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Recommendations to ASDENIC for a Potential Water Social Enterprise

David Hong

Elia Kazemi

Aidan O'Neill

Miller Center
for Social Entrepreneurship

AguaNic: Proposal to ASDENIC for Launching a Drinking Water Social Enterprise

Elia Kazemi, Aidan O'Neill, and David Hong
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Santa Clara University
www.scu.edu/MillerCenter

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Prepared by:

Miller Center for Social Entrepreneurship | Santa Clara University

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Executive Summary

Opportunity

People living in rural and semi-urban communities in Northern Nicaragua drink contaminated water on a daily basis and struggle with the effects on their health. ASDENIC is in a unique position to create a social enterprise within its organization to provide sustainable clean water solutions to the communities it already serves, and beyond. By distributing and/or manufacturing affordable, effective household water filters, this enterprise could fill an important need through a financially self-sustaining model.

Research Activities

We conducted 70 semi-structured interviews with potential beneficiaries in six communities: Daraili, Bramadero, Buena Vista, El Pegador, Condega, and Las Sabanas. Additionally, we administered 37 written surveys of 20 questions each and conducted two focus groups with a total of 10 participants, all in rural communities. We met with 15 key informants from local water nonprofits, local governmental organizations, and ASDENIC employees to gather contextual knowledge on the history and infrastructure of water purification efforts. All activities were conducted in Spanish. We took 24 water samples from public and private water taps in rural, peri-urban, and urban areas to test levels of bacterial contamination. In addition, comprehensive water analysis tests funded by Miller Center were conducted, prior to our arrival. These tests assessed bacteriological, material, and chemical contaminants at regional water sources. Our interviews, surveys, meetings, and tests provide a blend of qualitative and quantitative data on the current drinking water situation from environmental, economic, and public health perspectives.

Key Findings

There is a need. On average, 90% of water tests conducted in rural communities in private and public faucets showed levels of coliform that exceeded WHO guidelines for acceptable drinking water. In addition, the vast majority of participants we interviewed expressed concern about the quality of their drinking water with a smaller, yet still significant portion reporting that someone in their family was currently experiencing diarrheal issues related to their water.

There is a market. A majority of individuals we interviewed stated they would be willing to pay for a filter that would provide cleaner water but currently this type of product is not accessible to them.

Research Deliverables

We provide a comprehensive report of our findings to inform ASDENIC on proposed next steps towards creating a water social enterprise. This report includes: an analysis of the drinking water market condition in the Segovia region in Northern Nicaragua; a detailed needs assessment, including a water quality report; and, recommendations to ASDENIC based on our key findings. The proposal section outlines the strategy we recommend, while the remainder of the report describes different paths to reach the social enterprise potential.

Recommendations

We recommend that ASDENIC create a subsidiary under the name AguaNic. The first step for AguaNic would be to launch a pilot program to test the market and inform next steps. If this market-sensing effort produces the results anticipated, we suggest that ASDENIC begin selling in-home ceramic filters. To distribute the filters, we recommend either a pop-up or mobile store that gives access to both semi-urban and rural communities. AguaNic would support outreach, sales, and post-sale customer services as well. Community safe-drinking water committees (CAPs) could take a variety of roles from community financiers to health promoters. Payments can be modeled after several options designed for expensive items in the US market, including layaway and down payments.

I. Our Proposal

This section outlines our recommended strategy for ASDENIC to launch a drinking water filter social enterprise (hereafter, enterprise). The strategic recommendation in this section conveys our suggestions, grounded in our research activities, for how to launch the enterprise. The balance of the report presents and evaluates other entrepreneurial approaches to enhanced access to clean drinking water.

Regardless of which business model ASDENIC develops, such a venture will require significant entrepreneurial leadership and expertise. Ideally, the subsidiary, a partner organization, or a manufacturing plant will be overseen by someone with high-level experience in the consumer goods industry. This leader should be skilled in organizing a small, driven team as well as executing community marketing efforts. Other areas of expertise should include last-mile distribution or other unorthodox retail experiences. He or she will be responsible with communicating the vision of this enterprise to the rest of ASDENIC, as well as his or her own team, and representatives within each community. Therefore, motivational and communication skills are key. If ASDENIC starts a manufacturing plant, the project manager will need to be adept at cost-benefit analysis and operational logistics, including supply chain management.

A. **ASDENIC Creates a Subsidiary Organization, AguaNic**

1. AguaNic launches by purchasing, within Nicaragua, ceramic in-home water filters
2. Filters are sold:
    - In temporary store fronts (where there is sufficient population density)
    - At pop up stands or out of trucks at community events (especially in rural areas)
    - By convenience stores in semi urban markets
3. ASDENIC and AguaNic collaborate with CAPS (local drinking water committees) to community health and safe drinking water with water filters
    - ASDENIC develops educational materials to stimulate awareness and demand
    - AguaNic sells water filters at community events and celebrations
4. AguaNic requires down payments on filters to assure that distribution costs will be covered
    - Offers layaway payments as an option for customers with lower income
    - If this payment approach proves unsuccessful, transition to community savings fund is an option

B. Pilot Program (market-sensing)

1. A Pilot Program is a low risk method of receiving feedback from potential customers. It is an example of a market-sensing activity, designed to gather in-depth knowledge on the attitude of the market towards the company and product. Market-sensing differs from market research in that it focuses on the needs of the community rather than the needs of the company. It creates a platform for customer opinions to be heard and feedback to be implemented

2. Test the potential success of a water social enterprise by the launch of a small-scale operation in one community

3. The Pilot Program could be led by employees of ASDENIC or contractors, with support from interns or future Global Social Benefit Fellows.

C. A Staged Approach to Launching AguaNic

1. Discuss these recommendations with the ASDENIC team, CAPS, and relevant local governments to gain support

2. Pilot program launch

3. Assign or hire a small team to lead this venture by creating a subsidiary of ASDENIC. The leader of this team must have an entrepreneurial or strong business background as well as a foundational knowledge of the communities. Ideally, he or she would be able to build upon the relationships and trust built by ASDENIC employees

4. Execution of the marketing channels described in the following sections in collaboration with CAPS or other local water suppliers

5. Bulk purchase of ceramic filters from a domestic supplier (quantity dependent on level of interest generated by marketing)

6. Sale and distribution of filters

7. Evaluate the opportunity to launch a small-scale manufacturing plant at Estelímar to scale enterprise

We are confident that the needs of this market, combined with the relationships and expertise of ASDENIC, create an environment for a viable and successful social enterprise. It is our hope that this report serves as a valuable guide throughout this process of establishing a water social enterprise in Northern Nicaragua.

II.Business Model Recommendations

A. The Relationship Between ASDENIC and the Enterprise

The role of ASDENIC is crucial to all business models we outline. Strategies for taking advantage of ASDENIC's positive reputation in these communities, plus its ability to support operational, and financial management activities, are fundamental to the successful launch of the enterprise, regardless of business model chosen.

We outline 3 possible business models: 1) ASDENIC as a parent organization sponsors the water social enterprise as its subsidiary under the name AguaNic, 2) ASDENIC launches a partner drinking water social enterprise with the name AguaNic, and 3) ASDENIC manufactures and sells water filters with operations and finances conducted under a subsidiary or a partner. Business models are necessarily flexible, and can evolve in response to changed conditions; they are not mutually exclusive. A single business model should be selected in order to launch this effort; however, the enterprise may change its business model over time. For instance, the enterprise could conceivably begin with option 1, transition to option 2, and eventually develop option 3 when distribution networks are robust.

First Model — ASDENIC Sponsors a Subsidiary Organization AguaNic: In this business model, ASDENIC is the parent and host to the smaller subsidiary enterprise. Operationally, ASDENIC would play the key role in business and organizational advising, in addition to maintaining and managing stock of the water filters. The subsidiary, on the other hand, would be a smaller team within ASDENIC that is in charge of the marketing, education, and direct sales via pop-up stands or mobile truck stores (See Channels and Marketing sections for more details).

The subsidiary's main duties would be sales, distribution, marketing, and education. Marketing and education would be absolutely essential aspects to the success of the enterprise for two reasons: 1) The two are very much in tandem--helping people realize the connection of clean water with health will lend itself to the importance of purchasing a device that helps clean water, and thus better health. 2) Education on maintenance will be essential for both the continued efficacy of the filter for families and also the prolonged continued business of replacement filters that need to be purchased.

ASDENIC would be responsible for raising the initial funding to launch the water social enterprise. We recommend pursuing program grants to secure start-up capital. The subsidiary, in turn, would need to work closely with its parent organization to make sure it is reaching its sales targets and revenue goals so that in time, the enterprise could be financially self-sufficient.

Pros: This option assumes that ASDENIC would provide significant leadership in the launch and growth of the enterprise. The ASDENIC name has a very positive reputation, and the community connections led by ASDENIC would confer trustworthiness on the new enterprise. However, misunderstanding or confusion could result were a non-profit NGO like ASDENIC to develop a "for-profit" social enter-

prise with the same name. To mitigate this potential issue, transparency would be essential. ASDENIC would have to clearly communicate the relationship between its historical non-profit mission and new, for-profit activities of this subsidiary enterprise, even with the AguaNic name. This business model emphasizes the major strengths of each organization and delegates responsibilities: ASDENIC does what it does best, and the subsidiary develops entrepreneurial expertise.

Cons: A potential drawback could be the perception of some community members of the incompatibility of ASDENIC's reputation and history as a nonprofit with "for-profit" business activities. It would be very important to carefully communicate the reasons for the evolution in mission to the communities long served by ASDENIC, and particularly how they might benefit from the AguaNic approach.

Second Model — ASDENIC Launches a Partner Enterprise AguaNic: In this business model, ASDENIC functions as a partner to a new enterprise, rather than as a parent organization. The operational roles are very much similar to the first model, but ASDENIC plays a supportive role rather than acting as direct sponsor. The financial relationship between the organizations would be essentially the same as the first model, but the AguaNic enterprise would have more decision-making autonomy. The enterprise would lead efforts in sales, marketing, and education. It would need to invest more effort in marketing, since it would be essentially starting a new venture.

Pros: In this model, ASDENIC would not have to worry about confusing local community members with an evolution in mission through the development of a for-profit subsidiary. In addition, the new organization could benefit from association with ASDENIC, but have a distinct for-profit mission.

Cons: The relationship between ASDENIC and this partner organization would have to be clearly understood and communicated. To succeed, the partner organization would have to take advantage of the deep knowledge of local communities held by ASDENIC. With no track record and institutional success, raising start-up funds would likely be significantly more challenging, possibly delaying the launch and therefore the impact of AguaNic.

Third Model — ASDENIC as Manufacturer: This business model differs significantly from the prior two: ASDENIC would manufacture ceramic water filters. This would require a significant amount of organization, financing, time, and manpower; however, this model would have several advantages over the long term. ASDENIC currently has two properties: their office in the middle of Estelí and Estelímar, a hostel/park/museum/education farm on the outskirts of Estelí. With a cocoa liquor and juice production facility already on-campus at Estelímar, a ceramic water filter production factory could be established as well, since there seems to be more than adequate space. ASDENIC would continue with business and organizational support with the added responsibility of maintaining the water filter factory and the production of water filters. A key resource for details on the initiation of a ceramic filter factory can be accessed through Potters for Peace (PFP).[1] Either through the use of their free online sources or through a professional partnership, PFP could assist ASDENIC with the initial steps of construction and operation.

Becoming a manufacturer is a significant investment, but it would cut down unit costs. To take advantage of the economies of scale in this situation, sales and marketing efforts should expand geograph-

ically, to other communities and even outside the Segovia region. With the significant added risk this represents, we recommend this model be explored and potentially implemented after successfully starting a filter market with model one or two, and ensuring there is an effective distribution system.

Pros: Once the factory is built, this model has many advantages. It would bring an affordable sales cost to people who need it the most. It would provide employment. It would reduce the cost of wholesale purchase of filters from a separate manufacturer selling it at their sales costs. Instead of increasing financial profit, ASDENIC and its subsidiary would be significantly increasing social gains by allowing more people to filter their water.

Cons: A major con that we see potentially occurring would be the administrative hurdles required to approve, build, and finance such a factory. ASDENIC would have to devote considerable effort to obtaining funding. A capacity development grant could be sought to fund this capital expense. In addition, there are questions of if there would be enough support within ASDENIC for such a task or if it is financially viable. Some stakeholders at ASDENIC might understand the relationship between its historic activities and such a new venture. Importantly, without a distribution system created by model 1 or model 2, manufacturing filters alone will not solve the problem.

B. Market Development and Marketing

Critical to the success of a water social enterprise is the required behavioral change of potential customers. Our interviews revealed that CAPS (local drinking water committees) are struggling to receive all of the monthly payments from community residents. If a seemingly small payment, even by Nicaraguan standards, of 15-30 cordobas (~$0.50-1.00) every month for a more than sufficient amount of water is hard to come by, how could anyone ever convince individuals to pay for a 600 cordobas (~ $21.00) water filter?

The key is establishing the connection between clean water and improved health. Furthermore, with good health comes increased time and money saved from sickness that would have otherwise forced them to stay home from work to either care for themselves or their child and from purchasing medicine. Since children are the most susceptible to water borne illnesses, we recommend the water filter be marketed as a purchase for the family and for everyone's health.

In order to effectively establish a health connection with clean water, marketing and education would be an emphasis for the subsidiary. Drawing from the marketing and education approach of the already established and successful Naandi Foundation,[2] a water social enterprise in India, we propose a similar "Safe Water Promotion Program." In essence, this Safe Water Promotion Program is an integrated aspect of what the subsidiary does but in 3 separate "phases":

1. Initiate pre-sale education and marketing. A few weeks prior to a proposed pop-up stand or mobile truck vendor, a Safe Water Promotion Team will travel to the community to help with education, marketing, and to gauge demand. This team would work closely with the local water committees (CAPS) to help schedule community wide events that have an entertainment theme such as a film or cultural event

with the added aspect of incorporating health and water education to this event (see section "Role of ASDENIC"). In addition to these events, the Safe Water Promotion Team would visit and work with schools to help educate children in an interactive manner on the importance of hygiene, clean water, and the connection of disease with contaminated water. For example, a demonstration of water tests before and after filtering could help both educate and market.

2. Deploy pop-up stands or mobile truck vendors. Evidence of interest during the pre-sale phase would help determine how long the sales team (could be same members of the Safe Water Promotion Team) should stay in a certain community. For example, a team might stay a week setting up shop in different parts of the community or they may otherwise just stay for one day in one spot in the central part of town. In addition to pop-up stands, employees can go door-to-door to help reach more customers on a personal level. Whether it is a mobile truck or pop-up stand (or a mixture of the two), the vending site should be well painted and designed with tabled demonstrations of the water filter. High quality of the filter and "brand" are aspects that would want to be emphasized by these demonstrations. For those that purchase a water filter, they would be given a small banner flag to not only help employees identify houses that have a filter so that they can assist in maintenance, but it would also serve as a social indicator to other households that they purchased one of these filters implicating the expressed desire to keep their family healthy. Social pressures can be powerful aspects of purchasing decisions.[3]

3. Provide post-sale support. This would take the form of continued education about health and how to maintain the filter. Either several weeks but no more than a few months at a time, the Safe Water Promotion Team would travel to communities assisting in questions, concerns, maintenance, continued education, and assurance of product usage. A key condition for the efficacy of water filters is that they be used correctly, cleaned regularly, and their filters replaced accordingly. Water filter users would be asked to demonstrate how they use and clean their filters to employees to help make sure that they are used correctly. Because water filters need to have their filters replaced at least every two years, these post-sale visits are a way to retain customers. In addition, any further sales can be made to families who did not make their purchases the first time around.

The above elements should be carefully aligned with the agricultural rhythms of the year, since this shapes the major purchasing decisions of rural communities. Since the majority target market are farmers, their income arrives in large waves at only certain times of the year during harvest. Thus, most of our pre-sale and sale events will occur around these months when farmers actually have the money to spend as opposed to the end of the growing season, when farmers are short on cash.

C. Technology

We evaluated a variety of clean water technologies to assess suitability for northern Nicaragua. We recommend household ceramic filters as the most appropriate for this venture, and have examined two other possibilities in depth.

We recommend the Filtron ceramic filter, which can be up to 99.99% effective at decontaminating water when used effectively.[4] It is already being made and sold at various factory locations in Nicaragua. The primary buyers are NGOs, which generally distribute the filters free of charge. Almost

every component of the filter can be sourced and made in-country, which is a benefit since it provides jobs and keeps shipping costs low. The number of jobs it would create would be minimal due to the fact that 3-4 workers can turn out up to 50 filters a day.

Another benefit of the ceramic filter is its size and ease of use. In our interviews, more respondents were familiar with the ceramic model than with the alternatives. The methods of cleaning and replacing ceramic filters would benefit the enterprise in two ways. First, ceramic filters have a history of being promoted by Potters for Peace in Nicaragua, and this organization has extensive marketing and health education resources already available and tailored to the region.[5] Furthermore, ceramic filters require a replacement part that must be purchased. This feature could be woven in to the business models we propose, since it creates opportunities for the enterprise to engage with the customers and provide ongoing education about water quality and health.

Biosand filters could also be incorporated into this model. The plastic component for each unit weighs 8 pounds, which makes it easily transportable; the sand, rocks, carbon, and other elements needed can be locally sourced by the consumer. One negative aspect of the biosand filter is the complicated nature of assembling and replacing the components when necessary. More instruction would be required than for a ceramic filter. Also, with a cost between $75 and $100, the biosand filter would be very difficult to sell without some kind of payment mechanism to ease the burden on the target consumer. The benefit of the biosand filter is that its lifespan is ten years when used effectively, making it slightly more sustainable than a ceramic filter, which can have a lifespan of anywhere from 2 to 9 years.[6]

We also researched options outside of Latin America for another filter model that may prove promising. Other Global Social Benefit Fellows worked over the summer with a successful enterprise named Nazava, which operates in Indonesia. Nazava offer a variety of different filters that are safe and effective. They are made in either India or Brazil but offer a significantly lower cost of $9, or $6 in bulk. It may be difficult or expensive to arrange to import these.

D. Activities for Channel Development

These channel activities correspond to the business model options in part A. This section details how the product can most effectively reach the customer in each of the business model scenarios:

Whether or not ASDENIC chooses to pursue a manufacturing role, AguaNic would need to distribute and sell the filters. As a subsidiary, AguaNic would begin distribution in semi-urban and rural communities primarily through pop-up stores or kiosks. These would be placed or constructed in semi-urban areas that would be publicized and operate independently of other businesses. It could also be possible to reach the rural communities from these semi-urban locations. These stores would not be permanent but rather be open for short periods of time in order to test the market and establish the brand.

Another option is to create a mobile store that brings the merchandise in a truck or trailer able to reach rural areas and sell directly to remote communities. We have identified a case in which the mobile approach is used for water; however, there are instances of mobile clinics for health. The mobile option could be beneficial for a variety of reasons. Primarily, it would allow the enterprise to reach more con-

sumers directly and allow for door-to-door marketing. Many rural locations are spread out and many people don't have a reliable form of transportation. This mobile method brings the product directly to their doorsteps, saving them money and time. This is also consistent with ASDENIC's history of regularly visiting rural communities and their willingness to bring services, or in this case, life-saving products, directly to those who can benefit.

If AguaNic were to be established as a partner to ASDENIC, as described in the second model, it would need to allocate more funding to the distribution and marketing portion. This could allow it to follow more distribution paths such as adding inventory to an existing hardware or appliance store in a semi-urban location. This would not give ASDENIC as much control over sales and the education that would be necessary to supplement the filters but it would require the least amount of distribution cost. However, differences may exist between stores with respect to revenues and costs and how these are split between the enterprise and the store. It may require purchasing shelf space in the store and keeping the revenue, or not paying for shelf space but rather sharing a percentage of the revenue with the store owner for retailing services.

The third model involves ASDENIC as both a manufacturer and distributor. The Estelímar property could host a ceramic filter factory which would not require space and potter employees. The factory could be featured as a crowning aspect of the Estelímar "technopark", adding value to their offsite location. The factory would be able to turn out as many as a hundred filters a day assuming several kilns are constructed. ASDENIC's city office could be used as a potential storefront or one could be created at Estelimar in addition to the factory. This would allow them to tap into the urban market before attempting to reach the semi-urban and rural areas and could be beneficial in establishing the brand and gaining some initial revenue. It would allow them to charge a higher price in the urban area, which could contribute to increasing initial revenue. However, the impact in more rural areas might be delayed.

E. Payment Options

Based on the low purchasing power of the large majority of potential filter customers, payment options that lower the financial risk to the buyer are necessary, at least initially. We evaluate a few options that could satisfy this important requirement.

Installment Plans: These are probably the most common payment tool used by other social enterprises (e.g. Elsevier, an off-grid energy company in Malawi).[7] Services from hotels to schools take advantage of the "time is money" mindset to lower the perceived cost of a product by segmenting payments into manageable chunks over a set period of time. The cost of this convenience is the interest rate on payments made after the product has already been received, but this rate can be set very low or even at zero if the main goal is to reduce the financial burden of customers. For some products and services, the seller is also able to ensure timely payment by repossessing the product or discontinuing the service if the customer misses deadlines.

Despite benefits to both the buyer and seller for expensive items, installment plans would not be successful for a water filter social enterprise because the product represents a higher risk in the case of a customer not paying the full amount. Customers who stop making payments would have to be tracked down individually, and even then a repossession of their water filter represents a tricky moral dilemma. An employee of the social enterprise would have to enter the customer's home and physically take back a

filter that was not paid for to ensure installment contracts are taken seriously, which would violate their human right to clean water.

Layaway: These payment plans are essentially a reverse installment plan. Payments are divided evenly across a set number of periods, but the customer does not receive the product until most or all of it is paid for. This allows the customer to budget more easily while dramatically reducing the financial risk incurred by the seller, since the product can be withheld until payment is received and the customer is incentivized to pay the full amount as soon as the first payment is made. The time value of money can also be a tool to effectively discount the product since payment is being made in advance, the same way an interest rate would be charged if the payment were made afterward.

The major disadvantages of this model are that the seller must agree to reserve the product for the customer in advance and have it ready when the agreed upon amount has been paid. Collecting payment several times instead of once can also be an extra burden, often referred to as "shoe leather costs," depending on the financial services available to the customer and seller (e.g. mobile banking, timely postal services, etc). These resources were largely absent in the communities we worked in, so it may be necessary to designate a money collector within each community or to collect payments when making visits to distribute more filters. A similar option is down payments, which includes paying a portion (e.g. 10-20% of the total cost) in advance to reserve the product, but making only one more payment of the entire remaining balance once the filter is received. From an impact perspective, a disadvantage of this model is that the families would not start benefiting until the filter was in their homes, thus delaying impact.

Community Savings Fund: This fund would function much like layaway payments, except that payments would not go directly towards a single filter for a single family. Instead, money would be pooled within a community until enough is raised to pay for a viable number of filters to be delivered. One or several community members would be tasked with informing their community of the purpose of this fund as well as the financial mark necessary for the contributors to receive filters. This would allow families to pay as they are able to, while at the same time generating social pressure to contribute to allow their neighbors to receive filters.

There are different ways of implementing this model. Under one method, it could function basically like a group layaway payment where the money is pooled instead of paid to the enterprise, and families have more flexibility to pay less or more than the cost of an individual filter, much in the same way that some community members currently overpay for their monthly water supply voluntarily. The financial goal would be a function of number of contributors multiplied by price per filter. A less direct method sets a lower financial goal for a certain number of filters, and as many families as possible are encouraged to contribute. Once that goal is reached, that certain number of filters are distributed to the first priority of contributors (e.g. families with small children, families with illnesses). Not all contributors receive a filter, so the fund renews with these filterless contributors climbing on the priority list.

This model ties in well with the egalitarian, participatory and communitarian attitudes we observed in this region. Many expressed concerns that cleaner water in the household would not be an improvement if their neighbors still had dirty water. This funding model plays to the values of these potential customers. However, it does also pose potential conflicts on how to prioritize families and how much a family must contribute to even be put on the list. This approach requires careful attention to appropriate

flexibility. More flexibility in this system may allow more customers to receive filters, however, this may also result in more error and argument, or mismanagement. The communities' trust in the seller is key in this model, so a conflict of this nature would be a damaging blow.

F. Possible Roles of CAPS

Nicaragua's Comites de Agua Potable y Saneamiento (CAPS - Safe Water and Sanitation Committees) could play an integral role in the solution to clean, affordable drinking water no matter what form the enterprise takes. CAPS are established by local governments, and generally enjoy the support of local communities. The relationships they have within the communities are too valuable to disregard, indeed, CAPS are composed of local community members.[8] However, their exact role is not clear, and may differ by community. Committee members are elected and serve two year rotations, so any engagement with the enterprise would be short term. Questions would arise about the legal and moral appropriateness of elected officials helping an enterprise, even it helps their constituents. We evaluate these factors below.

Franchisers: Our initial idea, discussed briefly during the final presentation with the ASDENIC team, was to encourage CAPS to become franchisers of the enterprise. Local franchises in rural communities are very common in water social enterprises, and the previous experiences the CAPS have attained running their community water systems, along with strong pre-existing relationships with ASDENIC, make them ideal representatives of the business. Selling water filters and educating customers on their proper usage could fit smoothly into their monthly routines of collecting payments for water from each household.

Global Social Benefit Fellows with CAPs members.

However, we have determined that this option is inadvisable because of the conflict of interest the CAPS would have as employees of a company who take advantage of their position as elected officials to sell a product. Members are chosen to provide the cleanest water possible to their communities, and if they were to make money selling a company's product to the community, they would most likely lose trust within the community.

Promoters: In order to ease this potential conflict, CAPS could instead take on a role as informal promoters. This would represent a direct marketing channel for the enterprise through a very credible source. CAPS would spread awareness of filter purchase options - key details such as when, where, and price they would be sold - and recommend that families buy one based on the knowledge that their own purification system is imperfect. This would be word of mouth marketing, but could also take the form of informational flyers or even setting up community events that representatives of the enterprise could attend to sell or promote filters.

This level of involvement would certainly create some discussion on what CAPS get in return for their efforts. To avoid the same conflict as the franchiser model, one possibility is sharing revenue from the filter sales with the community water fund. Several CAPS members reported that their organizations are in debt because total payments still do not always cover operating costs of tube maintenance and chlorine tablet purchases, so diverting some income from filter purchases towards this fund would reward CAPS for their efforts without creating a moral dilemma by compensating them individually.

Health Educators: Regardless, CAPS could function simply in an educational capacity. Almost all types of water filters take some level of learning to use properly, and this can be a crucial barrier both to keeping customers (frustrated filter owners will not buy replacements) and to gaining new ones through customer recommendation. Ensuring that families know how to use the filters after the purchase would eliminate a costly step for the enterprise while remaining a normal part of the CAPS role.

Each CAPS member could have a designated set of customers who they check in with at set intervals (for example: one day after purchase, two weeks after purchase, two months after purchase, and one year after purchase). These visits would begin as instructional sessions to teach the family to use their new appliance properly, but over time the purpose would gradually shift toward checking to make sure all parts are still working properly and noting when replacement parts become necessary.

Financing Organizers: If the enterprise uses the community savings fund option for payments, some group or individual would need to be in charge of setting a fund goal, collecting the pool of dedicated money, letting the enterprise know when the fund goal is reached and how many filters can be purchased, as well as potentially determining how filters are prioritized among the community. CAPS are an obvious choice for this role, as the community already trusts them with their money and health to a large degree. Instead of acting as employees of the enterprise, CAPS members would be community advocates, well in line with their current elected role.

The following summarizes our findings about the current drinking water situation in specific northern Nicaraguan communities. This includes qualitative and quantitative data on community profiles and their specific water conditions, interview themes, survey results, and water test results.

III. Situation Analysis

A. Profiles and Unique Needs of Individual Communities

Darailí: A relatively small sized rural town bordering Bramadero an hour and half away from Estelí. The residents we interviewed had piped water to their property and there were also public water taps. Although water tests showed contamination, it was significantly lower than other communities and its neighboring community of Bramadero.

Bramadero: Bordering Darailí, Bramadero had noticeably different aspects of water accessibility and quality as compared to Darailí. We heard from the Bramadero Comité de Agua Potable (CAPS), the local drinking water committee, that there are more than a dozen public water spouts throughout the town.

We saw significantly fewer private water faucets, and significantly more public water taps. In terms of quality, the Bramadero CAPS only chlorinate their water tank system to "clean" out the pipes "once or twice a month." According to this CAPS, the purpose of this was not to purify the water but to "clean out the pipes and system". This creates several problems: 1) the water is not filtered properly as seen by contamination levels (see Water Test Results section), and 2) there will be potentially harmful amounts of chlorine being piped to public water spouts intermittently throughout the month.

Buena Vista: Buena Vista is a small, rural community of just over 700 people located in the mountains of Madriz. It is the most difficult to access of the communities we visited because of the narrow, windy, steep, often muddy road that leads into the town. It has two different water sources, one on the south, downhill end (called Higueron, or Fig Tree), and the other on the northern, uphill side. The uphill source is used to pipe water to the people of Buena Vista through underground tubes. They clean this water through chlorine tablets that disintegrate over five day periods into the water tank. 137 out of the 151 households of Buena Vista have their own outdoor faucets. However, these often do not supply enough water because the uphill water source is not well fed. The downhill source has plenty of water, but it is bacteriologically contaminated, and would require an expensive pump to transport the water back uphill to the community. Despite this frequent shortage, residents of Buena Vista paid the lowest rate for water of our interview participants, with the most common payment being 7 córdobas for 1000 liters.

Crop fields in Buena Vista.

El Pegador: Bordering Las Sabanas, the majority of El Pegador residents are farmers. The exhibited the most hesitation to be surveyed possibly as a result of distrust of outsiders. Also showed the most signs of being the most strongly community-oriented.

Las Sabanas: A peri-urban town about 2 hours from Estelí, Las Sabanas is in a high, mountainous region with the majority of its residents working as farmers or shopkeepers. Buena Vista is a 40 minutes drive from Las Sabanas. A small government office is located within the town.

Condega: Also peri-urban. Nearly every household has water piped to their homes but water flow stops at 5 pm and begins back in the morning. The water is serviced by the governmental municipal water company, ENACAL.

B. Major Interview Themes

Some major themes emerged from the interviews we conducted in rural and semi-urban settings (See Appendices C and D for sample interview questions). In the rural communities our conversations revolved largely around the agricultural situation and the role of the CAPs. Crop inputs represent large costs to families and the recent drought (La Roya) has intensified the irregularity of crop prices. Monthly water costs generally do not represent a large cost to families; however, the CAPs members who we interviewed reported having difficulty collecting payments from some families. The result was that some families paid more than their fair share for the maintenance of the water system while others paid none.

Across the board, all interviewees stressed the importance of clean water to their lives and their desire to have improved drinking water. However, they also expressed a strong sense of pride for their natural water often describing it as "pure," "crystalline," and "clean." When asked how they would compare their water quality to that of the cities such as Estelí or Managua, almost all claimed that the water in the cities was dirtier and contaminated by pollution. In fact, most rural inhabitants reported buying bottled water only when they have to go to the city out of necessity. Furthermore, there also exists a mistrust of bottled water. Since it's not always clear where the water comes from, many rural inhabitants have suspicions regarding bottled water.

Elia conducting an interview.

Quality and quantity of water in rural areas are both of concern. Water quality concern increases during the rainy season where it's more likely to be turbid and visibly contaminated. Families are more likely to boil or try and treat the water when they can actually see the contamination. Similarly, the water is boiled more often for young children who are more susceptible to sickness. Families understand that children need to build up immunities to the natural water over time and childhood gastrointestinal sickness is considered a normal part of growing up.

The few families who owned household filters were gifted them by organizations that no longer had a presence in the community. Some used to have filters but they had broken and the families did not have the resources to search for and buy new ones. All interviewees who were asked indicated that they would pay more for guaranteed cleaner, safer water if it still tasted good. More preferred the option of a household filter over a community water filtration system. However, there is a strong sense of community and a desire for everyone to have equal access to clean water.

The semi-urban communities shared many of these issues but with slight differences. Most income came from construction work, small businesses, or remittances from family members working in other countries such as Costa Rica. Food and electricity represent the largest costs for most families. On top of water quality concerns, the communities of Las Sabanas and Condega only have running water for

12 hours a day. The quality declines during the summer rains as well. Many reported receiving yellow or even brown colored water with debris present. The monthly costs of water are greater (about 100 cordobas per month at the time of our visit) and going up by 20 cordobas each month. Interviewees reported that no improvements were visible to justify this monthly rise in price.

C. ASDENIC and GSBF Survey Results

We administered 37 written surveys in rural regions of 4 communities: Buena Vista, Darailí, Bramadero, and El Pegador (See Appendix E for sample survey questionnaire). These contained questions regarding water accessibility, availability, perception of water quality, and health-related issues. Table 1 presents a summary of our survey results.

Bramadero community members filling out surveys.

We found that in these rural communities, accessibility is not a major concern—water faucets are either right outside homes or within very short walking distance in the case of Bramadero. However, in Buena Vista, the community did report problems with the consistency of water service with day-to-day intermittency. Regarding perceived quality, almost every survey participant expressed concern with either the quality of the water, the quality of the water system, or the quality assurance of the purification methods used to clean the water. Regarding treatment methods, all 4 community water committees (CAPS) use chlorine in some form: 3 communities use it for purification of water while Bramadero CAPS members stated that they only chlorinated their tank for the purpose of "cleaning out the pipes." As can be seen in the Petrifilm™ test results (see Appendix I), Bramadero showed the highest average coliform counts of any other community. Community members we interviewed there provided divergent health reports. The majority of individuals wrote that they were not experiencing any diarrhea or vomiting episodes (exception being Bramadero and Buena Vista). This contradicted interview results which showed that although not a majority, a significant number of people stated either they or their children were experiencing potential water-related illness. In addition, there was a discrepancy between written survey results and interviews.

Our surveys were supplemented by the over 800 survey responses that ASDENIC had collected. The summary details are outlined by Table 1. ASDENIC's relevant survey results can be found in Appendix H.

Table 1. Summary of GSBF Survey Results.

	Daraili	Bramadero	Buena Vista	El Pegador
Accessibility	• No Distance • No time • All day	• Short Distance • Short time • All day	• No Distance • Short time • Day to day	• No Distance • Variety in time taken • Occasionally
Perception of Quality	• Preoccupied with quality • "No tiene un buen mantenimiento"	• Preoccupied with quality • "Me preocupa que el agua se desperdicie por la tubería que está rota…"	• Preoccupied with quality • "Se preocupa falta de mantenimiento nada…"	• Preoccupied with quality • "No se le está dando el tratamiento…"
Treatment	• Community system uses chlorine	• There is confusion on the treatment process of the water • Some have sand filters	• The community system uses chlorine	• Many do not treat • Some say they treat their water and other use water bottles on their roofs to treat their water.
Self-Reported Health	• No cases of diarrhea • One case of self-reported vomit case	• 4 self-reported cases of diarrhea • One case of vomiting	• 5 self-reported cases of diarrhea • 3 cases of vomiting	• No cases of diarrhea • One case of vomiting

D. Water Quality Report

Overview: Using the results of water tests on native water sources and point-of-use water sources, we can determine what water filter technology would be the most effective and most appropriate for the current water conditions in these communities.

During the first half of 2016, ASDENIC captured 16 samples of water in 8 local communities and had them evaluated by the laboratory at the Universidad Nacional Autonima de Nicaragua (UNAM). At each community, 2 samples were taken at "upstream", or native sources: one sample was taken at the native source while another sample was taken at the water tank used for storage and water treatment through chlorination. For "downstream", or point-of-use sources, the Global Social Benefit Fellowship team collected 24 samples at household and community faucets across all geographic sectors at rural, peri-urban, and urban areas).

David collecting a water sample to be plated on 3M™ Petrifilms™.

Materials and Methods: The exact materials and methods used for the water tests evaluated by UNAM are unknown. For upstream sources, a comprehensive array of bacteriological, chemical, and metal compounds were tested. For the downstream, point-of-use sources, we used 3M™ Petrifilms™ (See Appendix I for a table of all 24 samples with colony

counts). At each community we visited, we took 2-4 water samples at outdoor private faucets, public faucets, parks and elementary schools, and household water storage containers. We used 1ml syringes to pull 1 ml of water directly from the source and placed it immediately on the Petrifilm™. After 24 hours, we counted and photographed the colonies. According to the 3M™ Petrifilm™ counting procedures, only the small red dots with small air bubbles around them are confirmed Coliform (as a results of gas production from lactose during metabolic fermentation).[14] All other red dots are unknown bacteria species while the large black dots are E. coli bacteria.

Results: Because the regions we visited are agricultural communities, we suspected bacteriological and chemical contaminants from livestock and agrochemicals, including pesticides and fertilizers. The bacteriological results at the upstream sources (See Table 2) reveal that there are indeed varying (mostly low) levels of coliform and E. coli at native water sources (only communities that we visited are included in Table 2.). However, we see significantly lower colony counts in the tanks indicating that the purification methods by chlorination at the water storage tanks seem to be an effective method of purification. This also indicates the community-specific water drinking committees (CAPS) are doing an effective job at chlorinating the water. However, the chemical and metal test results reveal no significant elevated levels, indicating that at least in the communities that we visited, there is no significant metal or chemical contamination. The data in Appendix F demonstrates that the communities of Buena Vista, Naranjo, Los Llanos, and El Higuerón had no chemical and metal contamination levels above the acceptable guidelines[10] (See Appendices F and G for the full array of metal and contamination results).

Table 2. Bacteriological Contamination Levels at Native and Storage Sources.

Location	Date of Sample Taken	Total Coliform (Colonies/100ml)	Thermotolerant Coliform (Colonies/ 100ml)	E.coli (MPN/ 100ml)	Exceeds WHO Guidelines?*
Buena Vista Source	4/7/2016	4.5	4.5	4.5	Yes
Buena Vista Tank	4/7/2016	<1.8**	<1.8	<1.8	No
Daraili Source	4/6/2016	130	4.5	2.0	Yes
Daraili Tank	4/6/2016	<1.8	<1.8	<1.8	No
Bramadero Source	4/6/2016	330	450	4.5	Yes
Bramadero Tank* **	NA	NA	NA	NA	NA

*WHO Guidelines limit outlines that Coliform and E.coli levels must not be detectable in a 100ml sample.
**Limit of detection is 1.8
***Results were not listed

Samples from the "downstream" sources of water at private and public water faucets reveal significant levels of contamination well above the WHO guidelines for acceptable drinking water quality levels, which state that Coliform and E. coli levels must not be detectable in a 100mL sample[9] (See Table

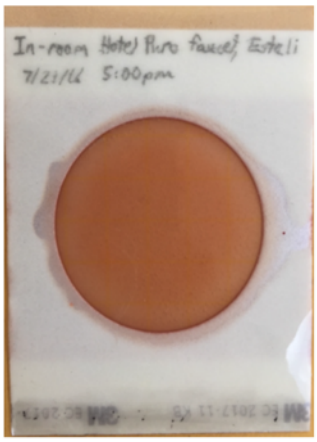
3.) In Figure 1., bacterial colony levels vary from the completely bacteria-free water from the tap in Estelí to the significantly more contaminated water through a private faucet in El Pegador, a rural community.

Table 3. Percent of Samples with Bacteriological Contamination Levels and Mean Colony Counts by Petrifilm™

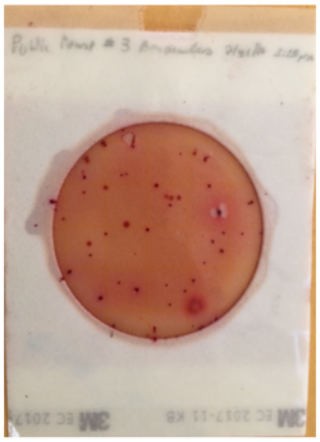
Geographic Sector	Total Samples Taken	% of Samples with Coliform Above WHO Guidelines*	Average Coliform Count (colonies/ 100ml)	% of Samples with E.coli Above WHO Guidelines**	Average E.coli Count (colonies/ 100ml)**
Rural	10	90% (9/10)	880	30% (3/10)	60
Peri-Urban	8	12.5% (1/8)	12.5	0% (0/8)	0
Urban	6	0% (0/8)	0	0% (0/8)	0

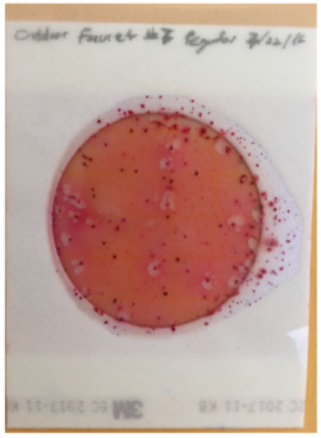
*3M Petrifilm™ guidelines outline that red dots with gas trapped around are confirmed coliform colonies

Figure 1. Petrifilm™ Samples Showing Differing Levels of Contamination.



Water through tap in Estelí


Water through a public spout in Bramadero


Water through a private faucet in El Pegador

Conclusion: The data suggests bacteriological contamination is of concern, primarily at point-of-use sources in rural communities. Data in Table 2 suggests that chlorinated storage water tanks are effective at reducing bacteriological contamination. However, results from samples taken at the point-of-use sources (e.g., a private water faucet), have significantly higher bacteriological contamination, as show in Table 3. We conclude that: 1) the water is somehow getting contaminated between the tank and the faucet

but the reasons are unknown; and, 2) people, whether knowingly or not, are drinking contaminated water, especially in rural communities. Knowing that bacteriological contamination is the main concern informs our water filter technology recommendations for the social enterprise.

E. Other Water Organizations Working in Nicaragua

Potters for Peace (PFP): We conducted an interview with a representative from Potters for Peace, a U.S. based organization working with potters in Central America to promote the establishment of ceramic water filter factories. This organization does not engage in marketing and sales, but advises individual parties on how to begin manufacturing low cost, effective filters. We visited one such factory near Jinotepe just south of Managua operated by Fundacion San Lucas. The filters were sold for $25 per unit mainly to NGOs for distribution. The PFP contact person is Robert Pillers: 8971-8827

Agua Para La Vida: Agua Para La Vida has been building community water systems in northern Nicaragua for about six years. In addition to installing tanks, pipes, and chlorination systems, this group also educates local communities on the importance of clean water, trash, and sanitation, as well as conducting focus groups with women and youths. When evaluating a community's needs, the factors they examine primarily are population density, contamination levels, existing system, quality of the water source, and location of the community. Their average projects range from 50-200 households served, with the mission to promote Family, Education, and Healthy Communities (FECSA).

IV. Economic and Market Analysis

A. Evaluation of Willingness to Pay: Responses and Calculations

Our conversational interviews suggest that approximately two thirds of our participants would buy an in-home water filter if it were available at an affordable price. Augmenting this conclusion, about 90% said that water was currently not a significant monthly expense.

However, our efforts to remain personally and culturally sensitive with respect to willingness to pay questions meant that we could not gather enough data to calculate a precise affordable price point. We were able to ask indirect questions that can inform a general price range. For example, one man in Las Sabanas, who was paying 40 córdobas a month for his water, said he would be willing to pay up to 50% more per month for filtered water. Several men and women raised their hands to say they would purchased a 600 cordoba water filter if it were available nearby.

According to data gathered by ASDENIC in Darailí and Buena Vista, more than half the families in these communities make an average of 2000 córdobas or less per month, with 30% earning less than 1000 córdobas a month on average (See Appendix H). Less than 10% earn 3000 córdobas or more. Although several implied that they would be willing to make a serious investment for a filter or improved water system, even a 600 cordoba water filter would represent somewhere between 25 and 50% of the median monthly income. With the day-to-day nature of spending for low-income families, it is highly un-

likely that many families, if any, will have enough to purchase a water filter at this price point. Therefore, these purchases require foresight and saving.

B. Evaluation of Market Size: The Potential

Our interviews and surveys reached 70 potential beneficiaries. These research participants were diverse in gender and economic status and many were community leaders. Our sample thus represents an initial target market of approximately 427 rural families and thousands of semi urban households. Our research found that affordable, in-home water filters could be a successful product in each of the six communities we visited; these communities would be viable places to pilot the AguaNic enterprise.

Aidan conducting an interview.

Although six communities may seem ambitious initially, for the enterprise to be financially sustainable, it will eventually need to scale to serve a larger market. Given the scope of the contaminated water issue in Nicaragua, this is certainly possible. According to one NGO, approximately 800,000 individuals lack clean water in Nicaragua,[11]which translates to hundreds of thousands of households that could potentially be interested in purchasing filters.[12] Nicaragua is only one country in the Central American dry corridor, a massive scale extreme weather phenomenon caused by El Niño.[13] The dry corridor extends to Guatemala, Honduras, El Salvador, and even Mexico. Viewed through this lens, the number of potential customers could be three or four times greater. This suggests that there is no practical ceiling in the potential market for an AguaNic social enteprise. Nonprofits and the bottled water industry are the only economic actors presently working in Northern Nicaragua.

C. Barriers to Adoption

Although water filters are extremely important to the health and wellness of the target market, they are not a familiar product to many families in this group. All but a handful of our interview participants did not have a filter and did not know anyone who did. The business could fail if the learning curve to adapt the product proves to be too steep or the benefits are not communicated well enough.

To overcome this obstacle, some preliminary steps should be taken when the filters are first sold. Customers may not know how to properly use or clean the filters, so demonstrations at the point of sale, much like those seen at a vendor fair for other household appliances, would be useful. Furthermore, visits to customers' homes to make sure filters are being properly used and cleaned will prevent frustration and dissatisfaction with the product.

V. Appendices

Appendix A-1. Rural Target Market Populations

Community*	Population	Households
Darailí	448	131
Bramadero	820	145
Buena Vista	711	151
Total	1979	427

Appendix A-2. Peri-urban Target Market Populations

Community*	Population	Households
Condenga	4,000	NA
Las Sabanas	9,000	NA

Population data for rural and peri-urban target market populations were provided by ASDENIC.

Appendix B. Household Filter Comparison[15]

Filter	Price/Bulk	Lifespan	Capacity	Pros	Cons	Picture
Filtron Ceramic Filter	Determined by local production costs and is usually between $15 to $25. Replacement clay filters will cost $4 to $6	About 5 years	1.5-2.5 liters per hour	Can be partially made in country	Pricey, precise cleaning	
Plastic Biosand Filter	US$75. Prices do not include shipping container, shipping fees, or clearing/related costs	10+ years for plastic filters but lids and diffusers may need replacement over time	24-72 liters per day	Components can be sourced locally	Heavier and more complex set up, takes 30 days for bio-layer to form	
Nazava	~$9 or ~$6 in bulk	Candle lasts 1-2 years	Depends on size	Cheap, easy to replace	Not made in country, needs replacement sooner	

Appendix C. Sample Rural Interview Questions

Introducción: Bueno, muchas gracias por prestar un poco de tiempo para nosotros. Tengo unas preguntas para usted aquí, pero solamente es una conversación, una oportunidad para usted decir cualquier cosa sobre sus preocupaciones o ideas con respeto al agua en su lugar. Nuestro meta es entender si puede funcionar una empresa social de agua por acá. Entonces, antes de comenzar, tiene unas preguntas para mi?

1. ¿Cuántas personas tiene su familia?
2. Cultiva usted cafe? Y granos básicos? (Que tipos?)
3. Cuántas manzanas tiene(n)? (Cuántas de café, de frijoles, etc.)
4. ¿Cuántas (quintales/libras) produce/vende cada semana/mes/ano?
5. ¿Cuanto cuestan los insumos para (el cultivo)?
6. ¿A qué precio se vende(n) ___?
7. ¿Hay mucha variedad en los precios?
8. ¿Cómo ha afectado a usted la sequía?
9. ¿Cuánto paga usted para el agua mensualmente?
10. ¿Representa un costo grande el agua para usted / su familia?
11. ¿Qué se preocupa más ? La cantidad de agua o la calidad ?
12. ¿Cómo se compara el agua en su comunidad con el agua de otros lugares (Estelí/Managua)? (otras comunidades)?
13. ¿Alguna vez ha comprado agua embotellada ? si es así, ¿por qué? ¿Cree usted que el agua embotellada es más limpia que el agua en su comunidad?
14. ¿Ud. tiene un filtro de agua en su casa? (Por qué no?)
15. Conoce alguien (más) que lo tiene? (Cuantos en esta comunidad?)
16. Si pudiera escoger entre un filtro domiciliar y un sistema de filtrar el agua al puesto, cuál escogería?
17. ¿Pagaría más para agua que gusta más pura?
18. ¿Siente como tiene control usted sobre la calidad de su agua potable?

Appendix D. Sample Peri-Urban Interview Questions

1. ¿Cuántas personas tiene su familia?
2. ¿En que trabajan?
3. ¿Cuales son los costos más grandes de su hogar o negocio?
4. ¿Cuánto paga usted por el agua mensualmente?
5. ¿Representa un costo grande el agua para usted / su familia?
6. ¿Piensa usted que sus ingresos son suficientes?
7. ¿Cuanto tiempo tiene usted agua en su hogar?
8. ¿Qué le preocupa más ? La cantidad de agua o la calidad?
9. ¿Ud. piensa que el agua pública por llave en su lugar es segura? ¿Por qué sí o por qué no?
10. ¿Cree que alguna vez se ha puesto enfermo como resultado de su agua potable?
11. ¿Ud. da algún tipo de tratamiento al agua en su hogar?
12. ¿Cómo se compara el agua en su lugar con el agua de los ciudades como Estelí o Managua? Y con las comunidades rurales?
13. ¿Con qué frecuencia compra agua embotellada? ¿por qué?
14. ¿Piensa ud. que el agua embotellada es cara?
15. ¿Tiene confianza en el agua embotellada? ¿Por qué?
16. ¿Tiene una botella de agua reutilizable?
17. ¿Ud. tiene un filtro de agua en su casa? (Por qué no?)
18. ¿Conoce a alguien (más) que lo tiene? (Cuantos en este lugar?)
19. ¿Pagaría más para un sistema de agua más segura? (Cuanto más?)
20. ¿Tiene ud. Control sobre la calidad de su agua potable?

Appendix E. Sample Survey Questionnaire

1.¿Dónde obtiene Ud. el agua para su casa?
- a. Mini-Acueducto
- b.Tubería de agua potable
- c. Puesto público
- d. Pozo público
- e. Pozo Propio
- f. Rio, cañada, manantial
- g. Agua de lluvia recogida en un tanque
- h. Agua embotellada
- i. Otra manera- _____

2. ¿Cuánto tiempo dedica para llevar agua a sus hogares?
- a. Menos de 5 minutos
- b. De 5 a 15 minutos
- c. De 15 a 30 minutos
- d. Si es más de media hora, dígame cuántos -_____

3. ¿Qué distancia recorrido para ir por agua?
- a. Ninguna distancia. Hay tubería que lleva agua al casa
- b. Menos de 2 kilómetros
- c. De 2 a 8 kilómetros
- d. Si es más de 8 kilómetros, dígame cuántos -_____

4. ¿Cuánto tiempo se abastece de agua?
- a. De vez en cuando
- b. Dia de por medio
- c. De una a cinco horas
- d. 6 a 12 horas
- e. Mas de 12 horas
- f. todo el dia

5. ¿Cuanto litros de agua usa en las siguientes actividades ?
- a. Beber_____
- b. Banarse_____
- c. Lavado las manos_____
- d. Lavado los dientes_____
- e. Limpiar la casa_____
- f. Lavar ropa_____
- g. Lavar a la alimentos_____
- h. Cocinar los alimentos _____
- i. Lavar la letrina_____

6. ¿Da algún tratamiento al agua que bebe de alguna manera? Si escoge *b. no* siga a la pregunta #8.
- a. Sí
- b. No
- c. no lo sé

7. ¿Qué tratamiento da Ud. el agua?
- a. La hiervo
- b. Uso cloro
- c. La filtro con arena
- d. La filtro con una tela fina
- e. La agito suavemente
- f. La dejo al sol
- g. Dejo que se asiente el agua en un receptor
- h. No lo sé
- i. Dígame de qué manera filtra el agua -_____

8. El tipo de tratamiento que Ud. utiliza le da un buen resultado? (agua potable)
- a. Sí
- b. Creo que sí
- c. No estoy muy seguro/a
- d. No creo que funcione

9. El agua que Ud. bebe, ¿le preocupa si estare potable?
    a. Sí
    b. No
    c. No estoy seguro/a porque _____
10. ¿Qué preocupaciones tiene al respecto?

_____

11. ¿ Cuáles cambios, soluciones le gustaría ver?

_____

12. De hacerse realidad estos cambios, ¿En qué le ayudaría?

_____

13. ¿En qué tipo de recipiente / contenedor guarda su familia el agua que bebe?
    a. Pila
    b. Pichinga
    c. Bariles
    d. Bidones
    e. Botellas
    f. Otro-_____
14. En general, cómo se encuentra Ud. de salud?
    a. Excelente
    b. Muy bien
    c. Bien
    d. No muy bien
    e. Mal
15. ¿Alguién en su familia ha tenido diarrea en los últimos 30 días?
    a. Sí
    b. No
    c. No lo sé
16. ¿Y, ¿en los últimos 6 meses?
    a. Sí
    b. No
    c. No lo sé
17. ¿En su familia, ¿alguién ha tenido episodios de vómitos este último mes?
    a. Sí
    b. No
    c. No lo sé
18. ¿En su familia, ¿alguién ha tenido episodios de de vómitos en los últimos 6 meses?
    a. Sí
    b. No
    c. No lo sé
19. ¿Quién tuvo los más episodios de vómitos o diarrea?
    a. La mamá
    b. El papa
    c. Los abuelos
    d. Los niños
    e. Varía mucho
    f. Dígame quién más_____
20. ¿Qué remedios utilizaron?
    a. Remedio casero (medicina natural como hierbas)
    b. Medicamento farmaceutico
    c. Otros_____

Appendix F: Table of Metal Contamination Test Result

Location	Parameter	Limit of Detection (µg/L)	Results (µg/L)	Maximum Acceptable Value
Buena Vista Source	Arsenic	0.99	<.99	4.5
Buena Vista Tank	Arsenic	0.99	<.99	<1.8
Daraili Source	Arsenic	0.99	<.99	2.0
Daraili Tank	Arsenic	0.99	1.32	<1.8
Bramadero Source	Arsenic	0.99	3.84	4.5
Bramadero Tank*	Arsenic	0.99	NA	NA

Water testing for Arsenic contamination was conducted by Universidad Nacional Autonima de Nicaragua (UNAM)

Appendix G: Table of Chemical Contamination Test Results

Parameter	Limit of Detection	Maximum Advisable Value	Results	
			Buena Vista Spring Source	Naranjo Spring Source
Turbidity	NA	5.00 UNT	10.95 UNT	2.6 UNT
pH at 25.0 C	NA	6.5-8.5 pH	6.74 pH	8 pH
Conductivity at 25.9 C	NA	NA	71.8 us/cm	203 us/cm
Total Dissolved Solids	NA	1000.00 mg/L	50.55 mg/L	140 mg/L
True Color	NA	15.00 mg/L	<5.00 mg/L	15 mg/L
Sodium	0.1	200.00 mg/L	4.6 mg/L	12 mg/L
Potassium	0.1	10.00 mg/L	0.98 mg/L	3.57 mg/L
Magnesium	0.2	50.00 mg/L	1.22 mg/L	7.29 mg/L
Calcium	0.08	NA	8.02	20.04 mg/L
Chloride	0.25	250.00 mg/L	5.87 mg/L	11.29 mg/L

Nitrates	0.25	50.00 mg/L	7.42 mg/L	1.52 mg/L
Sulfates	0.25	250.00 mg/L	1.9 mg/L	3.44 mg/L
Carbonates	2	NA	<2.00 mg/L	< 2.00 mg/L
Bicarbonates	0.75	NA	23.19 mg/L	109.84 mg/L
Total Hardness as CaCO	0.13	NA	25 mg/L	80 mg/L
Total Alkalinity as CaCO	0.62	NA	19 mg/L	90.01 mg/L
Alkalinity to phenolphthalein	1.67	NA	<1.67 mg/L	< 1.67 mg/L
Dissolved Reactive Silica	0.2	NA	19.55 mg/L	57.43 mg/L
Nitrites	0.003	0.10 or 3.00 mg/L*	0.003 mg/L	0.007 mg/L
Total Iron	0.02	0.30 mg/L	0.87 mg/L	0.08 mg/L
Flouride	0.25	0.7 - 1.5 mg/L	<0.25 mg/L	< 0.25 mg/L
Ammonium	0.0003	0.5 mg/L	0.073 mg/L	0.015 mg/L
Sample Iron Balance	NA	NA	1.33%	0.05%

Water testing for chemical contamination was conducted by Universidad Nacional Autonima de Nicaragua (UNAM). Tests in Los llanos and El Higuerón showed no contamination, so results are not shown. Although chemical tests were conducted in the same communities that we investigated in (Bramadero, Daraili, etc.), these tests give us a general indication of the chemical contamination because all of these communities are in the same region.

Appendix H: Table of ASDENIC Survey Results

Where do you supply your water?					
	Mini-acueduct	River	Well	Spring	Other
Total (out of 814)	452	18	178	115	110
How do you transport your water?					
	By Foot	By Horse	En Cart	No Need	Other
Total	521	18	10	257	11
How do you rate the quality of your water?					

	Good	Bad	Regular		
Total	432	75	303		
Cases of diarrhea in the last month for children less than 1 year of age?					
	Ninguno	Menos de 3	3 a 5	Más de 5	
Total	799	8	6	4	
Cases of diarrhea in the last month for children of 1 to 4 years of age?					
	None	Less than 3	3 to 5	More than 5	
Total	797	12	4	3	
Cases of diarrhea in the last month for children less than 5 years of age?					
	None	Less than 3	3 to 5	More than 5	
Total	780	21	5	3	
Type of Employment?					
	Own Business	Day Job	Contracted	Temporary	Permanent
Total	638	206	25	109	114
Average Monthly Income					
Amount (Cordobas)	500-1000	1001-2000	2001-3000	More than 3000	
# of People	210	296	197	75	
Average Monthly Income					
Amount (USD)	17-34	34.1-68	68.1-103	More than 103	
# of People	210	296	197	75	

Data from 814 surveys collected by ASDENIC from the communities of El Chaguitón, El Sontule, Venecia, El Naranjo, Los Llanos, El Edén, Buena Vista, San Jerónimo, and Darailí Survey were administered in 2013.

Appendix I: Table of Petrifilm™ Test Results

Water Source	Community	Sector	Coliform (Colonies/100mL)	Exceeds WHO Guidelines for Coliform?	E. coli (Colonies/ 100mL)	Exceeds WHO Guide-lines for E.coli?
Public Pump #1	Bramadero	Rural	800	Yes	200	Yes
Public Pump #2	Bramadero	Rural	700	Yes	100	Yes
Public Pump #3	Bramadero	Rural	700	Yes	0	No
Outdoor Private Faucet	Bramadero	Rural	1800	Yes	300	Yes
Outdoor Private Faucet #1	Daraili	Rural	400	Yes	0	No
Outdoor Private Faucet #2	Daraili	Rural	200	Yes	0	No
Outdoor Private Faucet #3	Daraili	Rural	0	No	0	No
Outdoor Private Faucet #1	El Pegador	Rural	300	Yes	0	No
Outdoor Private Faucet #2	El Pegador	Rural	3200	Yes	0	No
Outdoor Faucet at a School	El Pegador	Rural	700	Yes	0	No
Outdoor Private Faucet #1	Las Sabanas	Peri-Urban	0	No	0	No
Outdoor Private Faucet #2	Las Sabanas	Peri-Urban	0	No	0	No
Outdoor Faucet at a School	Las Sabanas	Peri-Urban	100	Yes	0	No
In-home Water Filter	Las Sabanas	Peri-Urban	0	No	0	No
Outdoor Private Faucet #1	Condenga	Peri-Urban	0	No	0	No
Outdoor Private Faucet #2	Condenga	Peri-Urban	0	No	0	No
Outdoor Private Faucet #3	Condenga	Peri-Urban	0	No	0	No
Outdoor Private Faucet #4	Condenga	Peri-Urban	0	No	0	No
Motel Water Faucet #1	Estelí	Urban	0	No	0	No
Motel Water Faucet #1	Estelí	Urban	0	No	0	No
Motel Water Dispenser	Estelí	Urban	0	No	0	No
Public Park Faucet	Estelí	Urban	0	No	0	No
Water Bottle Brand #1	Estelí	Urban	0	No	0	No
Water Bottle Brand #2	Estelí	Urban	0	No	0	No

The 3M™ Petrifilm™ Coliform Count (CC) Plates contain Violet Red Bile (VRB) nutrients, a cold-water-soluble gelling agent, and a tetrazolium indicator that facilitates colony enumeration. The top film traps gas produced by the lactose fermenting coliforms. U.S. Food and Drug Administration Bacteriological Analytical Manual (FDA-BAM) define coliforms as Gram-negative rods which produce acid and gas from lactose during metabolic fermentation. Coliform colonies growing on the 3M Petrifilm CC Plate produce acid which causes the pH indicator to deepen the gel color. Gas trapped around red coliform colonies indicates confirmed coliforms.[14]

VI. Endnotes

1. "Potters for Peace." Potters for Peace. N.p., n.d. Web. 10 Nov. 2016. http://pottersforpeace.-com/.
2. "Naandi Community Water Services Ltd." Naandi Naandi Community Water Services Ltd Comments. N.p., n.d. Web. 10 Oct. 2016. http://www.naandi.org
3. Banerjee, Abhijit V., and Esther Duflo. Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty. New York: PublicAffairs, 2011. Print.
4. Hagan, Judy, Nick Harley, David Pointing, Mickey Sampson, and Vanna SOAM. "Resource Development International - Cambodia Ceramic Water Filter Handbook." (n.d.): n. pag. Engineers Without Borders and RDI Cambodia, Mar. 2008. Web. 20 Oct. 2016.
5. "Getting Started." Potters for Peace. N.p., n.d. Web. 10 Nov. 2016. http://pottersforpeace.-com/?page_id=366.
6. "Fact Sheet: Biosand Filter." *Biosand Filters Knowledge Base*. N.p., n.d. Web. 12 Oct. 2016.
7. Adkins, Edwin, et. al, “Off-grid energy services for the poor: Introducing LED lighting in the Millennium Villages Project in Malawi.” Earth Institute and the School of Engineering and Applied Science, Columbia University, New York 10027, USA
8. Information on CAPS was provided by ASDENIC

9. Guidelines for Drinking-water Quality: First Addendum to the Third Edition, Volume 1: Recommendations. Geneva: WHO: n.p., 2006. World Health Organization. Web. (page 143)
10. Tests in Los Llanos and El Higuerón were taken but omitted to save space. Results of these communities showed no contamination. Chemical tests were not conducted in communities we investigated (Bramadero, Daraili, etc.) for unknown reasons.
11. ”Home Page.” *WaterAid America*. Water Aid America, 25 Oct. 2016. Web. 27 Oct. 2016.
12. “Using Indigenous Knowledge to Reverse Land Degradation in Angola.” *Food and Agriculture Organization of the United Nations*. FAO, 2016. Web. 22 Oct. 2016.
13. Bacon, Christopher M., William A. Sundstrom, María Eugenia Flores Gómez, V. Ernesto Méndez, Rica Santos, Barbara Goldoftas, and Ian Dougherty. "Explaining the Hungry Farmer Paradox: Smallholders and Fair Trade Cooperatives Navigate Seasonality and Change in Nicaragua's Corn and Coffee Markets." *Global Environmental Change* 25 (2014): 144.
14. "Interpretation Guide: 3M™ Petrifilm™ Coliform Count Plate." *3M*. N.p., n.d. Web. 6 July 2016. http://multimedia.3m.com/mws/media/236235O/petrifilm-coliform-interpretation-guide.pdf
15. "Nazava Filters." *Nazava*. N.p., n.d. Web. 12 Oct. 2016. https://www.nazava.com/?0

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