 if they show themselves to be responsible and are able to generate expanded business income.

Habitat for Humanity is a well-known Christian organization whose focus is lending to poor families so that they can build their own houses. (In most Third World countries, Habitat houses are built by groups of people in need of housing, with little if any help from building teams, which are common in the U.S.) Although they do not charge interest, Habitat is an example of micro-lending, where confidence is invested in poor people and poor communities who have a strong incentive to improve living conditions for their families and are willing to work hard to achieve those goals.

The purpose of this paper is to explore a unique way in which the Habitat for Humanity group in Oaxaca, Mexico, American churches, college students, researchers, and businesses are being brought together to tackle a key Third World need—namely, clean drinking water. A relationship of trust has built up over several years between Hope College and Habitat for Humanity in Oaxaca. Local Habitat groups of 10-18

families in small towns have received Hope students into their homes for two months every summer and made arrangements for students to work in internships with grassroots organizations serving in their communities.

Simultaneously, a new technology has been developed for building household-level water filters, costing about $15 in materials, lasting 5 or more years, and achieving a level of clean water that exceeds W.H.O. standards. That effort—of engineers, chemists, students, and nursing professors—has led to the creation of an organization called Aqua Clara Foundation.

In order for this appropriate technology—a water filter made with locally available materials—to be effectively introduced and expanded to needy communities worldwide, business models must be developed that are founded on the principles of social entrepreneurship. This part is more complicated to achieve than the technology itself. It requires the ability to connect with communities around the world, for mutual exploration of values and needs, as well as collaborative design of effective training, quality maintenance, and health impact assessments.

In the paper we describe the program that is being developed in Oaxaca (as well as Chiapas, Kenya, and Nicaragua). We hope to illustrate such basic principles as:

(1) The need for a strong relationship of trust between the group developing a new technology (in this case, Aqua Clara) and grassroots organizations, so that partnerships may be created to provide ongoing technical and business workshops for new communities and persons interested in creating small businesses around the manufacture and sale of the filters.

(2) The need for extensive exploration of suitable business models with the grassroots organizations, so that programs have local support (and good connections with local officials who may facilitate or block their expansion), based on a vital, preexisting sense of community solidarity.

(3) The need for such models simultaneously to inspire communities with the dream of better health through clean water, and to create small business opportunities required to bring filter technology into remote areas where access to clean water is critical.

It is our hope that the paper itself—accompanied by technical, business, and health information—will do two things: (1) give others a chance to consider integrating this water filter technology with their own development efforts; and (2) provoke a conversation about alternative models for small business development as a tool for introducing and extending access to appropriate technology.

II. Developing a relationship: Hope College, Habitat for Humanity in Oaxaca, and Aqua Clara foundation.

Beginning in 2006, Hope College started offering an opportunity for students with sufficient Spanish fluency to do two-month-long internships with a variety of grassroots organizations in and around Puerto Escondido, in the state of Oaxaca, Mexico. Because we had already developed a relationship with local Habitat for Humanity leaders in this region, we looked to them to locate host families for our students in several poor communities.

We quickly realized that members of Habitat, themselves poor, were also in a unique position of being able to identify internship opportunities in the same and nearby

communities. After all, they know the needs and who is doing something to address them in their own towns. With their help, Hope students have been placed in internships with private and public clinics, a library, schools, churches, youth programs, a radio station and newspaper.

As a result of our living and working over several years with Habitat leaders in Oaxaca, a strong relationship of trust and has developed. They and we value the rich experiences students and host families have, along with their communities. The students take bucket showers, wash clothes by hand, sweep the dirt yards in front of their houses, and eat with their host families. They share family events, help build houses, and become best friends with old and young, indigenous people and mestizos.

Our hosts are deeply touched by the opportunity to teach and to share their lives and dreams with young Americans. Typically, they have never before seen Americans in their towns, let alone taken them into their families. Our work with them is an encouragement in their own commitment to growing stronger families and better communities.

Our sharing in the work and vision of Habitat families along the Oaxacan coast (Costa Chica, as it is called) made us aware of local needs faced by poor families like those of Habitat. Clean and affordable water is one of them. Over the same period of time, we became involved in a project in Holland, Michigan, to develop a new filter technology that could meet such needs there and elsewhere in the Third World. The science and engineering advanced to the point where we were able to contemplate collaboration between Habitat for Humanity in Oaxaca and Aqua Clara Foundation.

The vision and development of Aqua Clara Foundation has largely been the work of Bob McDonald, co-author of this paper. It is inspired by the crying need for clean water in parts of the world, where health is seriously compromised by its absence, and by a commitment to the spiritual centrality of water to Christians. Jesus said that a person who gives a cup of water to little ones)...will certainly be rewarded (Mk 9:41, Mt 10:42). Our vision is that, by the grace of God, cups of water will overflow in communities where water has for generations carried more disease than hope.

III. Introducing the new water technology.

Habitat for Humanity leaders in Oaxaca are chosen from among hundreds of members (all volunteers) to train new groups of would-be home owner/builders and oversee the ongoing work with the same communities (over 40). When we described the rock and sand-based water filters to this group, they were immediately struck by how useful they would be for Habitat families. They waited a long time (at least 3 years) until, with the creation of Aqua Clara and the development of a technology that was of higher quality and readily made with local materials, it became possible to begin a project together.

Aqua Clara sent a technician to the area to give four workshops to Habitat members in four towns, on how to build the filters, supplying the tools and materials needed for 10 filters each. The workshop includes information about water quality issues, how to detect and remedy potential problems with the filters, and a suggested business model. The basic model entails the creation of a business by one or more of the

people trained at a workshop, its proper registration with local authorities, and a simple system of accounts and reporting back to Aqua Clara.

Most of the first forty families who built filters are now using the water and have substituted it for the costly purchase of large (water-cooler size) bottles of water (costing about $3/day per family). Among the four towns, the levels of education, income, and "sophistication" differ. In the poorer towns, most people switched immediately to the new filters. In other towns, some families waited for confirmation from water testing regarding the quality of the water.

In some parts of the world, like Kenya, where the choice is between bad water and demonstrably better water from the filters, nobody has hesitated to use the filtered water. Based on laboratory work with the filters in Holland, Michigan (putting raw sewage water through the filters), we are able to assure everyone that the filters are safe and that the water quality more than meets W.H.O. standards. When people in the field put brown river water into the filter and see clear, odorless, and tasty water coming out the other end, no further proof is needed.

However, in many parts of Mexico, it is much easier to introduce these filters to communities if we have locally verified the quality of the filtered water. Until recently, we were handicapped in this regard because the lowest cost water testing available where we are working in Oaxaca is about $200. Obviously, this is not a cost-effective way to test the quality of water of each filter, or even of a sample of filters in each community where we expect the filters to be introduced. A Hope College professor of chemistry located a source for a much simpler and less expensive water test that has now been used

to verify the purity of filtered water in several communities. Our plan is to test a sample of new filters in each new town where they are introduced.

We are very pleased by the partnership between the Oaxacan Habitat groups and Aqua Clara. The leaders of Habitat frequently repeat a moto: "We do not build houses; we build families." Their weekly meetings in each town include reading of Scripture—in Catholic and Protestant versions, so as to include everyone. They find that the Bible provides very practical guidance to them about how to cooperate, care for their families, encourage one another, and serve their community. In fact, one of the primary considerations about whose house will be built next is the number of hours that family has given to building houses and to providing help to those in greater need than themselves—such as food, medicine, and basic shelter.

In light of the vibrant vision and commitment of Habitat to their communities, it was not a surprise to find Habitat members interested in making filters for their own use and sharing this technology with others. The challenge for us has been to find a business model that fits the Habitat spirit and also has the dynamism necessary for outreach beyond their own circles.

The spirit of Habitat in Oaxaca (and throughout Mexico) is very much based on mutual help. The temptation for a family, once its own house has been built, is to stop putting the same amount of time and energy into ongoing construction (a house is completed in about 3-5 weeks). Hence, there is continuous conversation and leadership training to focus Habitat families on cultivating and practicing responsibility for others. They are also very good at teaching financial responsibility. In addition to proving title to a plot of land, each family must save enough to provide some of the building materials

before construction on their house is begun. They have to make monthly payments in person for up to 10 years (some paying off the loan earlier than others). All of this entails a strong commitment to their own families above competing desires that do not deserve the same priority.

Businesses, whose goal is to sell needed products—such as water filters—must be able to pay for the labor (at first self-supplied by owners) and earn profits. Without the latter, there is not much hope of the customer base expanding beyond the local community. It is not yet obvious how Habitat people—whose model is *mutual help*—can foster businesses that make, distribute, and price filters in a way that profits worker-owners. This is what we have been struggling with: How can the opportunity to make a profit on water filters be understood as consistent with filter businesses serving their communities?

Naturally, the first vision of Habitat groups in each town was for the group of 10 trained people to help other Habitat members with the construction of filters for their homes. Likely, a family wanting a filter would approach the trained group, asking them to build the filter, with the family providing the needed materials (mostly sand, rock, gravel, PCP pipe, and a plastic garbage can)—costing about $15. Nothing would be paid for the labor. That is the mutual help way. However, it does not provide the impetus or revenue to expand the network beyond the local Habitat group (10-25 families).

One possibility was to design the filter project in well-defined stages, working from the mutual-help model associated with Habitat, toward independent businesses. With that in mind, we sketched out a plan to begin the project with local Habitat families (as described above), which we will call *Stage One*. *Stage Two* would involve the

initially trained filter group in making filters to be placed in public places in their own communities, such as community health clinics, town halls, classrooms. Aqua Clara stands ready to pay the full cost of 10 (or more) such filters in each town, including a fair price for the labor. (A price of $30 is being considered as a benchmark.) The purpose of this stage is several fold, to:

(1) Provide access to clean water in places where it is needed.

(2) Give the filter group more experience in the construction of filters and a sense of which of their members is/are most eager and able to create a filter business—for subsequent stages.

(3) Get the word out to the community about the product and its availability for purchase.

(4) Enhance health education for elementary school students in classrooms where the filters are located. A strong curriculum has been developed by Hope College nursing faculty for use in Third World settings (available in Spanish).

(5) Possibly develop opportunities for exchanges of letters between children in U.S. elementary classrooms and school children in Mexico. Funds for placement of the initial filters have been provided by school children and others in Holland, Michigan.

Stage Three would take the form of the newly created filter businesses making and selling the filters on a commercial basis (i.e., no subsidy from Aqua Clara). They would start by selling in their own towns and then expand to nearby towns and villages.

Alongside, or perhaps after the initiation of *Stage Three*, we hoped the Habitat-based filter groups would go out into surrounding communities to give workshops (with

material support from Aqua Clara) on how to build and maintain filters and to start new businesses. Sharing the filter technology with other communities is something the initial trainees readily agreed to from the beginning.

The above plan sounded logical based on the nature of Habitat, their vision of community service, and the capabilities of Aqua Clara. It has not yet been tested—except for *Stage One*. We were held up by the need to test filter water quality in the existing four communities. There is enthusiasm among the filter-group leaders regarding *Stage Two*. They have already contacted health clinics, for example. And, a school principal has asked for filters to be placed in his school. However, we ran into an unexpected reluctance on the part of one leader regarding *Stage Three*—selling filters as a business. He is afraid that local water bottling companies will take offense at the competition and harass the filter groups with suits or complaints to local town officials. After all, the local authorities may have been happy to see self-help housing, but be reluctant to see competition for well-established water businesses.

This was a surprise to us, but not out of the realm of possibility, based on our experience in Mexico. Happily, in conversation with two other filter-group leaders, we learned that they foresaw no such threat. In fact, the owner of a bottled water company in one area was already assisting with the local work of Habitat.

This experience was a useful reminder to us not to generalize even about communities within 100 kilometers of each other. The differences suggest that the particular evolution of filter projects from mutual help to businesses should take different forms, even when working through the same organization (in this case, Habitat) and same region (Oaxaca).

In a meeting with Habitat leaders (including filter-group leaders), a suggestion was made that has changed our minds about one aspect of the staged transition from mutual help to business. Instead of starting business groups in the four towns with existing filter groups, the leaders suggested that initial outreach begin with these filter groups providing workshops in nearby towns where they do not have access to bottled water—either because it is not delivered to those towns, or because the people are too poor to buy water. Not only is the need great in such places, but there is also no threat of offending competitors. Filter businesses started there should have ready access to willing customers.

With this change of direction, each of the four filter groups has begun to select neighboring towns for workshops. They will soon be presenting Aqua Clara with their plans, including locations, timing, material needs (e.g., for tools), communication, and transportation costs.

IV. Beyond Oaxaca: Challenges shaping Aqua Clara's collaboration with other organizations to deliver clean water, using simple, cheap technologies and sustainable business models.

Aqua Clara Foundation realizes that the particular needs for clean water technologies around the globe are varied. For some, the best technology is the household-level filter now being introduced in cases where Aqua Clara is directly collaborating with organizations in Kenya, Mexico, Nicaragua, and Peru. In parts of these same countries and in other Third World countries, the best technology may be one of the following:

1. A larger version of the household-level filter for a school or neighborhood.
2. A different type of technology at the level of the town.

Through extensive conversation with experts in the field, Aqua Clara is in the process of assembling information about the alternatives, which will be made available to anyone going to its website. They are also setting up tech centers (first in the U.S. and then in Mexico) that can give real time technical assistance to anyone working on water purification projects, especially regarding the systems introduced by Aqua Clara.

However, the need for adaptation extends beyond choosing the best technology. Business models must also be chosen carefully to fit different cultures and the missions of Third World organizations with whom Aqua Clara partners to introduce water purification technologies. As we noted in our discussion of the filter project along the coast of Oaxaca, everyone is going through a process of discovery and experimentation, specifically regarding the business models. The mutual help spirit of Habitat for Humanity Mexico means that a *direct* route from organizing technical workshops to the formation of for-profit businesses is inappropriate.

In this section, we discuss a variety of business models that the adopters of Aqua Clara technologies are using to fit their local situations. For example, in Nicaragua, arrangements for filter-building and information workshops, and efforts to extend the household-level filters to rural communities, have been coordinated through the Nehemiah Center (where a number of Christian NGOs have their in-country headquarters). The intention is for the Nehemiah Center to draw up contracts with those who receive training and want to set up filter businesses in their communities. The contracts will help ensure quality control and adherence to pricing guidelines. As in

Oaxaca, Aqua Clara has provided each group with a set of tools and materials for 12 filters, two of which will be located in public places, such as a school or church. Apparently, there are no cultural or other barriers to these businesses operating on a for-profit basis.

On the other hand, in Peru, Aqua Clara is collaborating with a for-profit company that sells rainforest expeditions to tourists. Many residents in a nearby town work at the tourist center and are co-owners of the tour business. Their families' need for clean water persuaded company managers to invite Aqua Clara to offer a workshop in filter construction to interested worker-owners. Filters built during the training of 35 people are being used by their own families. The materials were paid for by the tour company. They plan to fund additional filters—at the rate of about 5 per quarter—through donations from tourists and labor contributed by those who received training. This particular project is not based on a for-profit business model. However, interest in the prospect of receiving training for the purpose of setting up filter businesses has been expressed by people living in nearby forest and river communities.

In Kenya, Aqua Clara is working with a number of partners. Students at a seminary were trained in 2007; and the filters they built were placed in the seminary. The hope was that these seminary students would bring the new technology to their own villages, where businesses could be started. Seminary leaders agreed to facilitate the process. As a result, Aqua Clara was invited to provide workshops in a number of communities. In one case, a pastor who had formed a farmers cooperative (in Busia), hopes that those trained will set up for-profit businesses to be run by the coop, selling filters in the two communities where the farmers live. In another case, a pastor of some

60 churches (in the Machakos area) has received funds from a U.S. church for 12 filters. He will help train others to start up filter businesses. In a third case, a workshop was given to members of a church (in Ainabkoi), and the filters were placed in a number of the town's largest churches. Their plan is to start filter businesses run by pastors, to fund the churches' ministries. In a fourth case, training was given to several people coming from the area surrounding a mission primary school. Filters made at the workshop were placed in that school's classrooms. The trainees plan to form a filter business, and already have orders for filters from schools in the area.

So far, in only one case have we seen the extension of water filter technology in Kenya lead to the formation of a business. However, in this case, the project's beginning was severely handicapped by violent uprisings in the area (2008). As we work with people in various communities, we hope that a variety of business models will be tried and adapted to suit local values, customs, and conditions. As we noted in the discussion of Oaxaca, even within 100 kilometers of each other, communities differ in their expectations and prospects for introducing water filters and for developing a business model that works well in their locality.

At this point, we can see groups using Aqua Clara technology choosing from among the following business/organizational models, each with its own advantages and disadvantages.

1. **To provide members of the organization/church with their own water filters.** A church (or other non-profit organization) may arrange for several members to be trained, with the expectation that those trained will build filters for other families in the church/organization. This might entail having trained

members do the work, with funds to cover the materials coming from each family receiving a filter.

Advantage: There is already a sense of solidarity within the organization, creating a spirit of mutual help.

Disadvantage: The technology does not spread to other people and communities in need.

2. **To earn more revenue for an existing organization.** An organization may arrange for several members to be trained, with the expectation that a business will be run out of the organization, selling filters to others in the area. The revenues might go entirely into the organization's budget, for the sake of paying for existing and expanding ministry/service. Aqua Clara's work in Chiapas, Mexico takes this form. Christian health care workers, trained to work in remote village clinics, have attended Aqua Clara filter-building workshops. These workers manufacture and sell filters in their villages, as a way to supplement clinic revenues, thereby enabling them to serve more people and improve the health of village families.

   Advantage: Usually Christians and non-profit volunteers are well motivated by the desire to serve (God and their communities), especially by contributing time and money.

   Disadvantages: Churches and non-profit groups in areas needing water filters tend to be small. They often already count on members spending most of their "free" time in ministry/service. It is not clear that without a

profit motive the same people would be able to dedicate enough time to manufacture, sell, and deliver a lot of filters.

3. **To provide a source of income to the pastor of a church.** Trained Third World pastors beginning their ministry are often unable to support themselves until the congregation(s) is large enough for members to pay the pastor adequately. As a result, many pastors are forced to leave the ministry just to take care of their families. It is possible for a water filter project to be owned and run by a pastor and his/her family to support the ministry until the church is large enough to pay a salary. This is one model being used in Kenya.

   Advantages: The pastor lives in a community where there is need for cleaner water. There is a strong motivation for the pastor to sell filters, thereby extending the technology to those who really need it.

   Disadvantages: In some places and cultures, it may not be acceptable for a pastor to own a business, to charge prices that make expansion possible, and to dedicate the time and effort necessary to make the business successful while continuing his/her ministry. Furthermore, pastors themselves may not feel comfortable with (or skilled at) running a business. (By *successful*, we mean that the business can support its owner and is able to extend its reach to meet the clean water needs of many more people.)

4. **To share the technology with people in other communities who are willing to start for-profit filter businesses.** An organization may serve as a transfer agent, by sponsoring workshops for interested members and others (in their

own or nearby communities), without any expectation of enhancing church/organization revenues. The workshops would provide information to participants on how to set up their own for-profit filter businesses.

Advantages: The organizations acting as transfer agents are keenly committed to, and serve in, their communities. They understand the local situation and have valuable contacts.

Disadvantage: Many small grassroots, non-profits do not have the staff or volunteer labor sufficient to organize many workshops, provide oversight of new businesses, and regularly communicate with Aqua Clara regarding filter business needs and results.

There are possible combinations of the basic business models mentioned above. For example, an organization might follow **Model 4**, primarily acting as a transfer agent, but expect/require the businesses created through their help to make some contribution to its own work. Or, the organization might charge for the workshops and assess a modest fee (e.g., per unit sold) for coordinating follow-up with the new businesses.

Alternatively, an organization might begin with **Model 1**, providing filters to their own members, but then move to **Model 4**, serving as a transfer agent, sharing the technology with other needy communities in need, where those trained are coached regarding the process of starting up and maintaining for-profit businesses. This is essentially what we are experimenting with in Oaxaca. Such a mixed model could be sustained by asking workshop attendees to cover the cost of training, including planning trips to communities, tools, and transportation of start-up materials to the worksite.

It is not yet clear to us which, if any, of the models we mention above is viable for the purpose of substantially and continually extending the sale of filters to more households and communities. It has been difficult for Aqua Clara to maintain continuous communication with those organizations who have arranged workshops. To date, these have been given by Aqua Clara technical personnel traveling to the sites from the U.S.

Inadequate access to phones and the Internet in many places seriously handicaps the frequency and quality of two-way communication needed to respond to questions, share insights, and report data on a regular basis. This becomes even more problematic as groups from new communities are drawn into the network of those who receive training and start businesses. As a result, we are coming to the conclusion that it will be necessary to have local Aqua Clara "agents" with the time, skills, and connections to oversee expanding networks. We assume that groups like the Nehemiah House in Nicaragua and the seminary in Kenya do not have the staff and finances needed to carry this process very far from their locations and contacts. After all, they have their own unique missions.

If local agents are enlisted, we will have to think carefully about how to do it wisely. Since the beginning, Aqua Clara's vision has been to yoke extension of filter technologies to sustainable business models. This implies that local agents will eventually need to receive a portion or all of their earnings through the business channels they help create and oversee. Aqua Clara is making plans in Oaxaca to facilitate better coordination and communication by funding phone and Internet connections for the leaders of four existing filter groups. Although improved communication channels cannot *substitute* for a local agent, the process of their development may help us identify

one of the current leaders as a potential agent. At this point, we are interested in learning from others about similar strategies for providing the necessary local management infrastructure to support rapid creation of for-profit filter businesses.

V. Conclusions and the way forward.

This paper describes a unique history of collaboration among Hope College, Habitat for Humanity Mexico, Aqua Clara, and an increasing number of communities in the Third World. Missing from the description is the *passion* behind our shared vision; the *humility* it takes to fully enter into any community to share their own dreams, resources, and needs; and the great mutual *delight* that we feel as friendships are made.

It is important to note that clean water was not the place where everything began. It began with a sense of God's call for Hope students to share in the lives of some people in Oaxaca—to learn from them and to dream with them. Further back, the foundation was laid by Habitat for Humanity Mexico (and other groups working in different parts of the world), a grassroots organization that has deep Christian roots, enjoys the trust of their communities, and fosters strong volunteer leadership.

Out of friendship with Habitat for Humanity families, grew our awareness of local needs, toward whose solutions students could work alongside local community organizations through internship placements. Only because Aqua Clara was in the process of being formed in Holland, Michigan at the same time, were we able to connect a unique filter technology with an important local need—for clean water.

In the process of giving workshops and having dialogue with groups in Mexico and elsewhere, we have experienced the difficulties of maintaining two-way

communication, some for lack of ready access to the Internet or phones. The rest is often a matter of entering into the lives of people, with different cultures, expectations, and possibilities for their communities.

We believe that God has been leading throughout this process and ahead of us. We see the need to continue experimenting with, and adapting, business models, so that sustainable filter businesses develop and grow, with the ability to significantly extend this particularly appropriate technology developed by Aqua Clara.

We offer an extensive appendix of technical information about the filter and plans for extending the network. Aqua Clara welcomes opportunities to connect with groups working with other Third World communities who have a need for cheaper access to clean, life-giving water.

The technical side of Aqua Clara International.

The Aqua Clara Water Purifier, a bio-chemical water purifier, is carefully designed to convert water containing concentrated pathogenic microorganisms into potable water using the technology of slow trickle sand filtration. The standards for this purifier are that it be as simple as possible to construct, as cheap as possible to produce, and best at cleaning polluted water. The requirements we began with:

- No moving parts
- No power required
- Constructed with indigenous materials
- Very little maintenance required
- Life span of 10 years or more
- Output Water passes World Health Standards at 0% e.coli

The water purifier is modeled for a 70-100 liter high density polyethylene barrel with a cover, PVC pipe, and a combination of filler material layered with fine sand, coarse sand, gravel, stone and ACX material for disinfection. The materials for the purifier can be scaled for various size containers as needed. The tools that are needed for the actual construction are a barrel, pvc piping, a drill (hand or electric), holesaw – 22mm, drill bit-5mm, hack saw or PVC pipe cutter, tape measure, bucket, and PVC glue. Screens are made to separate the size of stones and sand.

The top layer of the Aqua Clara Water Purifier is an active bacterial field called a "schmutzdecke" which is German for "filth layer". It is this layer that will attack and destroy the water's impurities. The microorganisms that naturally form in the schmutzdecke intercept, digest, and break down organic matter contained in the contaminated water. The good bugs eat the bad bugs. These bugs come from the polluted water that is poured in twice a day. As the water flows through the layers, there is less oxygen available for the microorganisms. The ACX layer completes the disinfection cycle.

Twice a day the purifier should be "fed" with the polluted water. The flow rate is estimated at 1 liter/minute.

AQUA CLARA FOUNDATION
GENERAL PROGRAM DESCRIPTION

Per our mission –

- We've developed technology and designs for inexpensively processing fecal polluted water and providing clean, disinfected water for a family's daily needs
- The present forms of the technology are small, point of use water purification units per the adjacent picture from a Kenyan business
- In specific countries we work with local business people to make these units with local crafts people, using local materials, for their sale to their customers in their markets
  - Made locally, the water treatment unit
  - Typically costs ~$10-11 to make, and sells for ~$15-20
  - Has a projected maintenance cost of ~ $1 per year
  - Has a projected life of 5+ years
  - Cleans 30-40 liters of water per day (dependent on the contaminant levels of the polluted water)
  - Does so at a cost $0.0004 per liter
- As part of the business, a Health & Hygiene business element is included
  - Teaching/training materials for local teachers and medical people, plus
  - Provides access to related Health & Hygiene products as local sales opportunities
- This package is available to each local entrepreneur or group in the form of a fully detailed business franchise
- For perspective, several new locally owned businesses are making these water treatment units in Kenya, Mexico, Nicaragua and Peru which is part of an on-going and expanding program
- In addition, we have designs using this technology for the management of other pollutants including arsenic, mercury and other heavy metals; and manufacture of higher output, inexpensive water purification units

ACF works directly with local entrepreneurs as well as through intermediaries such as NGOs, missionaries, and volunteers. For those persons and organizations with contacts who may be interested, ACF has fully prepared resources to facilitate technology transfer and business launch (see photo below of a training session in Peru). These modules (ex: Transfer Agent and Program Manager modules) are fundamental to our work, as by passing on such information the spread of ACF technology can be scaled significantly in order to reach the largest number of persons in need.

In Summary –

- Our mission in this work and program is

  "To provide clean water to those in need as a tool for the transformation of lives"
- Our goal includes doing this in a sustainable fashion
- Our programs are all structured so as to also teach us
- Our value system in its pursuit is that as Christians
- Our vehicle for accomplishing the mission is to develop and work with for-profit, locally owned, businesses and local entrepreneurs

In this pursuit, we have and will continue developing the franchise package so as to help build these self-sustaining businesses. We have a generic business model; however, we locally morph the package with the local business people to fit their specific, local conditions and opportunity.

453-3

2.1 PURIFIER CONSTRUCTION

H$_2$OPE

DETAILED STEP-BY-STEP

STEP 1: Drill hole in purifier body

DRILL A 22 MM (7/8") HOLE APPROXIMATELY 10.16 CM (4") FROM THE TOP.

STEP 2: Cut PVC pipe to appropriate length

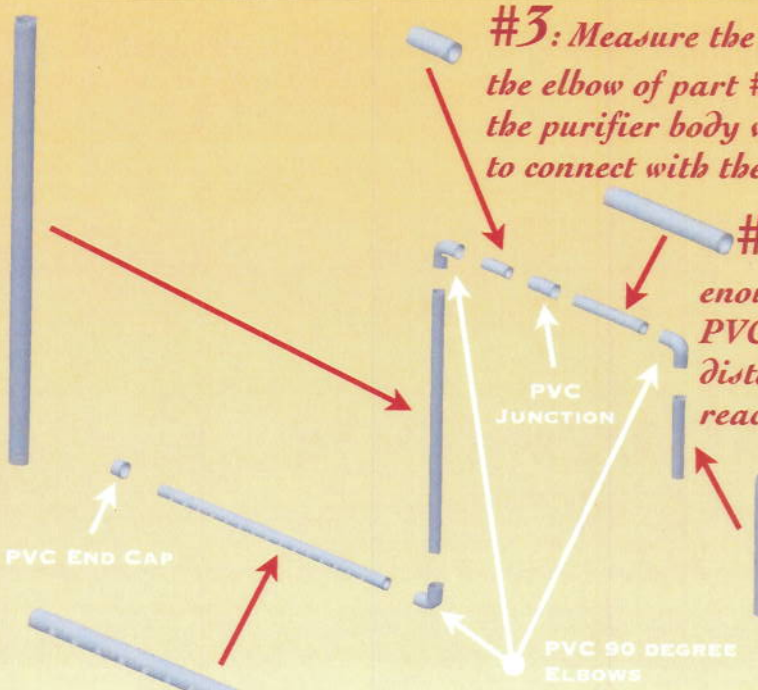
CUT SECTIONS OF PVC PIPE TO FIT APPROPRIATELY INTO THE PURIFIER BODY. SIZES TO BE CUT ARE SHOWN IN DIAGRAM BELOW.

#2: *Measuring from the elbow of part #1, determine the length required to reach the hole drilled in the reactor body. Cut this length.*

#3: *Measure the length needed from the elbow of part #2 to exit the hole in the purifier body with just enough space to connect with the PVC Junction.*

#4: *Cut a section long enough to extend from the PVC Junction to whatever distance is needed to reach the receptacle.*

#5: *Cut a section of whatever length is convenient for the water spout.*

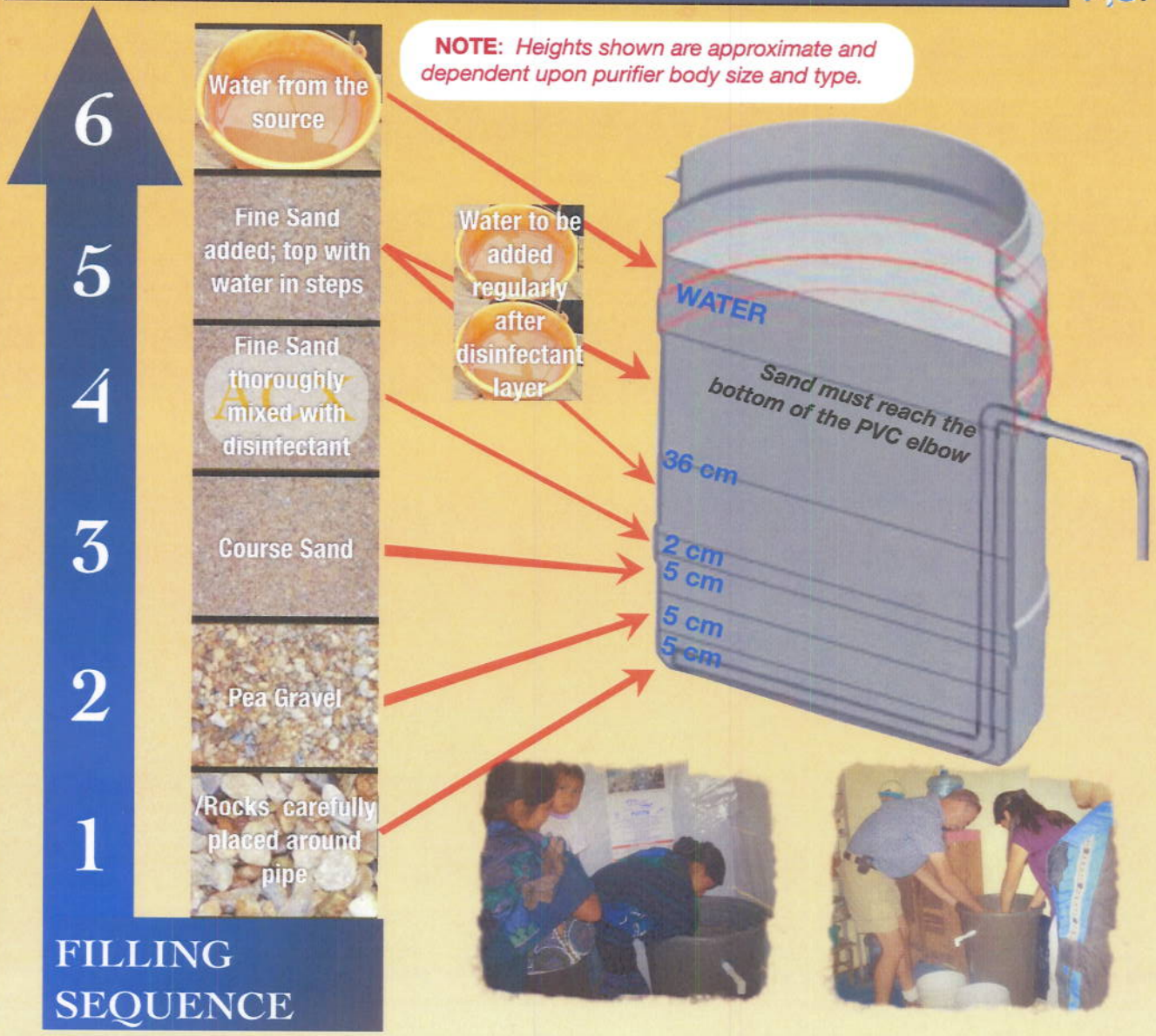


#1: *Measure bottom of the purifier body - cut PVC to appropriate length so that with end cap and elbow, the pipe fits snugly across the bottom.*

STEP 3: Assemble PVC sections without glue to ensure proper fit.

CUT TO MAKE ANY ADJUSTMENTS THAT ARE NECESSARY.

2.3 FILLING THE PURIFIER

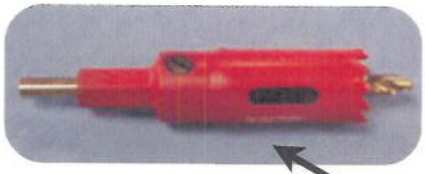


1	By hand, carefully place the stones (2.54 cm / 1") at the bottom of the reactor body until the pipe is completely covered. Be careful to not damage pipe. An approximate height of 4 cm.
2	Pour smaller pea gravel (1.27 cm / 1/2"); a 4 cm layer should result.
3	Pour course sand (.8-1.2 cm / .32-.46"); a 4 cm layer should result.
!	From this point forward, **water should be added occasionally** to ensure no air bubbles are trapped. When pouring water, **BE CAREFUL TO DISPERSE THE WATER TO NOT FORM CHANNELS IN THE LAYERS.** Using a colander, plate, upside down bucket, or hand to disperse is recommended. Tap the sides of the container to 'burp' out any possible air bubbles.
4	Evenly mix 135 grams disinfectant (ACX) with fine sand; pour to form a uniform 2 cm layer (do not add water).
5	Pour fine sand, in sections **(adding water at least two more times)**, to form a layer of at least 36 cm. This layer must reach exactly the bottom of the PVC elbow. Ideally this is a 40 + cm layer.
6	Now, pour water slowly, diffusing so as to not disturb the sand, until water reaches to top of the PVC pipe neck and water begins to flow from the nozzle.

CBCR PURIFIER CONSTRUCTION: Tools Required

H2OPE

TOOLS REQUIRED FOR PURIFIER CONSTRUCTION



- Drill - Hand or Electric

- Holesaw - 22 mm (7/8") (From ACF)

- Drill Bit - 5 mm (3/16")

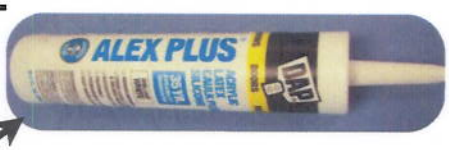
- Hack Saw or PVC Pipe Cutter
- Tape Measure

- Pen/Marker
- Bucket - 18 or 20 Liter

- PVC Pipe Glue

OPTIONAL YET USEFUL

- Multi-Tool

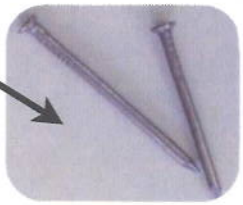


- Waterproof Caulk and Caulk Dispenser

- Wood Drilling Block

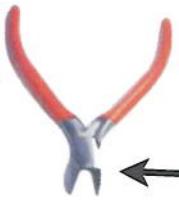
TOOLS REQUIRED FOR SEIVE CONSTRUCTION

- Hammer
- Nails - 50 mm (2")
- Wood Saw



- Tape Measure *(repeat from above)*
- Pen/Marker *(repeat from above)*

- Scissors



- Wire Cutter

CBCR PURIFIER CONSTRUCTION: Materials Required

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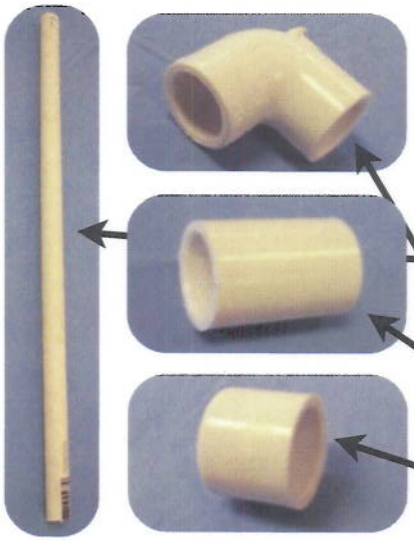
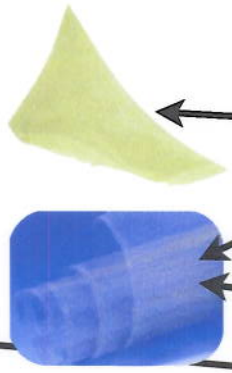


MATERIALS REQUIRED FOR CONSTRUCTION OF PURIFIER BODY

- Container - 70-100 L capacity, durable plastic, with cover
- 1.0 m of 1.27 cm (1/2") PVC Pipe
- PVC 90 Degree Elbow Joints (3)
- PVC Junction / Union
- PVC End Cap (*if available*)



MATERIALS REQUIRED FOR SIEVE CONSTRUCTION (3)

- 45 cm x 45 cm *(approximate)* Mosquito Screen
- 45 cm x 45 cm *(approximate)* .64 cm (1/4") metal screen
- 45 cm x 45 cm *(approximate)* 1.27 cm (1/2") metal screen (2)
- 6 m of 1.9 cm x 1.9 cm wood
- 6 m of 1.9 cm x 9.55 cm wood

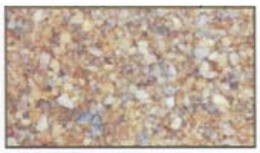
REQUIRED FILLER MATERIAL (WASHED)

FINE SAND
Enough to reach bottom of PVC elbow - about 36-40 cm of height.

Estimated Quantity: *Two 18 liter buckets.*

.8-1.2 CM (.32-.46") COURSE SAND
Enough for 5 cm of height in the container.

Estimated Quantity: *1/3 of an 18 liter bucket.*



1.27 CM (1/2") PEA GRAVEL
Enough for 5 cm of height in the container

Estimated Quantity: *1/3 of an 18 liter bucket.*

2.54 CM (1") STONE
Enough to cover pipe at bottom of container (5 cm).

Estimated Quantity: *1/3 of an 18 liter bucket.*

ACX - *FROM ACF*
Granulated metal alloy for disinfection. To be mixed with fine sand.

Estimated Quantity: *Approximately 135 grams... or 1/4 cup*

AQUA CLARA FOUNDATION
MICROFRANCHISE TIMELINE

Site Selected:
Preconditions Met

On-Site Purifier Manufacture
Training & Certification:
Initial Set Completed

Reexamine Feasibility Report; **Business Plan** Adjusted as Needed

Business Growth:

- Kids-to-Kids Program
- Health & Hygiene Training
- Health & Hygiene Products
- Other Products

1 2 3 4 5 6 7

Market Studied:
Feasibility Report Completed

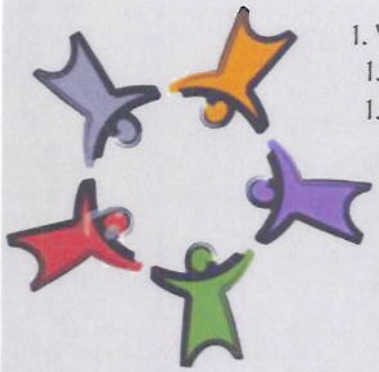
Initial **Purifiers Tested** and Proven Functional

Official Business Launch:

- Legal Entity
- Business Plan
- Franchisee License
- Startup Support
- Tracking Procedures

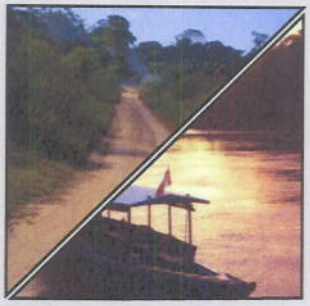
MICROFRANCHISE BUSINESS MODULE
BUSINESS ANALYSIS & PLANNING

The figure below displays the different components that must be contemplated while evaluating the potential for an ACF business franchise startup in a given location. The following pages cover these issues in more detail - the *whys* and the *hows*. Additionally, a more wide-ranging view of business planning can be found in *Franchise Launch: Business Analysis and Planning* [FullFranchisePlanning.pdf].



1. Water Source:
   1.1 Need established
   1.2 Location

2. Community:
   2.1 Community knowledge
   2.2 Market potential
   2.3 Program adaptation & support potential



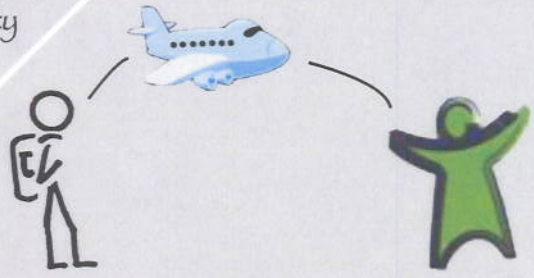
3. Transportation:
   3.1 Supplies and product transportation network
   3.2 Method and cost feasibility

1. Tools Needed:
   1.1 Availability
   1.2 Cost
   1.3 Startup Support

2. Materials Needed:
   2.1 Availability
   2.2 Cost
   2.3 Convenience

3. Production Space

3. Communication Maintenance Capability



1. Established Communication Relationship

2. Local Trust Relationship / Potential Franchise Owner