# Strategies for Implementing Biosand Water Filter Projects

## Case Studies from the Philippines



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Submitted by

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## Preface

Research for this paper was conducted while serving as a water/sanitation Peace Corps Volunteer in the Philippines from 2006 to 2008. After two months of cultural and language training I was assigned to the Municipality of San Joaquin, Iloilo on the island of Panay. In San Joaquin I worked with counterparts from the municipality and community on various projects related to water resources, solid waste management, and coastal resource management.

One of these developments was a pilot project of Biosand Water Filters (BSFs) which eventually resulted in providing a supplemental livelihood for a local I befriended. Towards the end of my service I became interested in assessing the best strategies for starting and sustaining BSF projects. I interviewed four of my fellow Peace Corps Volunteers and a Non-Governmental Organization employee all of whom worked on BSF projects within the Philippines. This paper is a collaboration of those experiences written to benefit future implementers of the BSF Technology.

Furthermore, this paper is submitted to complete my master's degree in civil engineering at Colorado State University in conjunction with the Peace Corps Masters International program.

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## Acknowledgements

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Most of all, I would like to thank the contributors to this paper that worked on Biosand Water Filter (BSF) Projects: Adam Lebow, Mariah Klingsmith, Page Weil, Tom Moustos, and Ben Magalgalit. This paper would not have been possible without their hard work and resources they provided. Furthermore, BSFs in the Philippines would not exist without Gemma Bulos, founding director for the Non-Governmental Organization, *A Single Drop for Safe Water* (ASDSW). Executive director of ASDSW, Kevin "Kiwi" Lee, was also instrumental in getting BSFs started throughout the Philippines. Kiwi was also a mentor for many of the Peace Corps Volunteers by providing trainings and advice with regards to water resource projects.

Lastly, I would like to thank my friends and family who supported my decision to join the Peace Corps, never forgot about me while I was gone, and helped me readjust upon my return.

## Abstract

In 2006 the World Health Organization estimated there were 884 million people in the world without access to safe drinking water. The majority of these water quality issues are related to microbial pathogens. The Biosand Water Filter (BSF) is a relatively recent technology being implemented to help solve this crisis. BSFs are simple household water filters constructed from locally available materials of sand, gravel, and cement. They have been proven effective at removing 90-99% of waterborne pathogens. Although this technology is effective and simple, there are many challenges associated with implementing it in the field through sustainable projects. This paper utilizes the experiences of six BSF project implementers within the Philippines to better understand the best strategies of project implementation. Project successes and failures are assessed with regards to *Initial Assessment, Project Planning, Education, Transportation, Innovations,* and *Monitor and Evaluation*. The purpose of this paper is to give future implementers methods they can apply to create sustainable and successful BSF projects.

# 1 Introduction

As of 2006 there were an estimated 884 million people globally that lack access to safe drinking water (WHO[1] 2008). As defined by the World Health Organization (WHO), access to drinking water implies the source is less than 1 kilometer away from its place of use and that it is possible to reliably obtain at least 20 liters per member of a household per day. Safe water is defined as that which is free of microbial, chemical, and physical contaminants to the standards of the WHO guidelines (WHO[1] 2008). Children under five are the majority of those affected by unsafe water sources. An estimated 4000 children die each day from water related illnesses (WHO[2] 2009).

In 2001 the Millennium Development Goals were established by 192 United Nation states in an effort to reduce poverty, hunger, disease, and child mortality while improving education, gender equality, environmental sustainability and development (United Nations, 2009). One goal aims to halve the proportion of people without access to safe drinking water and sanitation by 2015. Meeting this goal will not only help improve global health but can also benefit other goals in alleviating poverty and improving education. When people are healthy they are more capable of making a living and children are able to attend school.

The Biosand Water Filter (BSF) is a technology being implemented in 70 countries worldwide to address water quality concerns. When installed and used properly, the BSF has been proven effective in numerous studies to remove 90 to 99% of waterborne pathogens (CAWST[1] 2006). Made from locally available materials, the BSF offers a way for people to improve their lives and the lives of community members in a sustainable manner.

This paper helps provide a guide of best practices for future implementers of BSF projects. It is recommended that any individual looking to start a BSF project should first understand the BSF construction techniques and filtration processes that are not fully covered in this paper. These concepts can be learned from various training manuals offered by NGOs such as *Centre for Affordable Water and Sanitation Technology* (CAWST) or from the website of BSF creator David Manz (ManzWaterInfo, 2009). Understanding the construction and filtration processes are essential, but often the most challenging aspects of a BSF project involve the methods for transferring the technology to the field.

In September of 2006 I underwent a technical training on the BSF along with 30 other US Peace Corps Volunteers (PCVs) assigned in the Philippines. The purpose was to help volunteers address the water quality concerns of a country where diarrhea is the highest cause of morbidity for children under five (ASDSW, 2009). The training was conducted by the NGO *A Single Drop for Safe Water* (ASDSW) and facilitated by a former PCV named Kevin Lee who had been trained by members of CAWST. All the participants of the training received a CD of the CAWST manual which provided valuable resources for education, training, and technical details with regards to the BSF technology. However, with the exception of a few handouts covering the details of a broad dissemination model, there was little information on the best practices of implementing a BSF community project. Considering this was the first training of Peace Corps Volunteers in the Philippines, the majority of us were very enthusiastic but had little guidance as to how to best get the technology started in our own communities.

Over the course of our remaining service much was learned by the volunteers who worked on BSF projects as well as the NGO ASDSW which continued BSF trainings throughout the Philippines. Often times we found ourselves experiencing similar challenges or realized that someone was doing it a better way. This paper is an attempt to combine those stories of past failures and successes to help give a guide for future implementers of best practices in developing BSF projects. Although the stories only take place in the Philippines it is hopeful the lessons learned could benefit other regions where the BSF may be applicable.

This paper will first provide brief sections related to the background of the BSF as well the contributors and their projects. It will be followed by the section entitled *Initial Assessment* which focuses on the three questions of need, appropriateness, and level of commitment essential for a successful project. After a BSF project is considered feasible, *Project Planning* will be required to address the scope, resources, tasks, timeline, budget and business plan necessary. Next, the *Education* section will cover topics related to promotion and the education of BSF users and Filter Technicians. This will be followed by the two brief sections that discuss issues related to *Transportation* and various *Innovations* that were developed. The last section, *Monitoring and*

*Evaluation,* covers methods of ensuring sustainability of household use and providing feedback of whether project goals are being met.

It is my belief that the BSF has the potential to help the world meet the Millennium Development Goal of halving the number of people without access to safe drinking water. The BSF technology is not only incredibly simple and effective but can be extremely sustainable as a local livelihood producing solutions from local materials. Nevertheless, the greatest challenges associated with the BSF involve transferring the technology to the communities that need it most. The goal of this paper is to provide implementers a guide of methods they can utilize to make this a reality.

## 2 Background on BSF

Developed in 1990 by Dr. David Manz at the University of Calgary, the Biosand Water Filter (BSF) was designed to utilize the century old practice of slow sand filtration in order to clean water at the household level (ManzWaterInfo 2009). Rather than using a large community filtration system from a single water source, the small design of the BSF allows for water treatment within the home. This makes it ideal for rural consumers that utilize wells, surface water, or rain catchments for drinking purposes. As of 2004 it was estimated that the BSF technology was being implemented in approximately 26 developing countries (CAWST[1] 2006). Just four years later it was projected there were 200,000 working BSFs in 70 countries (ManzWaterInfo 2009).

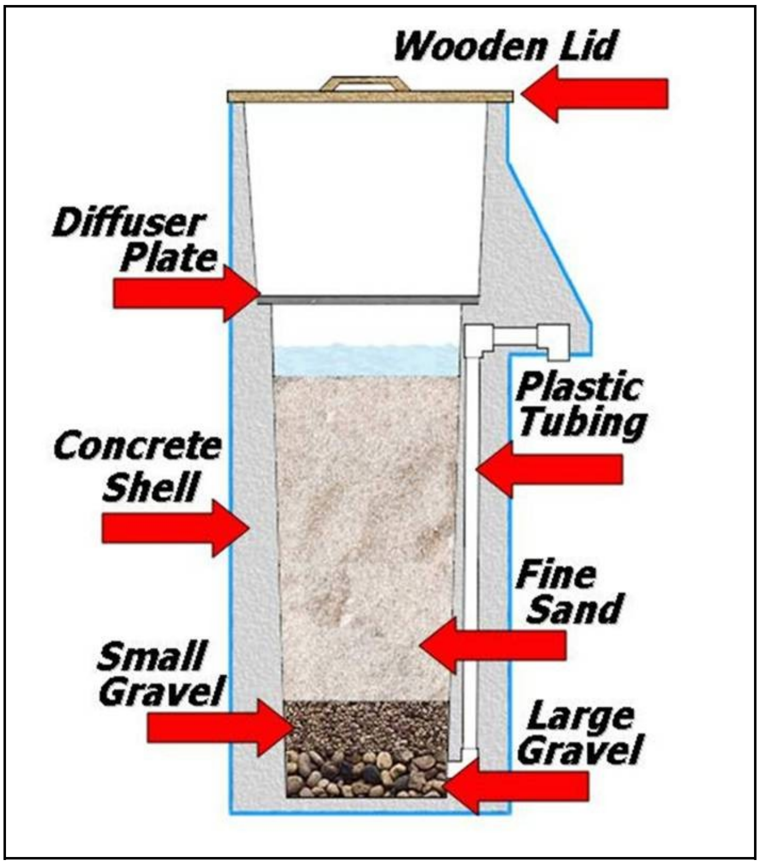


**Figure 1: BSF Diagram** (CAWST[1] 2006)

**Figure 2: Recently Constructed BSF**

### *2.1 Physical Description*

One major benefit of the BSF is that it can be constructed entirely from local materials available in the developing world. The BSF is essentially a 1 x 1 x 3 ft high concrete box. A 3/8 in. copper tube (or plastic equivalent) runs from the bottom of the BSF through the inside of the front concrete wall. The construction process of creating the concrete casing requires a steel mold that can be used to mass produce multiple BSFs (CAWST 2006). On the inside of the concrete casing there are two separate layers of gravel each approximately 2 inches in depth. The bottom layer is the coarse gravel (roughly ½" diameter), which acts as a media to prevent the fine gravel above it from passing and allows the filtered water to run through the pipe. The fine gravel layer (roughly ¼" diameter) is in between the coarse gravel and sand layer. The top layer is sand (approximately 2.5 feet deep) that has been cleaned using the processes described in the *Media Preparation Appendix* of the CAWST Manual (CAWST[1] 2006). The sand layer acts as the media that filters and kills the organic contaminants. Above the top of the sand layer is two inches of standing water. This water level is equal and dependent on the highest point of the tubing within the concrete casing. After water is poured in the top of the filter the hydraulic head difference between the water surface elevation inside the BSF and the height of the tubing pushes the water through the pipe. When the water elevation in the BSF drops to the same as the highest point of the tube, water ceases to flow and the standing 2 inches of water above the sand layer provides an ideal environment for the biological layer or *'schmutzdecke'* to develop. In order to protect the biological layer the BSF is also equipped with a diffuser plate. This plate is simply a thin metal (preferably rust resistant) or plastic sheet with nail size holes punched every one inch to allow even and slow distribution of water to the top surface. Without it, the shock of falling water poured from a bucket would disrupt the biological layer. The last component of the BSF itself is a lid on the top to keep out contaminants. A good addition to every BSF is a container for storing the treated water with narrow openings for filling and dispensing as well as tight fitting lids.

### *2.2 How It Works*

The BSF works to remove organic contaminants using four processes. The first and most effective process is the predation that occurs at the biological layer, or *schmutzdecke*, in the top layer of sand. Here, microorganisms consume pathogens composed of carbon and nitrogen through an aerobic process. It generally takes a minimum of two weeks for the biological layer to fully develop in a BSF and field tests have demonstrated dramatic decreases in pathogens once this layer is matured. A second process utilized in the BSF is adsorption. This occurs when viruses and certain organic compounds are adsorbed (become attached) to fine silt or sand particles. The third process is mechanical trapping in which larger pathogens like protozoa are trapped between the sand grains and removed from the water. The fourth process is natural die off where organisms simply expire from a lack of food or oxygen during the pause periods when the filter is not in use. All four of these processes are interrelated in removing organic contaminants from the water. Various studies have proven with a mature biological layer the BSF is capable of removing 90 to 99% of pathogens allowing for safe drinking water (CAWST[1] 2006).

### *2.3 Operation and Maintenance*

After installation, using the BSF on a daily basis is quite simple. Owners are encouraged to use their best source available for filtering and only use that one source for the filter. The reason for this is the biological make up for the *scmutzdecke* might vary for different sources affecting the predation process. The owner can simply pour a bucket's worth of water in the top of the filter and then begins collection in a clean storage container. It's important to note that the diffuser plate should always be inside the BSF before pouring water. The BSF should have a flow rate of around 1 liter per minute but recent studies have shown more effective pathogen removal with slower flow rates (CAWST[2] 2009). The flow rate will be dependent on the sand particle sizes which result from the degree of cleaning performed on the sand. Once the BSF is done filtering, the water level inside should reach equilibrium with the top of the pipe resulting in about 2 inches of water above the sand surface to optimize the performance of the biological layer. The filter is designed for intermittent use and a pause period over night is beneficial for the treatment of the water. Recent studies have found the water with the best treatment is the first 5 liters after a 12 hour pause period (Baumgartner, Ezzati, Murcott 2007). Because there are no moving or replaceable parts with the BSF, maintenance is minimal. However, in the case of an extremely turbid water source the owner may occasionally have to perform the "swirl and dump method" to remove fine sediments from the top two inches of sand to achieve a usable flow rate. The "swirl and dump" method simply involves stirring the top layer of sand with your hand to suspend the fine sediments in the water and then removing the turbid water with a cup or ladle. This should only be performed when flow rates are extremely slow due to the fact a new biological layer will take two weeks to reform. However, in some cases the BSF's main purpose may be for sediment removal rather than pathogens depending on the water source.

### *2.4 Advantages and Limitations*

The primary advantage of the BSF is its effectiveness at removing 90-99% of pathogens for safe water consumption. The filter can be built from local materials, which can provide an opportunity for a local business. The total labor and material cost generally ranges from $25 to $35 making it an affordable option when compared to other water treatment devices. It should also be understood that this is a one-time cost since the BSF has no replaceable parts or additives. The robust and heavy design ensures a lengthy lifetime but can also be seen as a limitation for transportation purposes. Generally, once a filter is installed it is intended to remain fixed in place. The operation and maintenance is quite simple but it is required that the filter is used on a regular basis in order to maintain the biological layer. Although it is a benefit that the BSF can remove sediments from highly turbid water, performing the "swirl and dump" maintenance hinders the biological layer that provides the primary treatment of organic contaminants. The BSF has been shown to not only remove pathogens and sediments but also small amounts of iron and manganese. The BSF cannot remove dissolved compounds but there is a modified design capable of removing arsenic (Murcott, Ngai and Shrestha 2004). Although the biological layer takes two weeks to develop, the water quality in the BSF will improve over time. Compared to other filtration methods the BSF has a relatively high flow rate of one liter per minute. Finally, the BSF's filtered water looks and tastes great. Several owners have commented how "natural" tasting the water was compared to distilled or bottled sources.

## 3 Background of Contributors' Projects

The following section gives a brief background on the BSF implementers and projects that helped contribute to this paper through interviews and stories. Five of these contributors were PCVs (*Peace Corps Volunteers*) assigned to the Philippines and began their service in June of 2006. These volunteers along with almost 25 others underwent a four day technical training on the BSF technology in September of 2006 conducted by the NGO (*Non Government Organization*) ASDSW (*A Single Drop for Safe Water*). The other contributor is an employee of ASDSW who has conducted several BSF trainings throughout the Philippines.

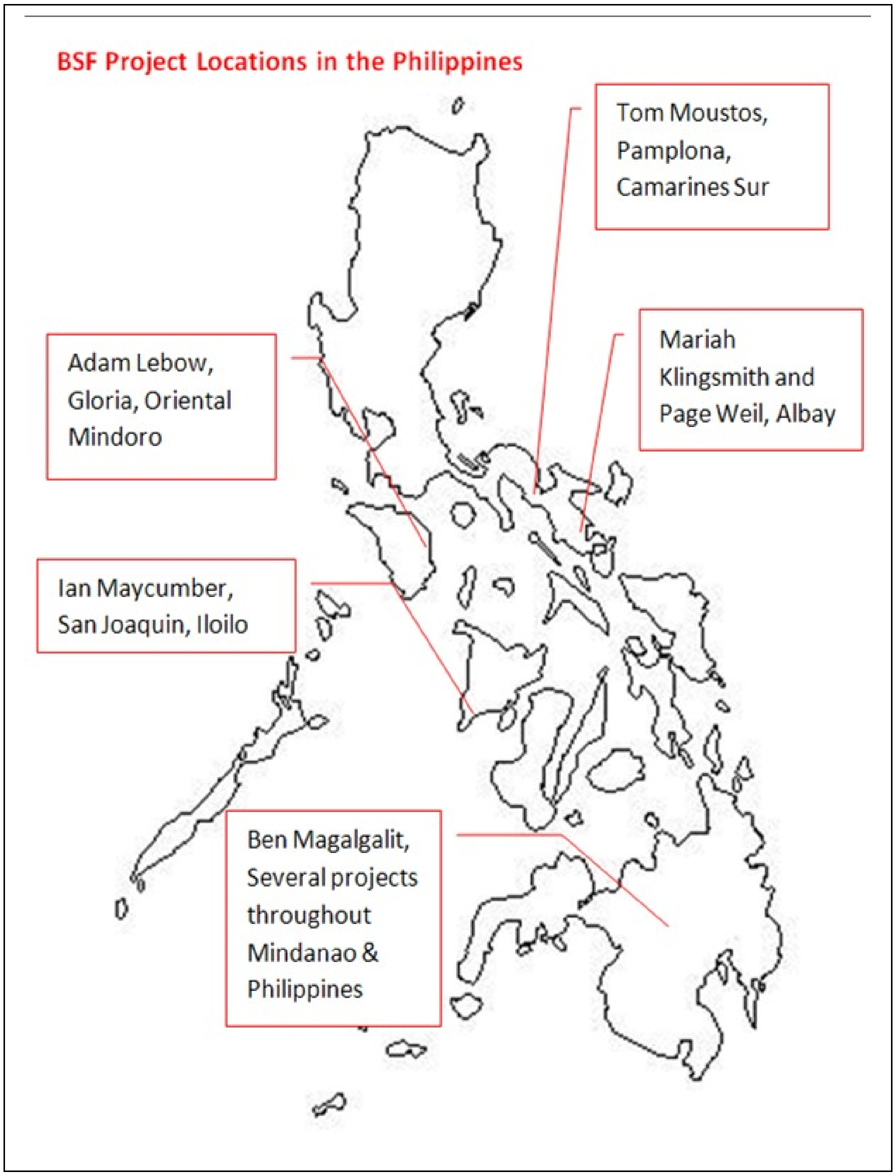


**Figure 3: Contributors' BSF Project Locations in the Philippines** (Map adapted from *About, 2009*)

### *3.1 Ian Maycumber, San Joaquin, Iloilo*

I was assigned to the LGU (Local Government Unit) of San Joaquin, Iloilo as a water/sanitation PCV. The municipality of San Joaquin consists of approximately 50,000 people located in 85 *barangays* (villages or neighborhoods). Its geography consists of coastline, rice farms, and mountains. Drinking water sources were primarily natural springs for communities located in or near the mountains (roughly half of population) and shallow and deep wells for communities in the lowlands. My work with the BSF included a pilot project to produce and sell 21 filters funded by my LGU. The need for improved water quality in San Joaquin was of less priority compared to the depleting coastal resources, deforestation and solid waste management issues of the municipality. Understandably, this resulted in less incentive to invest in further projects with the BSF by either the LGU or a local NGO. Despite this, a local friend was interested in the technology and I was able to train him. He continues building and selling BSFs as a private supplemental livelihood.

### *3.2 Adam Lebow, Gloria, Oriental Mindoro*

Adam was assigned to the LGU of Gloria, Oriental Mindoro as a water/sanitation volunteer. The municipality of Gloria consisted of approximately 40,000 people. The geography was similar to San Joaquin in that it had coastline, rice fields, and further inland was mountains. During his first month at site, Adam reviewed data from his local Municipal Health Office. He found that the highest levels of waterborne disease incidences were along the coast and in upland communities, while regions in between appeared to have safer drinking sources from free flowing artesian springs. After building four BSF demonstration models, Adam was promised P180,000 ($4000) from his LGU for mass producing BSFs. Over the course of this project he faced numerous bureaucratic and political challenges that are discussed in further detail throughout this paper.

### *3.3 Mariah Klingsmith, Santo Domingo, Albay*

Mariah was assigned to the LGU of Santo Domingo as a water/sanitation volunteer to work primarily on solid waste management issues. During the first part of 2007 she spent a considerable amount of effort working on a joint UNICEF (*United Nations Children's Fund*), ASDSW, and local NGOs' project to build and install 100 BSFs in a three month period. The project was sparked by typhoon *Reming* which hit the province of Albay hard in late November of 2006. The typhoon killed almost 1000 people and displaced countless more. UNICEF was taking proposals for water related projects in the area that could help mitigate future calamities. ASDSW responded with a BSF proposal where the Albay Disaster Relief Network, ADRN (6 local NGOs and 1 local university extension group) would act as implementers; Mariah and fellow PCV Page Weil would help give technical assistance; and ASDSW would provide project management. UNICEF, working with the Provincial Government of Albay, elected to have the filters installed in Rural Health Units and schools which would act as disaster relief centers during a calamity. Mariah's primary focus for this extensive project was working on the educational aspects of the filters. Although all 100 BSFs were built and delivered in the short time period, the majority initially failed due to reasons explained further in this paper. As a result, many lessons were learned regarding project development which benefited later BSF projects these organizations worked on. Today, Mariah is working for ASDSW in Africa educating women's groups on water and sanitation technologies including BSFs.

### *3.4 Page Weil, Legaspi, Albay*

Page was assigned to Aquinas University as a water/sanitation volunteer. In the work with the UNICEF project mentioned above, Page acted primarily as an advisor in the technical trainings for production of the filters as well as logistics for transportation and installation. However, Page was and still is involved in several BSF projects run through his host country agency Aquinas University. One such project is the installation of 50 BSFs on the remote island of Rapu Rapu, Bicol funded by the Peace and Equity Foundation of the Philippines. Page contributes valuable lessons he has learned regarding transportation, site placement and educational tools throughout this paper. Page still resides in the Philippines after extending his service a year to continue his work with BSFs and the development of community water distribution systems.

### *3.5 Tom Moustos, Pamplona, Camarines Sur*

Tom was assigned to the LGU of Pamplona as a natural resource management volunteer. Similar to the geography of Page and Mariah's site; Pamplona, like much of the Bicol region is flat rice fields with an occasional volcano outlining the horizon. Because of this low lying terrain, salt water intrusion to ground water sources is often times unavoidable when rivers backflow during high tide. Tom soon discovered that one of the most pressing concerns for his municipality was poor water quality. With the help of his wife Cara who worked as a child, youth, and family development volunteer, he was able to create a business utilizing Out of School Youth to produce and sell BSFs. The project's business model was selling filters at full price to those who could afford it, while offering one filter per five poor households which was subsidized by outside sources. Tom's project proved to be the most successful and sustainable of the PCVs who worked with the BSFs. While many lessons were learned from other projects' mishaps, Tom's offers a template for successful implementation.

### *3.6 Ben Magalgalit, BSF/PODS trainer, ASDSW*

Ben was born and raised in the northern Philippines and before working for ASDSW he was a Language and Cultural Facilitator for incoming Peace Corps Volunteers. For the past few years Ben has been conducting BSF and PODS (People Offering Deliverable Services) trainings throughout various regions in the Philippines including the southern island of Mindanao. ASDSW started offering five week long PODS trainings after a few of NGO's initial one week BSF trainings resulted in little sustainability. The PODS trainings give groups planning and business skills to create self sufficient income generating projects that benefit their local community. Due to his extensive work with both successful and unsuccessful organizations, Ben offers invaluable experience as to what works and why, in developing a BSF project. He also provides a local's perspective on the issues and solutions.

## 4 Initial Assessment

Obviously before creating any product there has to be a demand for it or at least a potential demand prior to investing time and resources. In assessing a community's need for Biosand Filters there are several factors that should first be considered before jumping into a project. The first would most likely be recognizing water quality issues that adversely affect the health of a community. In some cases this might be a very straightforward task. If it is known that a large majority of people continually get sick on a regular basis from their drinking water source(s), then the BSF might be an appropriate solution to solving this health problem. However, assessing the numbers, locations, and degree of poor health can often require more time and consideration as to what size of a BSF project is appropriate. Other factors to consider include available water sources and treatment alternatives. If in fact a BSF project is deemed as a feasible solution, then the level of commitment from project stakeholders will ultimately determine its success. The implementer's job is to sort through the health statistics, water sources, community opinions, and level of commitment from stakeholders, to determine if a BSF project is appropriate.

### *4.1 Is There a Need for Improved Water Quality?*

Checking local health statistics is usually the best first step in assessing a community's need for improved water quality. Determining the level of waterborne incidences can give an implementer an idea of just how great the problems are and what size of a BSF project might be appropriate for addressing the issue. However, as straightforward as this first step may seem there can often be complications with assessing this data or circumstances that skew results. As explained through the following case studies an implementer may have to go through a variety of procedures before determining the necessity of a BSF project.

After undergoing the 4 day BSF technical training I returned to San Joaquin excited to share the new technology and hopeful that it could help benefit the municipality. One of the first people I spoke to about the BSF was Dr. Elgario, the municipal physician. We discussed the status of waterborne diseases in San Joaquin which Dr. Elgario felt was a growing concern. He gave me some statistics of waterborne incidences that he had treated at the Rural Health Unit (RHU). I inputted the data into an Excel spreadsheet in order to graph and possibly identify trends with problem areas (APPENDIX 1). Adam Lebowe had done the same thing in Gloria and discovered that the 27 barangays with the most waterborne incidences were in the rural highlands and coastal areas. For San Joaquin I found that the highest numbers of cases were also along the coast in highly populated barangays. However, I also noticed that the vast majority of these locations were along the National Highway, which provided easier access to the RHU than the more rural locations, and this may have skewed the results.

Tom Moustos encountered a similar observation when checking on health statistics from his RHU in Pamplona. He found that the treated patients for waterborne cases were from barangays that only encircled the RHU. His theory was that poorer families in more rural communities could not afford the travel costs to seek treatment at the RHU. Despite the doctor of Pamplona discrediting his notion, Tom was proven right a few weeks afterword when a diarrhea outbreak affected 50 people and killed one child in a remote barangay.

Nothing as drastic as a diarrhea outbreak occurred in San Joaquin, but I discussed the possibility of the rural poor's inability to access the RHU with both my LGU counterpart Rodel and Dr. Elgario. The RHU statistics showed a growing number of cases over the past 3 years but there were a total of only 313 treated cases in 2006 in a Municipality of roughly 50,000 people. This equates to only a little more than half a percent of the population. The three of us decided that creating an all encompassing water/sanitation health survey would help us to not only get a better idea of the overall problem (if there was one) but also pinpoint the areas of greatest concern.

We created a very simple health survey that covered topics of water supply and quality, sanitation, and solid waste management (APPENDIX 2). Questions for the survey were similar to those outlined in the joint WHO and UNICEF publication *Core Questions on Drinking-Water and Sanitation for Household Surveys* (WHO[3] 2006). By keeping it simple, we were able to utilize local Barangay Health Workers (BHWs) to conduct the survey. These women work off limited pay but act as educational health advocates for their local communities. They were the perfect citizens for carrying out the survey because they were equally distributed throughout the Municipality (every barangay had at least one BHW while larger populated barangays had 2-4) and they personally knew the community members. The three of us gave these women one half day training and created a BHW survey guide in the local dialect to assist them with technical terms

(APPENDIX 2). To provide incentive to complete and turn in the surveys, we promised a raffle where the BHW names would be submitted if the surveys were complete and on time. After one month, 143 BHWs completed 10 household surveys each which represented a substantial 17% of the entire population of San Joaquin.

The results demonstrated that water quality concerns throughout the entire municipality of San Joaquin did not appear too drastic. Only 10% of those surveyed claimed to have had issues of waterborne related illness and only 22% expressed they were not satisfied with the purity of their water. This is not to state there was no problem with almost 150 households surveyed claiming to have waterborne related issues, but because it was based on the subjective opinions of the residents, 10% did not seem to justify a Municipal wide water quality problem. There is a strong possibility that certain incidences might have been due to cases such as improper food preparation, lack of hand washing, or possibly not even water related. However, because the survey was conducted on a community by community basis this allowed us to individually look at each barangay and identify communities where for example 80% surveyed were not satisfied with the purity of their water (APPENDIX 3). Depending on varying circumstances these barangays could benefit from BSFs but any project undertaken would most likely be small in scale for San Joaquin given the limited water quality problems.

In contrast, the need for an extensive BSF project in Pamplona became evident to PCV Tom Moustos. He began asking locals about their drinking water sources and discovered that most either bought purified water from a local business at P35 ($0.78) for 20 liters or treated water by boiling it. Those too poor to treat their water usually drank from questionable wells. Tom looked into other resources beyond the RHU health statistics and discussed matters with BHWs who had a better idea of the water issues in their local communities. He also discovered a poverty survey conducted by the LGU that outlined water quality as a primary concern for all 17 barangays of the Municipality. To address this issue the LGU had purchased a water truck to make deliveries to communities in need selling water at P6 ($0.13) for 20 liters. However, even the quality of the water from the truck was often considered questionable and deliveries were sporadic. Given the immense need for improved water quality throughout the Municipality of Pamplona, an extensive BSF project was certainly a possible solution.

The aforementioned case studies demonstrate that even the simple task of assessing the need for improved water quality is not always obvious. Various sources of information and community members should be consulted before determining if the need for improved water quality is a priority among the community itself. For situations where health data is non-existent or lacking, the implementer may need to find ways of surveying a substantial portion of the population to evaluate the need. In other circumstances the need may be great enough that water related illnesses are common knowledge to most community members and a BSF project could be an appropriate solution.

### *4.2 Is the BSF an Appropriate Solution?*

The BSF is best suited for treating water from contaminated point sources such as deep or shallow wells but can essentially be used to treat any biologically contaminated source. However, it is important to consider all the alternatives available to treating water and weighing the advantages and disadvantages of each. The case studies discussed below present situations where a water quality issue existed but the BSF was not the most appropriate solution.

After analyzing the San Joaquin survey data, I took time to identify the 10 out of 85 barangays with greatest water quality concerns. I informed the Barangay Captains of those 10 communites that I was available to help them if they were interested in investing community resources towards improving their water quality. One of those captains had heard of the LGU BSF pilot project carried out the previous summer and was interested in a similar venture for his barangay. After talking with the Captain about the water source it became apparent from the outset that a BSF project was not the most appropriate solution in solving this community's water issues. He proceeded to inform me that the primary drinking source for the residents was one open spring that was piped down to the homes in the community. The survey data further supported his claim with 100% of those surveyed declaring their water source was an unimproved spring, which by definition of the survey was open to outside contamination from runoff or animals (APPENDIX 3). After discussing the alternatives, the best solution to improving the water quality of the barangay was to construct a concrete box enclosing the spring and preventing outside contamination. Clearly for this situation, creating a spring box at the cost of approximately one BSF was a much better alternative than several BSFs installed in multiple homes.

For the UNICEF project that Mariah and Page worked on, a few BSFs were installed in schools that had no readily available water source. This oversight was due to a rushed deadline of installations and the fact the project was supposed to coincide with wells being constructed at those schools. But it still demonstrates an important point with regards to water source supply. Due to the fact a BSF should be used on a daily basis from the same water source, it is important to consider that that source can be depended on year round.

Ben Magalgalit was working on a project in Iloilo City that was attempting to use BSFs as an alternative to purified water stations and the city water system which had complaints of bad taste from chlorination. A member of the organization trained in the BSF technology attempted to sell the product to a local resident but failed to do so after discussing issues regarding his well water. The resident lived substantially close to the Iloilo River and during the summer time when river flow was relatively low, his well water would become salty from high tide sea water back flowing in the river and affecting the groundwater supply. Because the BSF cannot remove salt, the resident was not interested in purchasing a unit if he could not use it three to four months a year. Similar circumstances to water sources of users should always be considered for both the feasibility of large scale projects and the installation of a single BSF.

There were other challenges associated with the Iloilo City project that related to the site being urban. According to Ben Magalgalit a BSF project works best in rural areas for several reasons. The first is that the social ties in an urban setting tend to be less strong. This can cause problems for a BSF organization if members do not trust and work well together. It can also pose problems selling to a community that is less socially integrated as opposed to a rural site where everyone knows everyone else and word of mouth spreads faster. The BSF will also be in direct competition with water purifying stations and other treatment methods that may be more appealing to urban dwellers. This is especially true if the urban water sources contain chemical contaminants as opposed to just biological. From Ben's experience he finds that rural areas appreciate the BSF as a new technology while urban sites have doubts whether it is safe to use.

It is important to consider all the various household water treatment methods before deciding a BSF is the most appropriate solution. The two most traditional methods of treating microbial contaminants are boiling and chlorine. Boiling is certainly the simplest process but the primary disadvantages are that it requires fuel which can cost money, and it takes time or refrigeration for the water to cool down for drinking. Chlorination is fairly cheap and very effective at killing bacteria and viruses. The limitations of chlorine are that it works best for clear water, but it's not always effective at killing protozoa which can form cysts, and the taste is often unpleasant. Another issue is that people often don't chlorinate properly and a residual amount is not enough to effectively disinfect the water. Solar disinfection using clear plastic bottles is cheap and effective but also requires clear water free of suspended particles and 6 to 12 hours of strong sunlight. A relatively new water treatment technology is Proctor and Gamble's product *Pur* (CAWST[1], 2006). This product is a small packet containing coagulant, flocculent and disinfectant that when added to highly turbid water coagulates and settles sediments that can be easily removed with a cloth filter. This is a very exciting development but currently requires outside supply and lacks local sustainability. There are also various alternative filters such as porous clay but their main disadvantage is a flow rate of approximately one liter per hour versus a BSF of one liter per minute. In some cases a BSF may also be combined with disinfection methods like chlorination or solar disinfection if there is a concern to completely remove 100% of pathogens versus 90 to 99%.

### *4.3 What is the Level of Commitment?*

Once the BSF has been identified as a viable and appropriate solution in addressing a community's water quality problems, the implementer must assess the level of commitment from community stakeholders. However, before potential stakeholders are willing to invest in a project an implementer must first educate them on the benefits of the BSF. The same methods discussed in the *Education* section relating to promoting the product can also apply to getting people interested in investing in a project. Starting from scratch this can be difficult but if a working model can be built and demonstrated the BSF can often sell itself. If a model cannot be built for demonstration, consider taking interested investors or entrepreneurs to meet with successful BSF organizations already established. As explained further in the *Education* section seeing is usually believing, but if this is not possible stories, statistics, and facts about the BSF can always help establish a good case.

The various stakeholders needed for a basic BSF project will include the trainer or implementer, financial investors, filter technicians and laborers. Various other positions may fall within or overlap these roles but these are the basic constituents that will be needed to make a BSF project successful. Large projects may involve several of these positions while smaller projects may include just a few individuals carrying out several roles.

The trainer or implementer in most cases will be a volunteer or NGO employee and act primarily in a capacity building role. They will be the initial educators of the technology to other stakeholders involved. They will need to bring the various stakeholders together to set objectives and goals for the project. In some cases a trainer may only act in a technical role regarding filter construction for a brief period. If this is the case a local Program Organizer as defined by the CAWST Manual 3.2 (CAWST[1] 2006) would still need to have a working knowledge of the BSF and work to bring various stakeholders together. The trainer or implementer must be committed to investing their time and energy in the initial stages while establishing a framework for the project to continue without them. A trainer or implementer can act as a catalyst but sustainability of a project will ultimately depend on the other stakeholders' level of commitment.

Depending on the framework of the plan, outside investors may be needed throughout the lifecycle of the BSF project or simply for startup purposes. In either case they will be needed to provide the bare minimum initial capital for a mold, tools, and materials. Typical investors for BSF projects discussed in this paper include local government units and both national and global charitable organizations.

The UNICEF project is an example where large funding was given to produce many filters but the investors failed to recognize the importance of information and education dissemination despite lobbying from the NGO ASDSW. Cases like these represent situations where donors mean well but projects can ultimately fail. Investors must be committed to working closely with implementers and organizations if they are setting the conditions of how funds are spent.

Working with LGUs as investors can pose their own unique challenges. Politicians in the Philippines, like many developing countries, are often corrupt and look for ways government investments can benefit themselves before the people they were elected to serve. On the other hand, LGUs are often the only means available to support community projects. As an implementer the keys to working with government officials is outlying the BSF project as a win-win program while limiting their power and influence after it is established. Both Adam and Tom worked their projects through LGU funding discussed in the case studies below.

After undergoing the BSF training, Adam Lebow created a BSF and installed it at the Municipal RHU. He presented the idea of a producing several more to various government officials. They supported the idea and Adam was told by his supervisor they would provide P180,000 (~ $4000) as well as 4 workers for a project to produce and provide transportation for the installation of 130 filters. It was a fantastic start but over the course of Adam's service the logistics with having the entire project tied to the LGU created several problems. The four workers promised were actually assigned to a separate department and could initially only work two days building filters and later none at all. Because they were government employees, Adam had no way of holding them accountable for any work done with the BSFs. No one within the LGU was assigned to work with Adam on the BSF project other than his counterpart who was either unable or unwilling to step into a managerial role. There were also problems with assessing who would receive filters and complications became political when Adam's counterpart began making promises of a BSF for those that elected him as a municipal councilman. There was even an issue with funding since Adam was held to the same standards as department heads that were required to provide initial funds for a project and were then later reimbursed. This was very difficult for Adam considering his monthly Peace Corps allowance was a fraction of a department head's salary and was supposed to be used for personal needs.

In Pamplona Tom Moustos was able to successfully strike a balance between his LGU funding the initial start-up costs of the project and keeping it a separate business for Out of School Youth. Initially Tom thought the LGU would like to take on the project as a service to the poor, but found that even though they supported the project no one was enthusiastic about running it. He was also wary of sustainability issues with regards to corrupt officials managing the business or a newly elected one ending the project. In fact, as the project became more successful, Tom and the OSY faced frequent challenges related to corrupt officials attempting to cash in. Excerpts from Tom related to *Dealing with Corruption in Pamplona* can be viewed in APPENDIX 4.

Despite these challenges, Tom was still able to utilize the LGU for the start-up investment of P42,000 ($930) to purchase two molds, tools, and materials. With the initial investment the

LGU would receive recognition for starting a local business that not only improved water quality for its citizens but provided jobs for Out of School Youth. However, establishing the OSY as an independent organization from the LGU was essential to ensure the long term sustainability of the project.

The most important element to a successful BSF project is the Filter Technician. The CAWST manual defines this person as the local individual who essentially constructs and installs BSFs as a microenterprise. In contrast, CAWST defines Community Steward as the community member who makes follow-up visits to users and understands the processes of how a BSF cleans water. Depending on the size of the project these two categories may in fact be different individuals, but for the majority of small community based projects they are one in the same or multiple individuals understanding the concepts of both roles. For this paper the Filter Technician will be described as the individual who understands the construction, installation, education, and business aspects of BSFs. One reason for combining the two distinct roles that CAWST outlines is that any Filter Technician must be able to explain how the BSF cleans water if they are going to effectively sell it. In most cases they will also fill a Community Steward's role in following up on an installation or promoting the technology simply because it is good business. Unlike the general laborers, the Filter Technician will be responsible for identifying and meeting with users, educating them on how the BSF works, installing the filters properly, and providing follow-up visits for monitoring and evaluation. The case studies below demonstrate the need for an implementer to find a committed long term Filter Technician if a BSF project will prove sustainable.

For the initial pilot project in San Joaquin I trained 10 summer student employees to understand all phases of the BSF with regards to construction, installation, and how it works. A few of the students took on the role of Filter Technicians in explaining the technology during installations or to interested community members. However, because the pilot project was only a summer job the sustainability of these few students as Filter Technicians was never realistic. After the summer ended the students returned to class and I was left with 17 filters that still needed to be installed. My initial hope was that one or two Rural Sanitary Inspectors (LGU employees of the RHU) would be interested in learning the technology and accompanying me for installations. But, as mentioned previously, the concern for improved water quality was not as great as other health issues. The RSI's were generally very busy conducting education campaigns with regards to dengue fever and rabies that at the time were more prevalent concerns. For the installation of the remaining filters from the pilot project, I was accompanied by at least one of my two counterparts from the LGU. But neither was in a position to work as a Filter Technician in addition to being the Secretary to the Mayor and Municipal Tourism Officer. A sustainable project within the LGU seemed inappropriate and after pitching the idea to a local NGO with no response, I was ready to accept that an ongoing BSF project in San Joaquin was unlikely.

I often spent evenings explaining my current work as a volunteer to friends in my local barangay. My good friend Lloyd "Bong" Mamauag became fascinated with the BSF through various conversations and expressed more enthusiasm for starting a project than anyone I had encountered in San Joaquin. I was reluctant at first to mix work with my friends but his persistence and enthusiasm won me over. I trained him during my downtime and received permission for him to use tools and materials from the LGU pilot project. There was not a drastic need for a large BSF project in San Joaquin but Bong's commitment to learning the technology accompanied with his savvy business skills has resulted in a small supplemental livelihood for him and his family. I helped him install his first five BSFs and since then he has installed an additional 11 on his own. Although his BSF business is small, it is still sustainable and successful due to Bong's initial and long term commitment.

The sustainability of the BSF project at Tom's site in Pamplona was also driven primarily by the commitment of one primary Filter Technician. Although all of the Out of School Youth understood the BSF technology, Maricel was the most driven to create and sell the product. She soon became the supervisor of the group managing finances, identifying future owners, and conducting follow up visits. She was so good that fellow PCV Page Weil was interested in his organization hiring her to manage BSF projects at his agency Aquinas University. Although Tom would have been happy for her to move up to a higher paying position, he did have concerns about the sustainability of the project in Pamplona continuing without her. Ultimately, Maricel elected to stay in Pamplona and is still running the Out of School Youth BSF project today.

Both cases in San Joaquin and Pamplona address concerns with project sustainability by possibly having too few stakeholders involved. The downside is that if a BSF project only has one or two motivated and capable Filter Technician's to manage a project, then the success of the project lies with those few people.

One way this issue is addressed by ASDSW is by conducting BSF trainings for organizations of roughly 10-15 people. If one member of an organization leaves, the group can still be self sustaining through multiple stakeholders carrying out various functions. There is also a sense of community ownership with a project that is run by various stakeholders. However, this is only economically sustainable if the need for the BSF is sufficient to cover all the labor costs (even as a supplemental livelihood) associated with 10-15 workers. There are also challenges associated with multiple stakeholders having multiple opinions of how things should be done.

In San Joaquin, Bong only sells enough filters for the BSF to be a secondary livelihood to his primary business of selling rice cup cakes. He also acts as his own boss hiring help when he needs it but making business decisions on his own. Despite the great need for the BSF in Pamplona, the project could only sustainably support four Out of School Youth that collectively ran the business with less conflict than a large organization. Today, Maricel occasionally hires an extra one to three workers depending on the need, but four remains the ideal number of workers for the project.

The laborers of a BSF project are the last essential component. In most cases general laborers can learn how to completely build a BSF in three to four days. This includes constructing the concrete casing, lid, and diffuser plate; sieving and washing the gravel and sand; and the process of installing a filter. It would take substantially more effort to completely understand and educate others regarding how the filter functions as well as be able to sell the concept to a customer. In this instance a general laborer would become a Filter Technician. In the Philippines like many developing countries there is a greater supply of laborers than work available. Because of this, laborers for a BSF project are probably the least essential in determining a level of commitment by an implementer. If there is a profit to be gained, people are willing to work and can be trained relatively easily by a Filter Technician.

In general, assessing the level of commitment from multiple stakeholders is often a very subjective task. The implementer will have to rely on their own judgment and past experiences to determine if stakeholders are truly committed to a BSF project. If that past experience is lacking they should seek advice from others with more experience. However, if the need is great enough and the BSF is the most appropriate solution, it should be possible to find committed community members to invest in a project.

Overall, before a BSF project can get started an implementer must first ask:

1. **Is there a need for improved water quality and to what degree?**
2. **Is the BSF technology the most appropriate solution?**
3. **What is the level of commitment from future stakeholders involved in this project?**

As demonstrated in various case studies, these questions may be relatively easy or quite difficult to answer. But before proceeding to planning a potential project they should be addressed by the implementer and assessed by stakeholders. Other questions are likely to emerge from these three and should be evaluated accordingly.

Furthermore, although these questions were applied in the framework of evaluating a BSF project, they can also apply to assessing the installation of a single filter. In this instance the stakeholder would be the potential owner of the BSF and their level of commitment would depend on either their monetary or labor counterpart. The need and appropriateness for the BSF would depend on the circumstances of water sources available to the beneficiary.

# 5 Project Planning

After the initial questions and assessment have been made and a BSF project is deemed an appropriate solution to addressing water quality concerns, the planning phase of the project begins. From the initial assessment the stakeholders should first identify the size and scope of the project. The various goals and objectives of the project will be determined here. Next they should consider the resources and tasks that will be needed to meet the goals and objectives in the context of a timeline. Resources will include tools, materials and a construction site. Tasks will need to be identified and assigned to various project stakeholders. Lastly, a cost estimate and budget for the project should be developed as well as a business plan to ensure sustainability. Revisions and adjustments to the plan should be expected through all phases of the project implementation.

## *5.1 Determining Scope*

If a thorough job of an initial assessment was completed the size and scope of a BSF project should be a rather straightforward task. If a large community has major water quality issues and there is a high level of commitment, than a large project involving several stakeholders may be the best option. In contrast a small project would be considered for a site with few water quality concerns and less commitment. Like most start up endeavors it is usually best to start small and then expand as demand for a product increases. Both short and long term goals and objectives should be discussed by the stakeholders in the context of a timeline. An example of a goal may be improved water quality and community awareness of the BSF. While an objective is more specific in meeting that goal such as 30 BSFs installed in the first month of production. These goals and objectives can be categorized based on production, installation, marketing and education (or other topics) where resources and tasks can later be designated. The following case studies demonstrate examples of how the scopes of various projects were determined:

Before the water and sanitation survey for the Municipality of San Joaquin was complete, there was an opportunity to create a BSF pilot project utilizing summer student employees for a 30 working day period. The objective of the project was simply to build and sell 20 BSFs to determine if there was a great enough demand or interest for a more permanent BSF project.

After the pilot project and evaluation of the survey data, a small project, if any, seemed most appropriate for San Joaquin. What resulted was a small supplemental business run by a single stakeholder. The goal was simply to sell filters to community members who could benefit, while sustaining a profit.

The scope was quite large for the UNICEF project in Albay. It involved the collaboration of several agencies and various stakeholders performing different tasks. The primary goal of the project was to build and install BSFs in schools and RHUs to act as future disaster relief centers. The objectives included the production and installation of 100 BSFs, a BSF training for the Albay Disaster Relief Network, training municipal sanitary inspectors to assist with education and monitoring, and sufficient education regarding the BSFs for beneficiaries. These filters needed to be built and installed in only 3 months over a very wide area. Due to the time constraint, resources for education were diverted to completing the fabrication of filters. Although the objective of all 100 BSFs was accomplished, the limited education of beneficiaries resulted in the majority of filters not being used. In hindsight, the stakeholders of this project would have reevaluated the total number of BSFs to save more time and money for education. However, even agreeing to this change during the project implementation would have been challenging due to the large scope and the number of stakeholders involved.

Ultimately, the complexity and cost of a BSF project plan will depend greatly on the size and scope. For the UNICEF project in Albay a team of workers was assigned solely to the production of the filters while another group conducted installations and a third was responsible for education and advocacy aspects. The budget involved close to P500,000 ($11,000; APPENDIX 5). In contrast, the post pilot project of San Joaquin involved me working with only one stakeholder who either carried out all functions or contracted out work for construction and transportation. The startup fees for this project which included purchasing a BSF mold was a bare minimum of approximately P15,000 ($333).

### *5.2 Resources, Tasks, and Timeline*

After the goals and objectives define the scope, stakeholders will need to identify the resources that will be needed to create the BSF project. These resources will include tools, materials, a construction site, and transportation for installations.

A complete list of tools and materials used in the San Joaquin pilot project is given in APPENDIX 6. It is important to consider the various expendables that will be needed, such as vegetable oil and candle wax for preparing the mold. Some tools such as the sieves for obtaining the proper gravel sizes and sand will need to be built prior to training. If funding is limited, consider borrowing expensive tools or other available items to cut costs (APPENDIX 6).

As outlined in the CAWST manual, obtaining a good source of sand and gravel is a priority if the project is to be feasible. Ideally, the best source for the media is crushed rock from a quarry. However, sand and gravel from a river can be used if that is the only source available. The implementer should visit sources with stakeholders to collectively determine the best media to be used for the project. If possible, getting sand and gravel donated for the project can also help save costs.

The construction site is an important consideration in the evaluation of available resources. Ideally the site will have a flat concrete floor which makes construction easier and creates a level base for the filters. It is also beneficial to have a site which is roofed to protect workers from the elements during construction. An adequate space to store and shelter filters after construction but before installation should also be considered. If rock and sand washing will be occurring at the construction site, it will be important to have an adequate water supply available and good drainage. This will also require a budget if the water supply is not free.

As will be discussed in a later section, transportation of the filters can be a big challenge. During the planning process it is important to identify the primary form of transporting the filters and how much this will cost. It is also important to consider the distance traveled from the construction site to beneficiaries in order to budget fuel expenses. If the transportation vehicle can only be used during specific times this will need to be scheduled accordingly.

Labor is the last major resource to consider and will coincide with defining people responsible for the various tasks that need to be carried out. These tasks could include the various roles in the construction process such as building the casts, sieving and washing sand and gravel, and building lids and diffuser plates. Beyond production, Filter Technicians would be assigned to conduct installations, follow-ups, marketing, and education of the BSF. Someone will also be responsible for organizing and scheduling transportation.

An example of an Action Planning chart for defining activities and assigning roles is shown in Table 1 below. Ben Magalgalit of ASDSW conducted the session for a BSF/ PODS (People Offering Deliverable Services) organization in Iloilo City that defined the various categories. ASDSW began offering the five week PODS training in order to achieve project sustainability for the organizations they trained in the BSF or other water resource technology. The 5 week program gives organization members skills related to business planning, marketing strategies, finances and bookkeeping. According to Ben, BSF projects that underwent the five week PODS training proved in general to be more sustainable than those that only received the one week technical construction training.

| Key Result Area | Objectives | Task/Activities | Person Responsible |
|---|---|---|---|
| *Production* | -Produce BSFs over a 2 year period<br>-Maintain Supply of Raw Materials<br>-Provide Employment to PODS members<br>-4 spaces for production site | -Construction<br>-Scheduling of PODS members<br>-Regular Monthly meetings<br>-Barangay resolution of production site | -Product Committee<br>-Manager (councilman Marcelo)<br>-Production Chairman (Mr. DeJuan)<br>-Chairman of the Board, Manager, Production Chairman |
| *Marketing* | -Sell 300 units<br>-Expansion of Market<br>-Coverage: 7 barangays, 3 Municipalities | -Orientation seminars in every barangay/town<br>-Promote in subdivisions and relocation site | -Chairman on Marketing (Norberto Tevas) |
| *Education/Advocacy* | -Decrease Water Borne Incidences<br>-Community Aware of BSF technology and safe water | -Orientation on BSF technology and Maintenance to owners<br>-WASH (water, sanitation, hygiene) program | -Chairman of Information, Education, Communication<br>-8 members |

**Table 1: Example of Action Planning Chart.** Developed from Iloilo City BSF-PODS

Tasks that can often times be overlooked during the planning process include educational programs, marketing, and monitoring and evaluation strategies. These topics will be discussed in later sections but they should be considered initially during the planning process. Without proper time and money invested in educating users and promoting the BSF technology the filters will either not be used properly or not sold at all. Education of the filter will also require additional resources in the forms of brochures and posters to be produced. Monitoring and evaluation will also be essential to ensure customer satisfaction and proper use. This helps further promote the BSF business through word of mouth.

Before discussing the budget of the project, the stakeholders should first consider the timeline of tasks necessary. This can be developed on a daily to weekly basis for the initial start up of the project as well as monthly and yearly for long term objectives. The timeline will help give a visual to stakeholders regarding the order and length of steps to be carried out.

It is also important to consider how the timeline of the project will coincide with the environmental and social calendar of the community. If a region experiences seasonal drought it would be advisable to wash more sand and gravel during a period of the year when water is most abundant. An example where timing with the social calendar was overlooked was BSF installations for the UNICEF Albay project. Installations occurred during school vacation which hindered education about the filter to students and teachers.

### *5.3 Budget and Business Plan*

The general start up budget will essentially cover all the items already discussed in the Resources, Tasks, and Timeline section. These include tools, materials, construction site, transportation, labor, as well as costs associated with education and monitoring and evaluation programs. The program of works estimate for the San Joaquin pilot project is given in APPENDIX 6 but this is quite simplified and only includes materials and tools, as the construction site, transportation, and labor were all provided separately by the LGU. The mold was borrowed from Peace Corps while the education, monitoring and evaluation were carried out voluntarily by me and counterparts. This would not be practical for a long term sustainable project, but proved sufficient for the purposes of the pilot project.

Once the initial budget is determined the stakeholders may have to revise their initial objectives if costs exceed the initial funding. In the same manner, the budget may be shaped to define the initial goals and objectives if a set amount of funding is promised for the project before planning begins. Ways of reducing the initial budget will ultimately be up to the stakeholders, but experience has shown that cutting out funds for education and monitor/ evaluation programs will ultimately hinder the project. A more advisable solution would be to downsize the overall objectives (i.e. produce less filters initially).

After the general start up budget is complete, the stakeholders will need to consider how much to price the BSFs in order to ensure long term sustainability. In general a BSF can cost anywhere from $20 to $45 to produce, transport, educate, and install (CAWST[1] 2006). In the Philippines they were generally sold for P1300 to P1500 ($29 to $33). This can be an expensive onetime cost for the rural poor that the BSF is intended to benefit. As a result the majority of the costs are generally funded through charity organizations or the government for low income families. However, experience has demonstrated that "handouts" (free units) do not prove successful and beneficiaries should be expected to provide at least some labor or small payment to establish a sense of ownership. There were several methods developed by the contributors of this paper for determining how best to price filters to maintain sustainability while still benefiting those which need them most. One example is ASDSW's BSF cost estimating spreadsheet shown in APPENDIX 7.

For the pilot project in San Joaquin it was decided to price the filters at P700 ($15), or half the price, because labor, transportation, and education were all being provided by the LGU. The steel mold used to make the filters was being borrowed from Peace Corps. It was thought that selling the BSFs at half price would help make them a more appealing offer to those willing to invest in a brand new technology. Because the LGU funded the project, the revenue could all be used to purchase a steel mold for a future project at the exact cost of P14,000 (P700 x 20 filters). All 20 of the filters from the pilot project were sold and customers seemed happy. The problem occurred when the private livelihood began selling filters at the full price of P1500. New buyers had heard from owners that the price was P700 and this created conflict. In hindsight we would have sold the initial 20 at either the full price or at a lesser discount. Donor funding to subsidize BSFs for the rural poor never resulted and as a consequence only middle class residents benefited.

In Gloria, Adam's LGU had plans to pay for all 130 filters produced and give them away to the rural poor that could benefit most. The future owners' counterpart to receive a filter would be to wash their own gravel and sand. This would give a sense of ownership to the beneficiaries while saving labor costs for a tedious process. However, logistical problems arose that included identifying future owners and how to train them to properly wash the sand and gravel. There were also wealthier citizens from a neighboring municipality that wanted to buy a BSF but were denied due to the project constraints.

Tom's project in Pamplona worked to sell filters to both private users and the rural poor through donor funding. For the private installations the Out of School Youth would sell filters at P1300. The actual costs to produce the filters were closer to P700 but because the organization employed four youth, donated 10% of profits to a youth fund, and demand initially was slow, the project covered expenses with a minimal profit. For the community filters intended for the rural poor, outside donors would pay for a given number and receive their name painted on the outside. BSFs were then subsidized to P40 per family for 5 households (P40 x 5 = P200). The purpose of the P40 charge was not for profits but to rather ensure a sense of ownership for the users. The organization also offered a day of labor at their work site rather than pay the P40 but there were never any takers. For some families that could not afford the P40 they provided transportation by water buffalo, railroad push carts, or carried the filter on foot. The Pamplona pricing system essentially allowed for all community members, both wealthy and poor, to benefit from the BSF technology while maintaining sustainability.

Ben Magalgalit has worked with several BSF organizations and because the PODS trainings result in organizational members coming up with their own business plans, he has seen how various strategies have worked. One method for pricing that has not yet been discussed is the idea of a payment plan. At first there seems to be a lot of challenges associated with this method such as the costs and effort associated with repossessing a 160 lb filter if payments are not made. *Utang,* debt, is a common cultural phrase in the Philippines that could prove disastrous for a BSF project. However, Ben has witnessed a payment plan work in Mindanao where farmers make payments on their filters during harvest time and teachers and other government workers make them monthly when they receive their paychecks. Ben says the key to this process working is a tight rural community where everybody knows each other. In this circumstance debts to friends or family are usually paid. If a family currently spends P40 on 20 liters of purified water a week a payment plan could be set up for a BSF in the same way.

### *5.4 Community Development Cycle*

This last subsection of Project Planning conveys the idea that a BSF project should remain dynamic and flexible through all phases of implementation. The Peace Corps Community Development Cycle shown in Figure 4 models this concept extremely well. It is important for all associated with the project to understand that revisions to the original goals and objectives, action plan, and budget may be necessary. The double headed arrows demonstrate that steps back in the project process may be needed before moving forward is possible. This can result because previous ideas were initially overlooked or because the original ones failed to produce desired outcomes. Ultimately, the Community Development Cycle can act as an excellent guide to stakeholders both during and after the project planning.

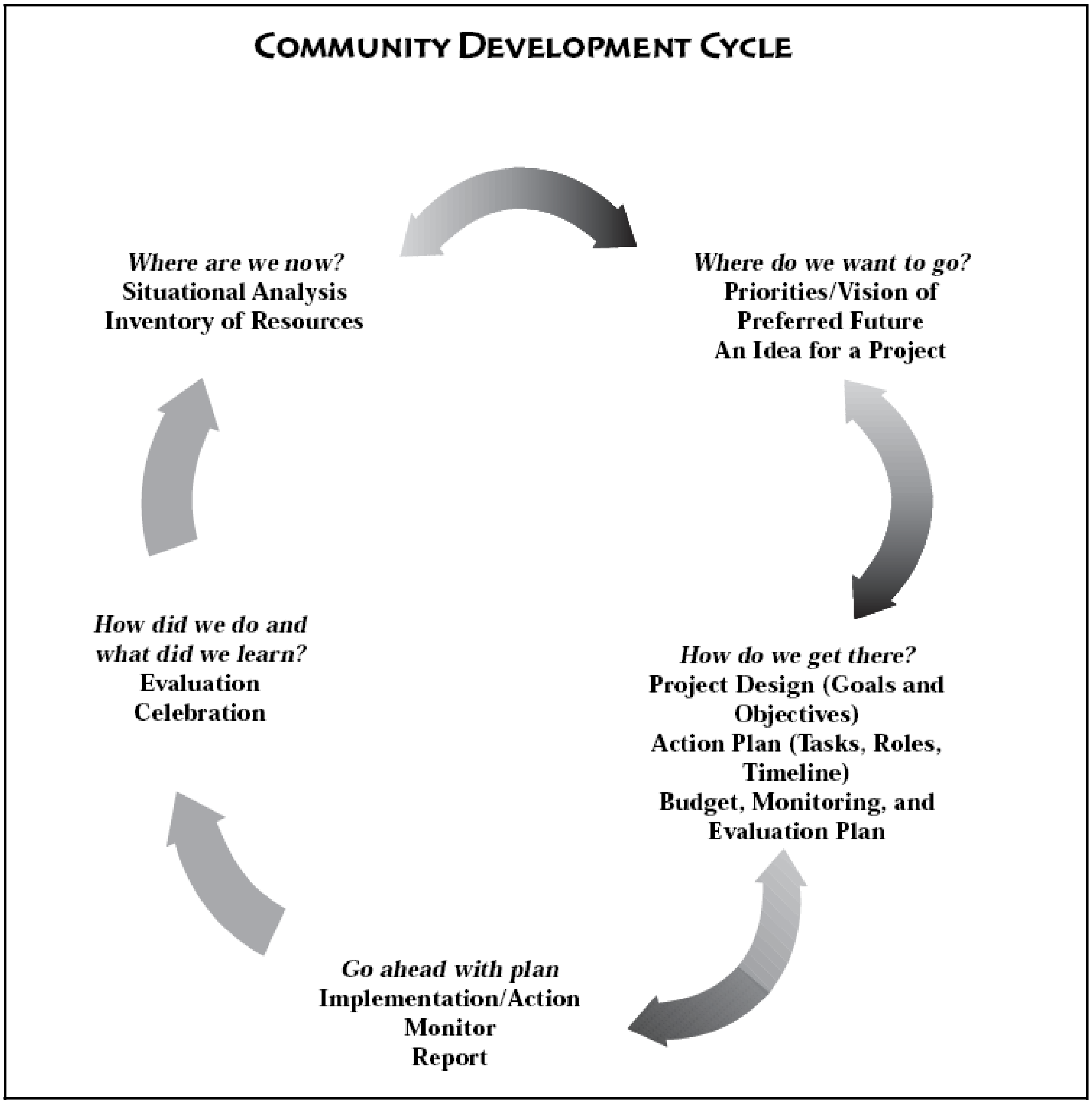


**Figure 4: Community Development Cycle** (U.S. Peace Corps PDM, 2003)

## 6 Education

As mentioned previously in the Project Planning section, education will be an essential component of any successful BSF project and funds should be made available in the budget. The first category discussed in this section will be education in the form of promotion. Without first marketing the BSF technology to future investors, community stakeholders, and beneficiaries, a potential project will never get started. The education to BSF owners and users is usually the most simple but also the most overlooked. Filter Technicians are one of the most essential aspects to a sustainable project. They will need to undergo trainings related to construction, installation, educating users, and basic business skills.

### *6.1 Marketing and Promotion*

The basic principles to selling the idea of BSFs are the same whether applied to a potential owner or donor to fund a project. As discussed in previous sections, the advantages to BSFs often far outweigh alternative water treatment methods such as boiling, which requires fuel, or chlorination, which can leave an unpleasant taste. Although the initial investment of roughly $20 to $30 per filter can seem quite high in the developing world, the filters are designed to essentially last a lifetime. This can create huge long term savings if you consider a family that spends P50 a week on purified water could pay for a BSF in less than eight months. Despite the economic and health benefits, people can remain skeptical of new technologies. The following are methods contributors to this paper used to win over skeptics.

According to Tom Moustos in Pamplona, their project's biggest challenge was selling the BSF to private users. They had tried posters, banners, and newspaper articles but in Tom's own words, "Filipinos want to see it to believe it." So the Out of School Youth began holding community seminars to educate locals and promote the BSF. The OSY would invite approximately 35 people to a community gathering place, hold a seminar and then install a filter. They then would have current customers give testimonials about why they liked the BSF. These seminar sessions proved to be the group's most effective method of promoting the BSF.

Women should be viewed as the primary marketing target for the BSF. They generally are more concerned with health issues that can affect their children than their male counterparts. This fact was made evident when the BSF organization that Page Weil worked with held an informational seminar for new users. The organization had identified a barangay willing to invest in 30 BSFs for 30 clusters of homes. The deal made with the barangay council was that each cluster would send a representative to attend an initial orientation that included an installation demonstration. 28 of the 30 representatives that attended the meeting were women. The orientation and BSF installations proved successful because the representatives that attended had a vested interest in the technology.

Creating initial BSF demonstration models is a great way to gain further interest for supporting a project. Funding for both the San Joaquin pilot project and Adam Lebow's project in Gloria were spurred by demo BSFs. Before any interest in the project by his LGU, Adam built four BSFs on his own that got his host agency interested in the project. In San Joaquin I held an informational seminar on the BSF but because no one could actually see a working model there was little interest. It was not until I purchased a BSF demo model for the Municipal Hall that my counterparts and other LGU officials became seriously interested in a project.

Installing BSFs in public places is a great way to spread the word. Almost every contributor to this paper installed a BSF in a Rural Health Unit. There are several reasons for using these medical centers as locations to promote the technology. Having the town doctor promote a BSF at the RHU gives it the credentials as an effective solution to waterborne illnesses. The RHU is also the first place a person will go if they come down with an illness. Having a working model with a poster that explains how the filter removes pathogens in a place where people may be suffering from those same illnesses is exceptional marketing.

Conducting water tests from sources that are known to be in jeopardy is another way to promote and educate. In San Joaquin we were able to solicit the help from a local university in a neighboring town to conduct a Total Bacteria Count for two separate water sources and their respective BSFs. The results proved a 95% and 99% removal of colony forming units for the two filters (APPENDIX 8). This data could then be utilized by my friend Bong to educate that the BSF is not only proven in international studies but also by the local university for users in the local town.

Like most products and services the best form of advertising and promotion is word of mouth from satisfied customers. The BSF is no exception to this rule. Selling the BSF to the very first customers will most likely be more difficult than those that follow. If customers are satisfied they will tell their neighbors, family and friends and do the promoting for you. To provide extra incentive in this process Tom and his group in Pamplona came up with a clever scheme to offer a small commission to BSF owners that brought in new customers. Another possibility is to install BSFs in the homes of prominent community members. If a respected leader promotes and uses the BSF it can have a far reaching affect on other community members considering one for themselves. However, it is important to consider that the promotion through word of mouth will only be possible if customers are satisfied. This in turn will only be possible if those owners were properly educated in how to use the Filter.

### *6.2 Educating the Users*

Certainly one of the most important steps to ensuring the success of a BSF project is educating the beneficiaries who will use the filter on a daily basis. If they are not properly educated on the technology, then the BSF could have little to no effect in providing safe, clean water. One of the things that make the BSF such a great product is that it is such a simple yet effective solution. In less than an hour people can learn how to operate and maintain a filter that could benefit them a lifetime.

Before installing a BSF in household or public institution the beneficiaries should have a basic understanding of what the filter does and how it works. As mentioned above some of the best strategies for implementing this initial orientation are through group seminars or by customers talking directly to others who have benefited. This initial orientation is needed so that beneficiaries recognize the responsibilities associated with ownership and BSF organizations can feel confident with regards to the filter's sustainability.

For any installation it will be important to provide each owner with a pamphlet or brochure that discusses the minimum of how it works, operation and maintenance. For filters that are installed in community settings, such as a Rural Health Office or school, a large poster should accompany the BSF that provides the same information. Other beneficial information to include in a brochure or poster might be frequently asked questions, and "do's" and "don'ts" related to common user mistakes. The CAWST manual gives excellent examples of frequently asked questions and common mistakes made by owners (CAWST[1] 2006). Examples of common mistakes, or "don'ts," include owners putting food inside the filter; attaching a valve to the spout which will prevent the two inch water level to maintain the biological layer; or attaching extra tubing to the spout, which can create a siphon and drain the filter. An example of a "do" is that every owner should plan to have an accompanying water container with a narrow opening and lid. This container should only be used for water coming directly from the BSF to avoid contamination from other sources.

The brochures and posters are most effective when they are explained in the local dialect or consist of only pictures. For the project in San Joaquin I first created a basic brochure in English and then worked with my counterpart to have it translated in the local dialect Kinaray-a (APPENDIX 9). This can be a slow process and finding a counterpart who has a good understanding of English to convey the message in the local dialect is essential.

In some cases posters and brochures are more effective when they can explain the filter processes through pictures and stories. This is a necessity if the majority of the community is primarily illiterate. Adam Lebow and his counterparts created an extremely creative brochure that featured a character named "Mr. Sandman" that explained the BSF as a comic book story (APPENDIX 10). Rather than simply listing the basic facts, Adam's brochure presented them in an entertaining way to children and adults. Examples where only illustrations are used to explain the BSF are various posters created by CAWST (APPENDIX 11).

Another important addition to include on both the brochures and posters is the contact information of the BSF organization. This will allow users to address questions or concerns easily and ensure the proper use of the filter.

Out of all the contributors to this paper, Mariah Klingsmith was the biggest advocate for the need of user education. She experienced firsthand the effects of the UNICEF project in Albay that was too focused on the numbers of filters installed rather than the necessary education to ensure sustainability. One major problem with the Albay project was that there was little to no time given for advocacy and information and education dissemination. For several cases the very first meeting between the filter technicians and beneficiaries was during the actual installation.

Beyond the issues of determining whether the beneficiaries even wanted a filter was the concern that the technicians often had to educate whoever was available rather than the people responsible for the BSF. There were cases where the group arrived to install at a school and the only available person was the janitor.

Other concerns with the project were related to no educational resources being left to beneficiaries. Because students and faculty had no idea what the filter was, it was often mistaken for a trash can or simply just never used. When follow-ups were conducted on 81 of the original 100 delivered, only 19 were being used. The remaining 62 were either unused, required reinstallation, destroyed (2), or were never installed (5) (APPENDIX 12). The time constraint was the biggest challenge, but Mariah and most everyone else associated with the project feels many of these problems could have been avoided with proper education of the users. If they could do it over again Mariah said she would make sure every school had a proper orientation given to the appropriate faculty; each school filter would have an accompanying poster; every teacher a book; and every student would get a brochure about the BSF.

Finally, the education with regards to the BSF is essential, but it's also important that users are educated in the basics of water, sanitation and hygiene. There must be an emphasis on how poor health is linked to poor water quality which can be linked to poor sanitation. Otherwise people will not make the connection of how and why a BSF could benefit them. In the Philippines there was a strong cultural emphasis placed on health where most people tended to understand these concepts. But other cultures may require an in depth orientation on this topic before a BSF could even be considered as a solution. They should also understand the basic hygienic principles of hand washing and food preparation to prevent illness that may propagate from sources other than water.

### *6.3 Education of the Filter Technicians*

As was defined in *Initial Assessment* section, Filter Technicians for this paper are individuals who understand the construction, installation, education, and business aspects of BSFs. They are the most important element to a successful project and their thorough education cannot be overlooked.

Even if Filter Technicians may not work as laborers to build the BSFs they should undergo the basic construction training to understand how they are made. Filter Technicians will have to educate the public on all phases of the BSF which includes construction. Customers may be curious how the sand and gravel were cleaned and that the inside of the filters were thoroughly washed so there is no cement taste. If an opportunity exists to conduct a training for another organization or for a large community project the Filter Technician will be the trainer of the technology. An example of this occurred when Tom's Out of School Youth organization passed on the technology by training organizations from two different municipalities.

An initial orientation to the BSF, such as the seminar sessions mentioned previously should always precede an installation. If a potential owner simply heard about the product from a friend but does not actually know what the filter is, how it works, or how much it will cost, a filter technician should take the time to initially visit and explain these matters to the customer. The filter technicians can also assess how beneficial a BSF may be to the household. As mentioned in the *Initial Assessment* section, a BSF may not be the most appropriate solution and it would be better to know this before making the effort of transporting and installing the filter. Other advantages to making initial visits with owners is determining the various logistics as to what day and time to deliver, will extra resources be needed to transport the filter, and determining the best permanent location for the BSF in the home.

Training the Filter Technicians to conduct installations on their own can be more tedious than expected. Surprisingly there are a lot of things to remember when installing a filter. The CAWST manual gives a good check list of items needed for an install and the order of procedure (CAWST[1] 2006).

From my own experience of working with both student employees and my counterpart Bong in San Joaquin, doing is the best way of learning how to install BSFs. For the first couple of filters installed I would have the filter technician accompany me, watch the installation processes, and listen to the information I gave to the user. Often times waiting for the water to drain to equilibrium in the filter is a good opportunity for the Filter Technician to review the various processes of the BSF and things the user should do for the first couple of weeks and for the lifetime of the filter. During the second or third installation I would usually have the Filter

Technician co-install. My counterpart Bong would perform everything he could remember and I would help him when he got stuck. I also encouraged him to educate the user as much as possible during downtimes of the installation process. By the fifth installation he was capable of doing about 90% of the installation and necessary education for the user. I attended his sixth and seventh installs only to observe. He was now capable to explain the filter better than myself given his fluency in the dialect.

One interesting cultural note that occurred for me and other implementers was that after my counterpart was sufficiently trained to install and educate on his own, people did not respect him as an "expert" in the technology. Instead, they expected that the tall white American should install their filter rather than the man known for selling baked goods. To overcome this I wrote my counterpart a letter certifying that he had been thoroughly trained by me and was an "expert" in the BSF technology (APPENDIX 13). I also made it clear to everyone at the RHU and LGU that Bong was now the BSF Filter Technician for the municipality. Similarly, ASDSW holds a graduation ceremony at the end of their 5 week BSF/PODS trainings to certify participants as Filter Technicians. Ensuring the public's trust in the filter technician is the responsibility of the implementer.

In order for a Filter Technician to continue educating and promoting the BSF technology they will need to be left with substantial resources beyond certifications. After I had trained Bong, I printed for him a hard copy of the CAWST training manual as well as soft copy on a CD. I also left him with the copies of the brochures we had created in the local dialect and the water test results from the local university. Anytime Bong went to install a filter or make a sales pitch he would bring his notebook of resources to help promote the BSF and educate customers.

In addition to construction, installation, and educational training, a filter technician may also need education with regards to simple business management and planning. Because my counterpart Bong already operated his own successful small business, he did not require further training with regards to budgeting and accounting finances. He was also an excellent salesman which made him great for promoting the new technology. However, if the Filter Technician lacks these business skills than further training from the implementer may be required. ASDSW seeks to address these concerns for Filter Technicians with the People Offering Deliverable Services business training.  This training gives the participants the basic business tools related to planning, marketing strategies, finances and bookkeeping.

## 7 Transportation

Although maybe less important than the previous sections of *Initial Assessment, Project Planning,* and *Education*, reliable transportation is still a vital part of any BSF project. The main reason transportation is a relevant topic to consider is due to the weight of the BSF. Before installation even occurs the empty concrete casing weighs close to 160 pounds. This can be an advantage for the filter's durability and life span but can pose challenges for transporting. Especially when considering that the BSF best benefits the rural poor where roads are less developed and transportation less frequent. This section will discuss of various strategies used to overcome these challenges.

Obtaining or hiring a suitable vehicle for transportation during installations is essential. The vehicle will need to be large enough to hold the filter, sand, gravel, and other materials necessary for installation. For the pilot project in San Joaquin we felt we could save a lot of money when the LGU agreed to let us use the municipal van for transporting filters. However, problems with scheduling of deliveries occurred when we found we could only utilize the van when it was not being used for other purposes. This created major delays and the project could have been completed much quicker if we allotted funds for private transportation. For the project with my friend Bong he never had a scheduling conflict for obtaining a motor trike but he of course had to pay a fee for each delivery.

**Figure 5: Transporting a BSF via motor trike**

In most circumstances it is best to consider hiring a vehicle as opposed to using public transport which can cause difficulties loading and unloading installation materials. Public transportation in the Philippines, like many developing countries, is unscheduled and sporadic. Tom's group in Pamplona occasionally used public jeepneys (similar to a small bus) for installations but found they lost time and money waiting on the infrequent transportation.

Beyond motor vehicles it is also important to consider methods of transporting the filter short distances. After the installation of the first few filters in San Joaquin we quickly invested in a small dolly for moving the filters from the vehicle to inside the home. As previously mentioned the BSF is heavy and a dolly can not only save backs but also allow more maneuverability and easy placement in the home.

In some cases the BSF may need to be transported over an area unsuitable for either a vehicle or a dolly. In such instances it is best if the filter technician can assess the terrain before delivery or at least grasp a general idea from the user. If extra man power is needed to carry the filter up a hill or through a field, this can be arranged prior to delivery. The BSF can be transported the same way other heavy goods are transported to remote places. In the Philippines this was done primarily with water buffalo on land and outrigger canoes by sea.

**Figure 6: Transporting a BSF via water buffalo**

If multiple filters are planned for a community, clustering installations on the same day can save transportation costs as well as time. Both the projects in Albay and Pamplona made use of one vehicle to haul filters to a specific site rather than making multiple trips. If a very large number of filters are planned for a community that is a considerable distance from the construction site, it may be more appropriate to build the filters at a site within the community. Transporting just the BSF molds and tools and finding a local source of sand, gravel and a cement supplier could save a lot of money compared to hauling hundreds of filters to a remote area. This strategy was utilized by a BSF group that Ben Magalgalit worked with in Mindanao. The group had to transport the materials by boat and because the BSFs can be quite awkward they only transported the prewashed sand and gravel and constructed the concrete frames at a community site.

As was previously mentioned in *Project Planning* and later discussed in *Monitoring and Evaluation*, transportation for follow up visits should be allotted in the project budget. This can be much cheaper compared to installations since few materials are necessary and visits to multiple users can be made within the same community.

## 8 Innovations

This brief section discusses the various innovations and improvements in the BSF construction process developed by projects that contributors worked with.

The first innovation came from Kevin “Kiwi” Lee, executive director of ASDSW, with regards to the design of the mold. Although he did not make major changes to the current square CAWST design, he did recommend an extra ½” to the length of the mold and added vertical angle supports (rather than square tubing) at the pressure points where the spider tool makes contact for extraction (APPENDIX 14). During the initial BSF training of Peace Corps Volunteers we had one mold with the original CAWST specifications and one with Kiwi’s adjustment. It was much simpler to level off the concrete for the base using Kiwi’s small adjustment than the original design that that needed extra concrete and created a more wobbly base.

Another problem that was encountered during the Peace Corps BSF training was the time consuming and tedious process of washing gravel. To speed up this process Tom’s group in Pamplona developed a Rock Washer machine. The group worked with a local welder to invent the machine that allowed them to wash the same amount of rock in one day that would take the Out of School Youth one week to wash by hand. To use the Rock Washer you simply add a portion of sieved gravel inside, attach the running hose, and turn the crank. Water slowly leaks out cracks of the machine and once it runs clear the gravel is clean. The machine was very simple and very effective.

**Figure 7: Rock Washer**

In San Joaquin we also had issues with washing gravel but solved our problem by finding another source. Ideally sand and gravel from the quarry is best for the BSF but because we were limited to a river source our gravel had issues with high levels of clay. Portions of clay in the river would ball up and appear to look like gravel but during the cleaning process these would crumble and continually cloud the water. However, the clay rock would not completely disintegrate but rather just slowly break down into smaller and smaller portions. When I started working with Bong he suggested using beach gravel to save costs since he lived right by a beach with gravel deposits. At first I was not sure if this was a good idea since the CAWST manual advised against using beach sources of sand or gravel due to the salt. We tested the washed beach gravel (while still using river sand) in Bong's personal filter and there was no salty taste. After taking random samples of gravel from both the river and beach sources we discovered that the beach gravel had approximately 70% less clay rock than the river gravel. Although we still used the river sand, the beach gravel source substantially sped up the washing process and also saved money.

During the construction of the BSF cast, the pipe used must be duct taped to the bottom of the steel mold to prevent concrete from entering the opening. This generally worked, but often the duct tape would get wedged in between the pipe and concrete layer and was difficult to easily remove by reaching inside. Often times the tape would rip causing even more problems. To overcome this Adam Lebow developed a plug that would attach to the end of the pipe preventing the concrete from entering but could easily be removed after the concrete set. In San Joaquin we still used the duct tape but combined it with a small piece of paper that contacted only the pipe. This allowed the tape to attach only to the steel mold so when extraction took place the tape could easily slide out between the concrete and pipe.

The last and most commonly used innovation for the BSF projects in the Philippines was switching from copper tubing to green plastic tubing that was still suitable for drinking water purposes. The price of the plastic tubing was roughly 1/3 the cost of the copper and was also much simpler to install during construction. However, a few problems did arise when projects first started using the plastic. In Pamplona, Tom's group found that if they did not tape the end of the pipe at the bottom before filling the filters with water to cure, the cement in the water would clog the inside of the pipe. In Gloria, Adam found the plastic tubing worked best if a smaller portion was attached to the very end of the spout to maintain the siphon.

In Africa, Mariah Klingsmith has been working with Jerry Ohs who has designed a round BSF mold made of 24 gauge sheet metal versus the traditional steel design. The design is much lighter and cheaper than the steel mold (40 lbs versus 200) but may also be less durable. Regardless, this innovation has the potential to more easily jumpstart BSF projects by lowering the initial investment to create a working model and generate interest. Figure 7 is a picture of a group constructing a BSF with the sheet metal design while a schematic of the mold can be seen in APPENDIX 15.

**Figure 8: Round sheet metal BSF mold**

Recently, the organization International Aid is trying to overcome the weight issues of BSFs by producing plastic filters (BushProof, 2009). This design would prove very advantageous for purposes of transporting filters to remote regions. The plastic versions can be easily stored and transported since the tapered shape allows them to be stacked. The NGO BushProof thinks the mass production of plastic filters could expand the overall global use. The major disadvantage to this idea is that BSF projects would no longer provide a livelihood for the laborers which construct the concrete versions or build the steel molds. Although BushProof claims the plastic is UV resistant and durable, the fact that users may be more tempted to move a light plastic filter may cause faster wear and tear. Currently the plastic version is also more expensive than concrete but BushProof thinks mass production and more design work could drive down costs. It will be interesting to observe if this recent innovation ends up multiplying the overall number of users that benefit from the BSF technology.

In general, basic innovations in the construction process will occur through trial and error of any BSF project. The purpose of this section is to encourage project stakeholders to test new methods and ideas that may improve the overall success of the project without compromising the effectiveness of the BSF.

## 9 Monitoring and Evaluation

Much like education, a monitoring and evaluation program can often be overlooked but is essential to the success of a BSF project. Follow-up visits are necessary to not only ensure the proper use and maintenance for beneficiaries, but also provide feedback to Filter Technicians with regards to which concepts require further initial education. A good monitoring and evaluation program can lead to a more efficient project and determine if the overall goals and objectives from the planning stages are being met.

Some of the key lessons learned from the UNICEF project in Albay was that there needs to be funds available for follow-up visits and these visits should be made sometime between two weeks to a month after installation. Because funds were not allotted for a monitoring and evaluation program, follow-up visits to the BSFs of UNICEF project were not made until almost a year after the filters were first delivered. ASDSW discovered that almost 80% of these filters were not being used properly during that time. Had money been available to assess these filters from the beginning, they might have not only benefited users, but the organizations involved could have learned sooner of the other problems previously outlined in this paper. The best time to make these initial follow-up visits is generally two weeks to one month after the installation. This gives the owner time to establish the biological layer as well as develop the habits of operating the filter on a daily basis.

The reasons for a Filter Technician to return for these follow-up visits are numerous. First and foremost is to ensure that the beneficiary is properly using the filter and any further questions they have about the BSF can be addressed. Filter Technicians can learn from user questions and mishaps which concepts need further attention during the initial education. Follow-up visits also provide an opportunity for the Filter Technician to verify the operational parameters of the filter such as proper sand to water level and flow rate. Meeting with users to ensure customer satisfaction is simply a good business practice. Filter Technicians can use positive feedback from follow-up visits to help promote the product to other community members or obtain funding from donor organizations. The money saved and gained from initial follow-up visits has the potential to more than offset the travel costs associated with them.

One simple example of a BSF organization learning from follow-up visits comes from Page Weil of Albay. He found that upon returning to assess various BSFs the users had commonly used the swirl and dump technique even when it was not needed. The swirl and dump maintenance is only necessary if the water source is highly turbid. If the technique is used frequently it continually disrupts the biological layer making the BSF less effective. Page realized that further education was needed during the installation to convey this fact to users. They could also assess how frequent the technique would be needed for the users based on observing the turbidity of the source used.

Tom Moustos' project in Pamplona had an excellent monitoring and evaluation program. The Out of School Youth made follow-up visits to every user one month after the installation. Along with the follow-up tasks stated previously, the group would also have the user fill out a survey (APPENDIX 16). This gave feedback on where improvements could be made but also demonstrated successes to local officials and donors that supported the project. In addition Tom's group developed a Customer Contract that stated if the owner did not use the BSF as directed by the filter technician, than they would incur any costs associated with additional visits to fix problems. This gave incentive for the owner to pay attention to the filter technician during installation as well as cut costs for the organization by not having to make or pay for unnecessary trips.

In the Philippines, a simple and inexpensive way to keep in touch with BSF customers and follow-up on their concerns was by texting via cell phone. During the installation the filter technician should record the name, date, address, and if applicable, phone number of the user. After the initial one month visit, a filter technician can plan to text the owner for a given time period to ensure the BSF is still working properly and address questions without having to make a trip. The filter technician could also inquire if the user knows of other community or family members who could benefit from a BSF.

Much like a health survey can help identify the need for a BSF project, they can also help evaluate its success. As was mentioned in the Project Planning section, various goals and objectives will be determined by project stakeholders. For the BSF these are most often related to the water quality and health improvements of a community. To evaluate if these are being met surveys of both BSF users and the community as a whole can identify where improvements have occurred and where further work is still needed.

Finally, the evaluation of a project or its steps is intended to help learn from and identify ways to improve it. This cannot only make a given project more efficient and successful but may also benefit others looking to improve or implement their own.

## 10 Conclusion

Biosand Water Filters have the potential to be a key solution to global problems associated with unsafe drinking water. The technology has existed for almost two decades and studies have demonstrated that BSFs are capable of removing 90 – 99% of microbial pathogens that cause waterborne illnesses (CAWST[1], 2006). The major challenge facing the implementation of BSFs is developing methods to transfer the technology to the field in a sustainable and successful manner.

The initial assessment for a potential BSF project involves evaluating the need for improved water quality, the appropriateness of the technology, and the level of commitment from project stakeholders. The level of work required to assess these matters will vary on the circumstances of the project. An implementer should consider health data, water sources, and community opinions to assist in determining the potential of a BSF project.

If a BSF project is deemed feasible from the initial assessment then planning will be the next step. Information from the initial assessment should help provide a template for the goals and objectives outlined in the scope of the project. Resources and tasks specific to the BSF need to be allocated in the context of a timeline. A major part of the planning process will involve the budget and business plan to ensure sustainability. Project stakeholders should recognize that the phases of implementation will be dynamic and revisions to the original plan may be necessary throughout the project.

Comprehensive education of the BSF technology is essential to not only ensure project sustainability but also the sustainability of filter use for the beneficiary. Applying marketing and promotional strategies that effectively educate the public will help spur sales of BSFs and improve community health. Although the BSF is rather simple, educating the users on proper operation and use should not be overlooked. The Filter Technician will require a thorough education with regards to construction, installation, promotion to beneficiaries, and basic business skills. The long term sustainability of the project will reside with Filter Technicians, so an implementer must certify they are capable of performing the necessary tasks.

Due to their heavy weight, transportation can be a prevalent issue with BSFs. Obtaining a reliable transport vehicle that is capable of hauling a BSF is beneficial. In some cases creativity will be necessary for transporting a filter to a remote area. Stakeholders should consider multiple deliveries to the same community at one time to save money. They may also consider constructing filters at the site of a large remote community as it could save transportation costs.

Various innovations may be developed during the construction or media preparation processes. Project stakeholders should be encouraged to experiment in new developments if it has the potential to save time and money without compromising the effectiveness of the BSF.

A monitoring and evaluation plan should be developed for a BSF project. BSF beneficiaries should receive at least one follow-up visit from a Filter Technician, two weeks to a month after installation. This will allow time for the biological layer to develop and the user to establish the daily habits of operation and use. The follow-up visit will allow the user to ask further questions and provide feedback to the Filter Technician regarding where more education may be needed in the initial orientation and installation. Various methodologies can be utilized for Filter Technicians to stay in touch with users and evaluate success of the project. A good monitoring and evaluation program can determine if the goals and objectives are being met and if not where changes need to be made.

The topics covered in this paper can help give future implementers and project stakeholders' successful strategies for implementing a BSF project. However, the resources in this document are limited to the experiences of a few implementers within the Philippines. Additional research is needed that incorporates the experiences of multiple projects from various regions around the world. Challenges with the BSF related to geography, environment, and culture may vary substantially from country to country or even village to village.

Websites like biosandfilter.org and manzwaterinfo.ca as well as NGOs like *Centre for Affordable Water and Sanitation Technology* and *A Single Drop for Safe Water* are helping disseminate information. However, more is needed from the field to prevent BSF projects from repeating mistakes previously incurred by others and provide successful strategies to improve project efficiency. The exchange of ideas and stories has the potential to not only educate stakeholders but inspire future BSF projects. In recent years the BSF technology has spread quickly with an estimated 70 countries implementing projects in 2008, up from just 26 in 2004 (ManzWaterInfo, 2009). Nevertheless, there is still an estimated 884 million people without access to safe drinking water (WHO[1], 2008). Biosand Water Filters could improve and save the lives of many these people but it will require more than the simple tangibles of concrete, gravel, and sand.

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APPENDIX 1: San Joaquin Health Data from Rural Health Unit

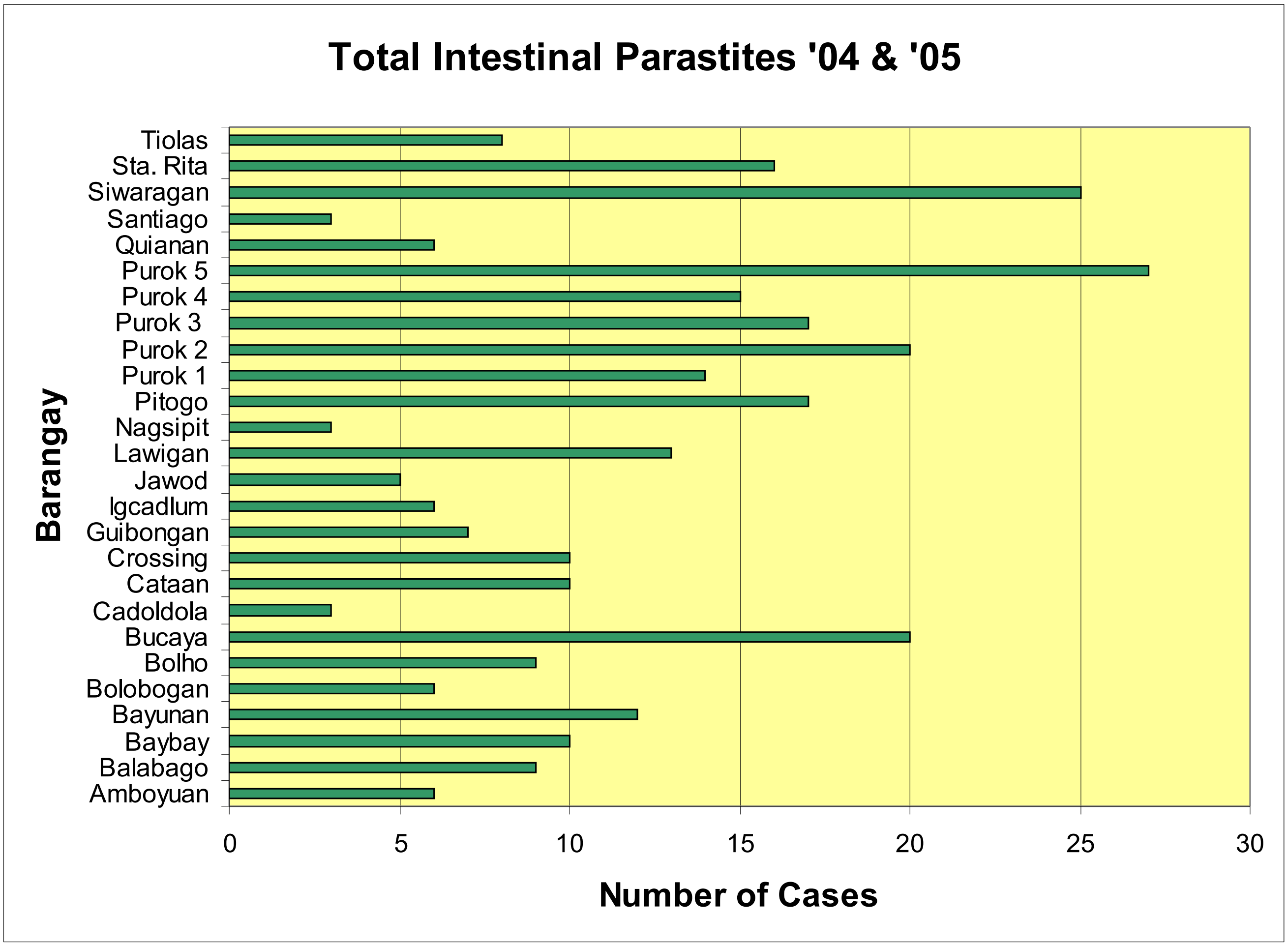



**Figure 9: Total Intestinal Parasites for Barangays of San Joaquin (2004, 2005).**

*The majority of barangays represented are located along the National Highway allowing for easier access to the Rural Health Unit office.*

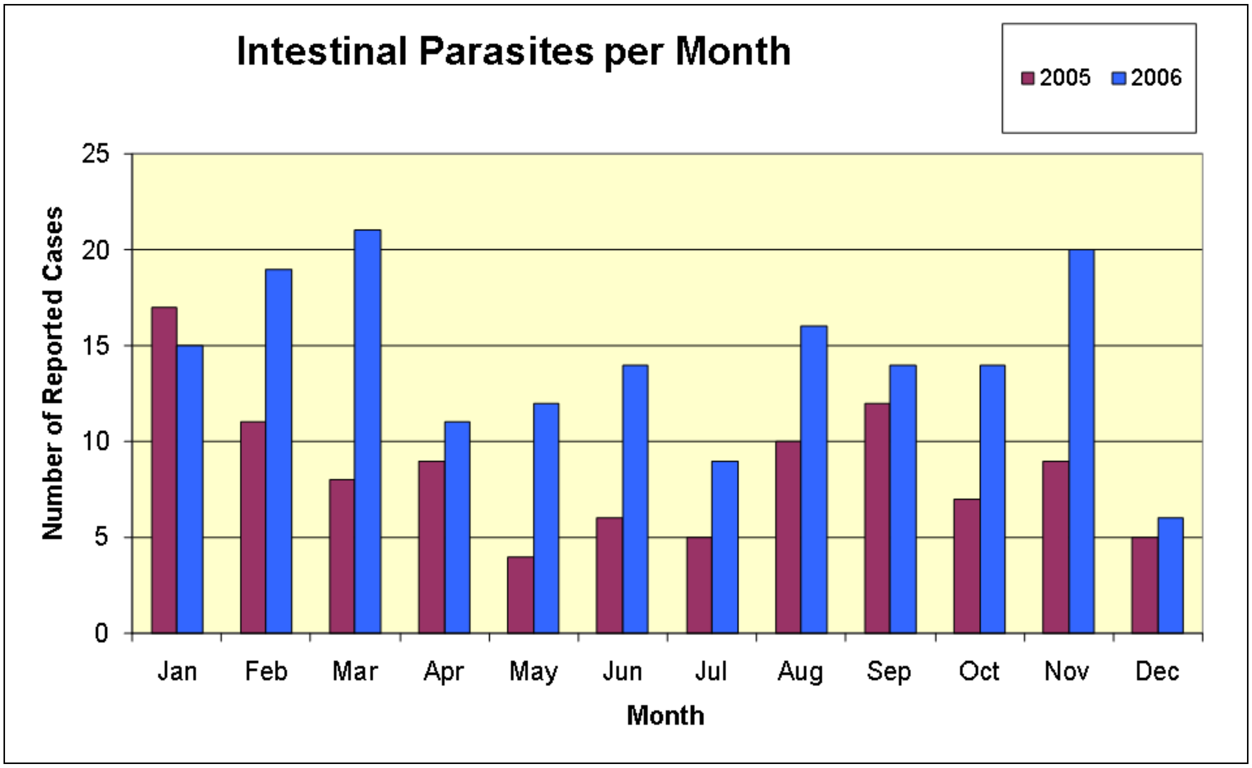



**Figure 10: Intestinal Parasites per month in San Joaquin (2005, 2006)**

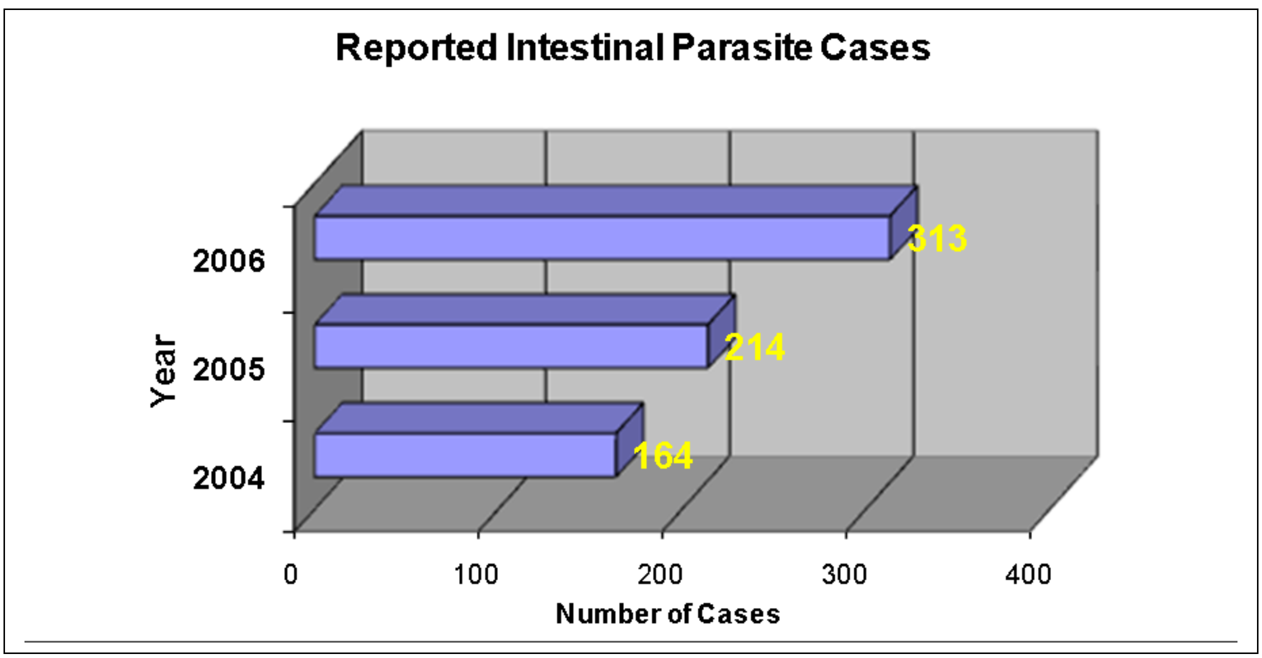



**Figure 11: Intestinal Parasites in San Joaquin (2004, 2005, 2006)**

## APPENDIX 2: Barangay Health Worker Water/Sanitation/SWM Survey and Guide

***Survey:***

Barangay Water, Sanitation, and SWM Assessment Form
MUNICIPALITY OF SAN JOAQUIN, ILOILO

Barangay & Sitio: ______________________________ Family: ______________________
Data Gatherer: ______________________________ # in Household: ______________
Date: ______________________________

I. Water Supply, Purity, Payment

1. Supply (Please Check Sources of Water and corresponding Level)

A. Deep Well ☐ B. Shallow Well ☐ C. Open Dug Well ☐

D. I Spring ☐ E. U Spring ☐ F. River/Creek ☐ G. Other☐___________

Level: I ☐ II ☐ III ☐

Satisfied with Supply? Yes☐ No☐

If No, Which Month(s) insufficient? Feb☐ Mar☐ Apr☐ May☐ Jun☐ Other______

2. Purity

Do you have occurrences of water borne diseases within household? Yes☐ No☐

If Yes, Which Month(s) prevalent? ________________________________________

Satisfied with the Purity of your Water? Yes☐ No☐

3. Payment

Average Household Monthly Income: P __________

Do you pay for water (either filtered or community water works)? Yes☐ No☐

If Yes, What is Average Monthly Payment? P________________

Would you pay more to improve: Supply? Yes☐ No☐ Purity? Yes☐ No☐

II. Sanitation

A. Flush Toilet ☐ B. Pour Flush ☐ C. Vent. Privy ☐

D. San. Pit Privy ☐ E. Open Pit ☐ F. Cat Hole ☐

G. Overhang ☐ H. Other (spec.) ☐__________________

Distance of CR from Water Source: __________meters

Is CR uphill of Water Source? Yes☐ No☐

Satisfied with Sanitation? Yes☐ No☐

III. Solid Waste Management

Segregation? Yes☐ No☐

Biodegradables: Compost☐ Animals ☐ Burn☐ Bury☐ Other_________

Residuals: Open D ☐ Collected☐ Burn☐ Bury☐ Other_________

*Comments:*

*Survey Guide (Kinarya/Hiligaynon):*

**Water, Sanitation, SWM Assessment Form Guide/Notes**

**TUBIG:**

***Ginahalinan***

-Tsekan ang tanan nga mga possible nga mga ginhalinan sang tubig sa bilog nga tuig. Kon sobra sa isa ang ginakuhaan sang tubig, tsekan ang tanan.

Halimbawa: Bubon sa suba kon tag-ilinit kag tubudan kon tingulan, tsekan ang darwa (2).

-Ang "deep well" may kadalumon nga 30 metros ukon masobra (Awang)

-Ang "shallow well" permanente apang menos sa 30 metros ang kadalumon (Awang)

-Ang "open dug well" ginkutkot sang alima kag indi permanente (bubon)

-Ang "improved spring" isa ka tubudan nga may permanente nga tabon ukon taklob.

-Ang "unimproved spring) isa ka tubudan nga wala sang taklob ukon sagang sa naga-ilig nga tubig.

-Ang "source" amo ang ginakuhaan sang tubig.

***Sahi/lebel sang distribusyon***

Level 1: Malapit ang lugar sa diin ginagamit ang tubig sa ginhalinan.
- Source protection
- Halimbawa: Bomba nga ginagamit sang isa ukon grupo sang lapitanay nga pamalay.

Level 2: Ang tubig nagakadangat sa halos kadamuan nga mga pamalay.
- Source protection, transmission, and storage
- Halimbawa: Tubudan nga ginbuhatan sang suluptan sang tubig, tubo, tanke, kag ang komunidad nagakuha sang tubig sa isa ka tilingban nga gripo.

Level 3: Ang tubig nagadangat sa kada lagwerta ukon pamalay
- Source protection, transmission, storage, convenient access
- Example: parehas sang Level 2 apang ang linya nagakadangat sa halos kada indibidwal nga pamalay.

-Halimbawa 1: Ang mga pamalay nga naga-angot sa Water District sa Banwa ara sa level 3

-Halimbawa 2: Ang isa ka nabukid nga barangay may tubudan nga ginsementuhan nga gin-angtan sang tubo paadto sa tnagke. Halin sa tangke, may darwa (2) ka tilingban nga gripo nga nagaserbe ang kada isa sa 5 ka pamalay. Ini level 2 nga tubudan ang source.

-Halimbawa 3: May tatlo ka pamalay nga naga-share sang isa ka aweang nga ginagamitan kang bomba kon tingulan. Sa tag-ilinit, ang awing nagakamalhan gain nagasag-ob sila sa isa ka tilingbannga gripo nga halin sa tubudan. Ang manalawsaw mgamarka sa level 1 (sang awang) kag level 2 (gripo) kag shallow well kag imnproved spring bilang ang ginahalinan.

***Purity***- Kalidad/Katinlo sang tubig, wala sang mga organismo nga nagadala sang mga pamalatian. Sintomas sang mga masakit dulot sang indi malimpyo nga tubig amo ang pagpalanakit sang busong kag/ukon paglupot. Ang pamangkutanon tuhoy sini maga-cover sa isa ka tuig ang nagligad halin sang paghimo sang survey

***Payment***

-Bulanan nga kita nagatuhoy sa kabilugan nga kita sang bug-os nga katapo sang panimalay. Ang sweldo sang kabulig wala na ginaisip kon ini nga kita halin sa tag-iya sang balay.

-Nagatuhoy man sa pagbakal sang tubig para sa sulod balay (wala nadala ang irigasyon)

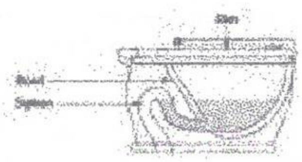
-Mga Halimbawa: Bulanan nga bayad sa Water District; Pagbakal sang mga "filtered" nga tubig irimnon.; Bayad sa kuryente sa bomba, bayad sa pagpanag-ob kag iban pa gingasto para makakuha/makagamis sang tubig.

**Notes on Water:**

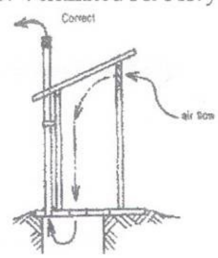
**SANITATION:**

A. Flush Toilet

B. Pour Flush

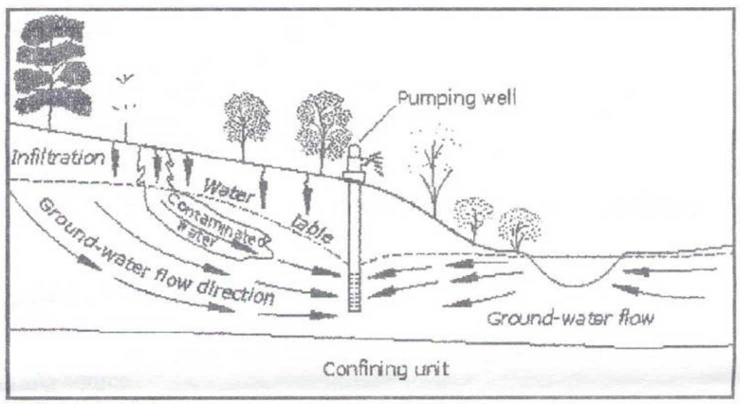


C. Ventilated Pit Privy



D. Sanitary Privy – Pareho sang Ventilated Privy pero wara ti ventilation.
E. Open Pit – Daku nga buho nga pirme ginagamit apang wala sang balay-balay
F. Cat Hole – Gamay nga buho nga ginkut-kot kag ginatabunan sang lupa
G. Overhang – Wala sing buho kag wala ginatabunan sang lupa

Halimbawa sang contaminasyon kon ang CR sa ibabaw naayon sang ginahalinan sang tubig




**Notes on Sanitation:**

**SWM**

Segregation – Pagpain-pain sang basura suno sa klase.
Recyclables – Halimbawa: Salaming, metal, plastic
Residuals – Halimbawa: Panit sang mga dulce, plastic bag
Biodegradables: panit sang prutas kag tulolan-on, uyang nga pagkaon, dahon

Open D – Paghaboy sa bisan diin lang ilabi na guid sa bakante nga lote, suba ukon sa dagat
Composting – Natural nga pamaagi sa pagpadunot sang basura sa lupa

**Notes on SWM:**

**Gathering Data:**

- Magkuha sang mga datos sa nagakalain-lain nga nga mga pamalay sa bilog nga barangay (Indi magkuha sang mga dato sa isa ka sityo ukon purok lamang)
- Kon madamu ang BHW sa isa ka barangay, istoryahan kon diin makuha sang datos ang tagsa-tagsa

**APPENDIX 3: San Joaquin Water/Sanitation/SWM Survey Results**

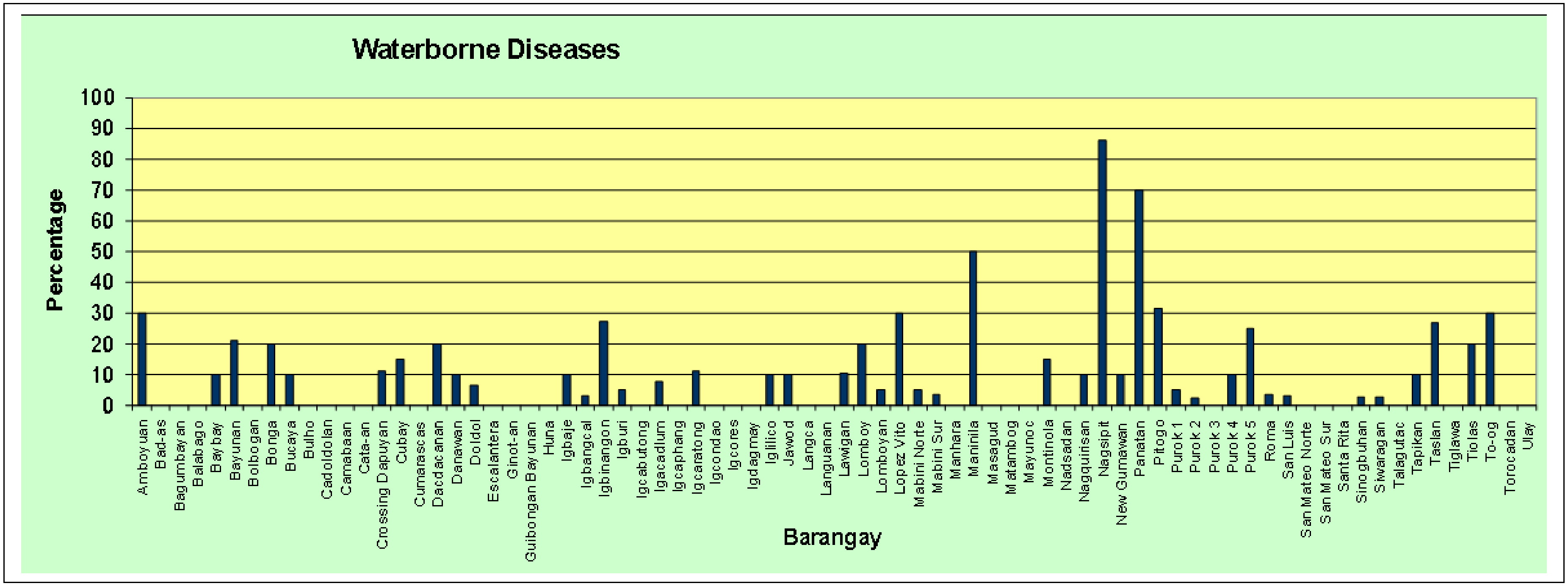



**Figure 12: Percentage of San Joaquin households experiencing waterborne diseases**

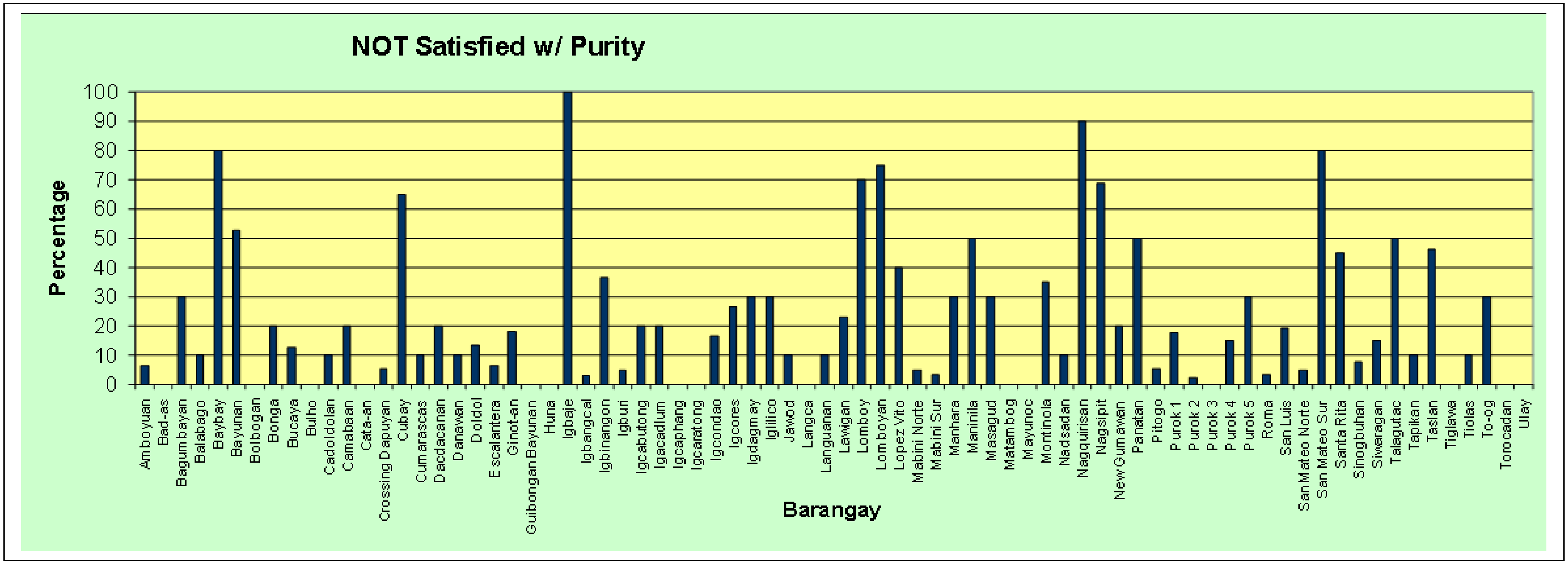
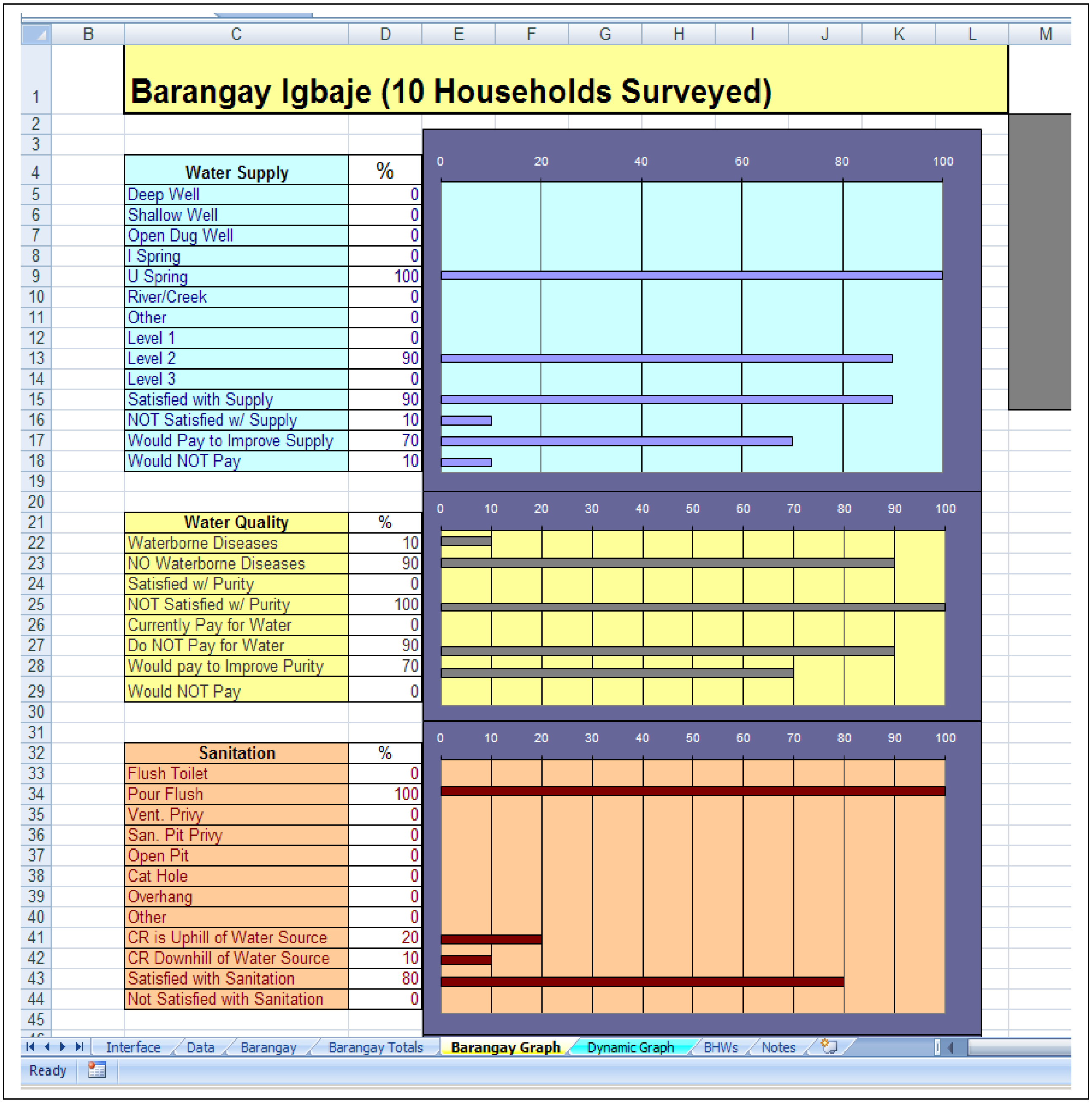



**Figure 13: Percentage of San Joaquin households not satisfied with the purity of water**



## Barangay Igbaje (10 Households Surveyed)

| Water Supply | % |
|---|---|
| Deep Well | 0 |
| Shallow Well | 0 |
| Open Dug Well | 0 |
| I Spring | 0 |
| U Spring | 100 |
| River/Creek | 0 |
| Other | 0 |
| Level 1 | 0 |
| Level 2 | 90 |
| Level 3 | 0 |
| Satisfied with Supply | 90 |
| NOT Satisfied w/ Supply | 10 |
| Would Pay to Improve Supply | 70 |
| Would NOT Pay | 10 |

| Water Quality | % |
|---|---|
| Waterborne Diseases | 10 |
| NO Waterborne Diseases | 90 |
| Satisfied w/ Purity | 0 |
| NOT Satisfied w/ Purity | 100 |
| Currently Pay for Water | 0 |
| Do NOT Pay for Water | 90 |
| Would pay to Improve Purity | 70 |
| Would NOT Pay | 0 |

| Sanitation | % |
|---|---|
| Flush Toilet | 0 |
| Pour Flush | 100 |
| Vent. Privy | 0 |
| San. Pit Privy | 0 |
| Open Pit | 0 |
| Cat Hole | 0 |
| Overhang | 0 |
| Other | 0 |
| CR is Uphill of Water Source | 20 |
| CR Downhill of Water Source | 10 |
| Satisfied with Sanitation | 80 |
| Not Satisfied with Sanitation | 0 |



**Figure 14: Excel File that displays survey data for each barangay of San Joaquin.**

*Notice that for Barangay Igbaje 100% of households were not satisfied with the purity of their water but 100% also received their water from an unimproved spring. Upon further investigation the most appropriate solution for this barangay was to construct a spring box and improve the spring source rather than produce BSFs.*

**APPENDIX 4: Dealing with Corruption in Pamplona**

The Philippines is one of several countries where development can be impeded by corruption. This can pose unique challenges to any micro enterprise including BSF projects. This is especially true if a BSF project becomes as successful as the one in Pamplona. With success come greater revenues which can often attract the attention of those looking to exploit a project for their own gain. In preparing this report I received feedback from Tom Moustos regarding the Out of School Youth and the battles with corruption they continue to face. His comments are given below:

*The LGU official and a kagawad* [town councilman], *tried to get me to lie on my receipts for the initial start-up costs, basically charge double the P42,000 and split the difference. I flatly refused and they backed off.*

*The police stationed in Pamplona would routinely steal our materials. Neighbors saw them walking off with our sand, rock, plywood, sheet metal, tools, duct tape- you name it. It got so bad that I had to request permission from the Mayor to build a shed to lock our stuff up. The LGU asked for a key but I refused.*

*Once we built the shed and improved the work site (new cement pad, better drainage), two LGU officials made plans to remove the kids from the work site after I left. They wanted to build a Bahay Cubo, or drinking shack on site. I caught wind of it and worked an MOA* [Memorandum of Agreement] *through the city council as fast as I could.*

*Maricel was invited to a conference on Out of School Youth, where she met and shook hands with GMA* [Gloria Macapagal Arroyo, President of Philippines]. *An NGO provided funds to the LGU for Maricel's travel (P500), but the LGU never gave it to her. She had to pay out of pocket. Our business made a profit for the Youth group, so I paid Maricel back out of the Youth group's money.*

*The LGU ordered 10 filters but refused to pay until the filters were installed. After they were installed, the LGU still refused to pay. It took me three weeks to get the money out of them, at last refusing to leave the Treasury office until they opened the safe and gave me the money. It doesn't sound like a big deal, but for a small business and with workers supporting their entire families, 3* *weeks with no pay almost broke the project. This was in the beginning before we had a lot of community support.*

*We installed a filter at the local high school (I am generally opposed to "public" filters). After a few follow-ups to learn why the students were not using it, Maricel learned that the teacher who said that she would watch over the filter was using it for her personal profit. She told the students that the water was unsafe to drink, but would make ice out of the filtered water and sell it at the canteen for profit. I talked to the principal who didn't seem to care. Maricel thought the principal was getting a cut.*

*I tried starting an Organic Compost program in Pamplona. I wanted the OSY to run it as another money generating project. I found a shredder for P200,000 and the LGU agreed to buy it. After months of delays (in fact I had totally forgotten about it) my counterpart told me they had bought the shredder for P600,000, and just smiled when I asked him what happened to the rest of the money. A few months later, when I wanted to try and start the composting project, the shredder was nowhere to be found.*

*There's plenty more. Corruption was one of the biggest challenges we faced, especially since we couldn't afford to piss people off. Learning how to deal with it, which battles to fight and which to let go, is so important to the success of a small business there. Especially if the workers are poor or disenfranchised like the OSY. I would say things are better now, mostly because the kids have won so much recognition and the villages love the filter. Lately though the LGU has been trying to get control over the bank account, which at times has over P300,000 in it. Maricel has resisted so far, and I have written to the LGU folks that if she loses control of the bank account, then I will tell all of our donors to stop giving money.*

*That's another important point, - control of the money. Adam's site is a great example. Even if you are dealing with an honest LGU that has promised financial success, it takes so much time and effort to get the money that it is impossible to run the project as a sustainable business. Materials cannot be bought, and more importantly the workers aren't paid and will leave. Then you have to train new people all over again. The BSF project in Sorsogon failed for this reason.*

*But overall, things are great. Dr. Dabu and the Rotary Club has pulled in over $5,000 this year already! I am helping Maricel plan for the future: find a new site away from the LGU, more training for the BSF workers, expand the market. Maricel no longer has to travel around Pamplona looking for customers, they come to her.*

**APPENDIX 5: ASDSW BSF Albay Project Proposal to UNICEF**

**Memo to**: UNICEF

**From**: Kevin Lee

Executive Director

A Single Drop for Safe Water inc.

**Date**: February 26, 2007

**<u>Re. Bio-Sand Filter Training Proposal</u>**

## Project Objective

Train 2 organizations to produce bio-sand filters for implementation into schools. 100 filters to be produced and they will then be able to continue production after current funding runs out in April 2007. This project will then be extended in the next phase to include ferro-cement tanks, more filters in more schools and the creation of Community Based Disaster Response Organizations

**Project outcomes are**:

- 100 filters for 33 identified schools, that's 3 per school = 600l/day capacity of filtered water
- 4 molds for full scale production
- Organizations fully trained for production of filters (This is based on Non-Government Organizations within the Albay Disaster Relief Network)

**Project Budget:**

| | |
|---|---|
| - Training Fees (ASDSW) | **140,000** |
| - Monitoring/Project Management (ASDSW) | **50,000** |
| - Expenses (per diem, accomm, travel and Training Materials) | **130,000** |
| - Molds (4 of) | **60,000** |
| - Tools/Materials | **80,000** |
| - Transport Filters to Site | **10,000** |
| - **<u>TOTAL PROJECT COST</u>** | **<u>470,000</u>** |

**<u>Local Counterpart estimated at 132,000P</u>**

Would include:

- Labor for attending training (30,000P)
- Labor for filter production and installation (30,000P)
- Meals for training (60,000P)
- Facilities for training and production (12,000P)
- Local Trained US Peace Corps Volunteers will assist with workshops and Preparation.

**Schedule**

To Complete this by April 16th Deadline:

- Project Approved funding released **March 8th**
- Order Molds **March 8th**
- Mobilize ADRN **March 8th**, Venue selected by **March 12th**
- First Workshop Prep **March 15th**
- Workshop 1 **March 19 to March 23**
- Second Workshop Prep **March 22**
- Workshop 2 **March 26 to March 30**
- Installation **Start March 30**
- Continue Full Scale production till all materials are used April 22

Attached sections:

1. Description of Training
2. Preparation work required by ADRN
3. Preparation work required by ASD
4. Mold
5. Tools
6. Materials
7. Training Fees and Expenses
8. Terms and Conditions

## 1. Description of Training

The Bio-Sand Filter (BSF) is a household water treatment system that can treat between 20 and 200 liters of water a day. Typical pathogen removal rates of 95% can be expected when used correctly.

This training is a combination of practical hands on training and theory. At completion of training the participants will have built and installed filters and will have knowledge of its workings as well as ideas on how to promote its use within the community.

**Preparation Day 1 to Day 4**

- Identify and purchase sand and gravel. (Gemma found some so shouldn't be a problem). Good to do with participants as it's very important.
- Review tools, sieves and assist in finalizing purchase.
- Build a filter in each mold so that two will be cured for installation and that the molds are OK. Make modifications to molds if required.

**Workshop**

**Day 1**

- Introduction to BSF Design and Theory (Theory)
- Household water treatment options and advantages (Theory)
- Sand Sifting (Practical)
- Mold Design and Construction (Theory)
- Construction of Filter (Practical)
- Gravel Preparation (Practical)

**Day 2**

- Detail Theory for BSF (Theory)
- Extract filter (Practical)
- Lids and Diffusers (Practical)
- Construction of Filter (Practical)
- Gravel Preparation (Practical)

**Day 3**

- Filter Extraction (Practical)
- Lids and Filters (Practical)
- Sand Selection (Practical and Theory)

- ❖ Sand Preparation (Practical)
- ❖ Installation (Practical)
- ❖ Trouble Shooting (Practical)
- ❖ SPLIT INTO TWO GROUPS
    - o Filter Technicians….filter construction
    - o Project Implementers…….Documentation

**Day 4**

- ❖ ***Filter technicians***, extract filters, construct filters and build lids and diffusers and Installation.
- ❖ ***Project implementers, those who will oversea the implementation of Project*** Project Implementation (Theory)
    - o Community, financial and technical sustainability Cost Analysis (Theory)
    - o Health and Hygiene IEC

**Day 5**

- ❖ ***Combined***
    - o Formulate Plan for construction and implementation of Rest of Filter
- ❖ ***Filter Technicians***, continue construction
- ❖ ***Project Implementers***, Prepare IEC Materials and plans for installation

**<u>2. Preparation Work Required by ADRN/USPC vols and ASDSW</u>**

1. **Construction of Mold**. ASD will arrange molds to be built and delivered. ADRN to arrange pick up and storage
2. **Purchasing of Tools.** See attached list. May include fabrication of Sieves if not able to be purchased.
3. **Purchasing of Materials.** See attached list.
4. **Sand Sourcing.** Host organization needs to identify different sand **sources** (not suppliers). Most preferable source is **Crushed Rock** with max gravel size about ½". River sand sources must have a range of sizes. Sand purchase will be done with ASD trainer during preparation week.
5. **Identification and Rental of Facility**.
    a. Requires a class room area for lectures, electrical supply for Laptop and LCD presentations.
    b. Practical area with large continuous supply of water, adequate drainage, shelter for sand storage and sheltered working areas for concrete preparation.
    c. Supply of Snacks and Lunch for participants and trainers.
6. **Co-ordination of Travel and Accommodation for Trainers.** One person will be the contact for ASD for all arrangements. Will also be needed for MC and introduction at beginning of seminar.
7. **Identification of Participants.** Those that will be employed to build the project as well as those that will be involved in future project planning. Ie. LGU health workers or Sanitary inspectors as well as members of NGO's.
8. **Printing/Copying of all hand out materials.**
9. **Coordination with Targeted Schools.**

## 3. Preparation Work Required by ASD

1. **Co-ordination with Host Agency.** Kevin Lee will be main contact for all arrangements and to answer all or any questions.
2. **Preparation of all Handout Materials.** To be supplied by ASD for Host agency for copying.
3. **Pre-Workshop Preparation**. Working with host agency contact. Assist with sand selection and purchasing. Construction of a filter in each mold, supervision of repairs/modifications if required. Set-up of workshop area and lecture room. These filters will be used for installation practice in workshop.

## 4. Mold

A steel mold is required for the fabrication of the filter. This mold is designed so that after the training it will be used for mass production of these filters. This typically costs about 15,000P each and requires about 1 week to build. These will be purchased from a fabricator in Masbate that has built molds before

For each workshop 2 molds are required to train 20 people.

**Max Mold Cost 4 molds @ 15,000 ea** **60,000**

**5. Tools**

| Item | Description | Quantity for workshop | Est Price |
|---|---|---|---|
| 1 | 1 ½" or 38mm combination wrench to fit Extractor Bolt | 2 | 2500 |
| 2 | 9/16" or 14mm combination wrench to fit bolts that hold mold together | 8 | 1200 |
| 3 | 6" slip joint pliers or adjustable Wrench | 1 | 500 |
| 4 | Hack saw with blades | 1 | 200 |
| 5 | Utility knife | 1 | 100 |
| 6 | Bending board materials | 1 | 0 |
| 7 | Tubing / pipe cutter | 2 | 1000 |
| 8 | Wire brush | 4 | 300 |
| 9 | Measuring tape | 2 | 200 |
| 10 | Hand saw | 2 | 600 |
| 11 | Masonry trowel | 4 | 200 |
| 12 | 2" paint brush and Or Rags to spread Oil | 4 | 150 |
| 13 | Fine sand paper - about 150 grit – sheets | 4 | 80 |
| 14 | Rubber mallet | 2 | 400 |
| 15 | Claw hammer | 2 | 400 |
| 16 | 12mm Re- Bar | 1 | 200 |
| 17 | Plastic Funnel | 1 | 50 |
| 18 | Plastic Tubing that fits over 3/8" Tube and funnel end | 1500mm | 50 |
| 19 | Shovels | 6-8 | 2500 |
| 20 | Pails – (White or Light color) | 20 | 1000 |
| 21 | Measuring container (1 litre bottle) | 1 | 50 |
| 22 | Tin Snips | 1 | 200 |
| 23 | ½" Sieve | 1 | 400 |
| 24 | ¼" Sieve | 2 | 800 |
| 25 | Metal mosquito Sieve – 14 or 15 gauge – 14 wires per inch | 4 | 1600 |
| 26 | Black marker / pencils | 2 | 100 |
| 27 | 1" scraper | 4 | 200 |
| 28 | Toilet Brush | 2 | 200 |
| 29 | Work gloves – pairs | Pr/pax | 600 |
| 30 | Bleach – household, 1 litre bottle | 1 | 50 |
| 31 | Hoses for Water Supply | As required | 1500 |
| 32 | Large Drums for Water for sand/gravel washing | As required | 1800 |
| 33 | Tarpaulin/Tents for shade and covering materials | As required | 1500 |
| | | **EST TOTAL each** | **20630** |

**TOTAL 42,000P**

## 6. Material List

Materials for Filter Production of 100 filters, including that used during training

Note that sand and gravel could be mixed and fine sand screened out. Excess can be purchased as it will be used for more filters. Will be purchased after ASD inspection during preparation time.

| | **Description** | **Quantity** | **Est Price** |
|---|---|---|---|
| 1 | Portland cement (40kg sack) | 50 | 10000 |
| 2 | Sand for concrete and Filtering Media | 8 | 4800 |
| 3 | Gravel for concrete (screened to ½”) | 4 | 2400 |
| 4 | Plastic Tubing | 100m | 1500 |
| 5 | Vegetable oil or Vegetable Lard | 25 | 2000 |
| 6 | GI Sheet #20 6’ x 3’ sheet | 6 | 7200 |
| 7 | 3/8 or ½” Plywood 8’x4’ sheet | 3 | 1500 |
| 8 | 1”x1” lumber | 400’ | 1000 |
| 9 | Duct or Masking Tape | 4 rolls | 800 |
| 10 | 1” Nails | 10kg | 500 |
| 11 | 2” Nails | 10kg | 500 |
| 12 | Candles | 10 | 500 |
| 13 | Dishwashing Soap | 10 | 500 |
| 14 | | | |
| 15 | | | |
| | **100 Filters** | **Est Total** | **33200** |

## 7. Training Fees and Expenses

ASDSW is a training organization whose sustainability is dependent on professional fees. Training fees include for 2 people at both trainings and involved in the preparation work with the assistance of US PC Volunteers.

Monitoring and Project management includes for 1 person to monitor ongoing production and installation of the 100 filters.

Per diems and Accommodation costs are required for these personnel and for the incidental expenses incurred by the Peace Corps Volunteers.

## 8. Terms and Condition (Standard Rates)

We understand that funds would be released to A Single Drop for Safe Water Inc. as per standard Project Co-operation Agreement to be disbursed as required with the production of supporting documents within 6 months of fund release. Listed below are standard rates for A Single Drop for Safe Water. Note that the professional fees have been discounted for this project for the 2 people required as designed.

Note that any changes requiring additional manpower will be charged at the rates listed below.

**Trainer Rates**

- Lead Trainer Workshop 10,000P per day
- Lead Trainer Prep Work 5,000P per day
- Secondary Trainer 4,000P per day
- Travel Days 1,000P per day per person

**Expenses**

- Per Diem No Meals Provided 600P per day per person
- Accommodation reimbursed at cost up to 1,500P per day per person
- All fares over 20P reimbursed at cost

**Materials and other Costs**

- All Materials, tools, accommodation, transport and other items apart from Per Diems will be reimbursed at cost plus 10% for overhead.

**Terms and Conditions**

- Airfares, Ship Fares or Bus fares to be paid for one week before ASD arrives on site.
- Per Diem and Accommodation to be paid for one week before ASD arrives on site.
- 50% of agreed on Training Fees to be paid for one week before ASD arrives on site.
- Final 50% of Training Fees to be paid within 15 days from completion of Training.
- All Materials and Final invoiced costs to be paid within 15 days of invoicing.
- All overdue payments will incur a penalty of 6% per month.
- Host agency can purchase air fares and accommodation on site.

Regards,

Kevin Lee
Executive Director
A Single Drop for Safe Water

## APPENDIX 6: San Joaquin BSF Pilot Project Program of Works & Actual Material Costs

Republic of the Philippines
Province of Iloilo
Municipality of San Joaquin

**Program of Works and Estimates**

| | |
|---|---|
| Name of Project: | Summer Job Student Employee Biosand Filter Production |
| Location: | Municipal Building |
| Brief Description: | Construction of Biosand Filters for Prevention of Waterborne Diseases |

| | |
|---|---|
| Construction Materials: | P 6500.00 |
| Supplies and Tools: | P 3500.00 |
| Total Cost: | P 10,000.00 |

SUMMARY

| | |
|---|---|
| I MATERIALS | P 10,000.00 |
| II LABOR COST | P 0.00 |
| **TOTAL ESTIMATE:** | **P 10,000.00** |

Prepared by:

Ian Maycumber
U.S. Peace Corps Vol

Approved by:

Hon. Ninfa S. Garin
Municipal Mayor

| ***Materials Need for Biosand Filter Training/Construction*** | | |
|---|---|---|
| | | |
| **Materials List** | **Quantity** | **Estimate** |
| ***Items to Borrow*** | | |
| BSF Mold | 1 | OK |
| 1 1/2" Wrench | 1 | OK |
| 15mm Wrench | 4 (at least 2) | 1 |
| Adjustable Wrench | 1 | |
| Hack saw | 1 | |
| Hand saw | 1 | |
| Pipe/Tube Cutter | 1 | |
| Masonry Trowel | 2 | |
| Rubber Mallet | 1 | OK |
| Shovels | 4 | |
| Hammer | 1 | |
| Tin Snips | 1 | |
| Tape Measure | 1 | OK |
| C - Clamps | 2 | |
| Slip Joint Pliers | 2 | |
| | | |
| ***Supplies to Purchase (or Possibly Borrow)*** | | |
| Work Gloves | 12 pairs | 200 |
| 1" Scrapper | 2 | 50 |
| Bleach 1 liter bottle | 2 | 75 |
| Rags | | Borrow |
| Wire Brushes | 2 | 75 |
| Sand Paper | 1 pack | 200 |
| Tarp 3x3m | 2 | 300 |
| Buckets | 10 | Borrow |
| Tabo | 2 | 50 |
| Tub | 2 | 150 |
| Large Bucket with cover | 2 | Borrow |
| Markers/Pencils | 5 | Borrow |
| 2" Nails | 2kg | 200 |
| 1" Nails | 2kg | 200 |
| Scrub Brush | 2 | 50 |
| Dish Soap | 1 bottle | 50 |
| Paint Brush | 4 | 150 |
| Paint | 2 cans | 350 |
| Small Candles (for Wax) | 10 | 100 |
| Cooking Oil | 1 litre | 100 |
| 1/4" GI Sieve 1m$^3$ | 1 | 75 |
| 1/8" GI Sieve 1m$^3$ | 1 | 75 |
| Wood (4 or 3)" x 1" x 12' | 4 | 600 |
| Wood 1"x1" x 12' | 4 | 400 |
| 1/2" Staples | 1 box | 50 |

(Continued on next page)

***Construction Materials***

| | | |
|---|---|---|
| Construction Grade Media (mix of sand and gravel) | 5 $m^3$ | 1500 |
| 1/16" Stainless Steel Flat Sheet Metal ~10$ft^2$ | 1 | 1000 |
| Sheet of 1/4" plywood | 1 | 350 |
| Portland Cement 40kg Bag | 10 | 2500 |
| 3/8" Copper Tubing (or possibly plastic) | 30ft | 1000 |
| Tie Wire | 50ft | 150 |

| | |
|---|---|
| Total Estimate: | **P10,000.00** |

**Table 2: Program of Works estimates for San Joaquin BSF pilot project**

**BSF Material Cost (P)**

| Item | unit | quantity | Location | unit cost | cost |
|---|---|---|---|---|---|
| GI Sheet | #18x4x8 | 1 | Far Eastern Hardware | | 1165 |
| 1/8" stainless steel screen | 1ft | 1 | Far Eastern Hardware | | 215 |
| 3/8 Copper Tube | ft | 36 | Nismal Marketing | 35 | 1260 |
| Enamel Paint | Liter | 2 | Nismal Marketing | 105 | 210 |
| 2" Paint Brush | | 2 | Nismal Marketing | 30 | 60 |
| 1/2" Paint Brush | | 1 | Nismal Marketing | | 10 |
| Sahara Cement | kilo | 1 | Nismal Marketing | | 35 |
| 1 bottle Paint Thinner | | 1 | Nismal Marketing | | 28 |
| Silicone Sealant | | 1 | Nismal Marketing | | 125 |
| Construction Media | m3 | 2 | Aris const | 300 | 600 |
| Push Cart | | 1 | Far Eastern Hardware | | 1230 |
| Finishing Trowel | | 2 | Far Eastern Hardware | 35 | 70 |
| 1 1/2 nails | kilo | 0.25 | Nismal Marketing | 50 | 13 |
| 1 nails | kilo | 0.25 | Nismal Marketing | 50 | 13 |
| 1 staples | box | | Nismal Marketing | | 50 |
| 2 nails | kilo | 0.5 | Nismal Marketing | 50 | 25 |
| 3/8 Copper Tube | ft | 30 | Far Eastern Hardware | 36.4 | 1092 |
| Wood (for Sieves) | 1x2x12 | 4 | DRV Marketing | 114 | 456 |
| Wood (for Lids) | | 1 | DRV Marketing | 114 | 114 |
| Wood (for Lids) | | 3 | DRV Marketing | 84 | 252 |
| Wood (for Sieves) | 1x1x12 | 2 | DRV Marketing | 84 | 168 |
| 1/2 Screen | m | 1 | Nismal Marketing | 75 | 75 |
| 1/4 Screen | m | 1 | Nismal Marketing | 78 | 78 |
| 1/8 Screen | m | 1 | Nismal Marketing | 78 | 78 |
| Gloves | | 10 | Nismal Marketing | 15 | 150 |
| Scrapper | | 2 | Nismal Marketing | 25 | 50 |
| Steel Brush | | 2 | Nismal Marketing | 30 | 60 |
| Sand Paper | | 5 | Nismal Marketing | 15 | 75 |
| Latex Paint | gal | 1 | Iloilo Paint | 441 | 441 |
| Chemical Hose | ft | 6 | Nismal Marketing | 12 | 72 |
| Tarp | m2 | 3 | Nismal Marketing | | 174 |
| Tube Cutter | | 1 | Robinsons | | 177 |
| Duct Tape | | 1 | Robinsons | | 160 |
| White Tape | | 1 | Robinsons | | 57 |
| Comb Wrench 15mm | | 1 | Robinsons | | 90 |
| Tube Bender | | 1 | Power Industrial Sales | | 700 |
| Cement | bag | 3 | JTRC Hardware | 198 | 594 |
| Cement | bag | 10 | Mac Trading | 200 | 2000 |
| Construction Media | m3 | 2 | Mac Trading | 330 | 660 |
| Tie Wire | kilo | 5 | Mac Trading | 55 | 275 |
| 1/4" Marine Plywood | 4x8 | 1 | Mac Trading | | 315 |

Others:

| | | | | | |
|---|---|---|---|---|---|
| Cooking Oil | liters | 2 | | | 150 |
| Candles | bag | | | | 50 |
| Nylon Line | m | 5 | | 10 | 50 |

(Continued on next page)

| | | | |
|---|---|---|---|
| Total: | **13722** | | |
| Not Needed: | 698 | | |
| One time Cost: | 3317 | | |
| Expendables: | 1164 | | |
| Filter Materials: | 8543 | 9707 | (Expendables & Filter Materials) |
| | | 462 | Unit Material Cost for 21 filters |

**Does not include:**
Transportation
Diffuser Cutting and Bending (P10/filter)

**Consider:**
GI Sheet and Plywood could make an extra 12

**Table 3: Actual costs and purchases of San Joaquin BSF pilot project**

# APPENDIX 7: ASDSW BSF Cost Estimating Spreadsheet

Bio Sand Filter Cost Estimate Sheet

## Variable Costs Materials

| Description | Part of Filter | Quantity | Standard Unit | No. of Filters/Unit | Price/Unit | Cost/Filter |
|---|---|---|---|---|---|---|
| Cement | Body | 13 liters | 40kg bag | 2 | 188 | Php94 |
| Sand | Body and media | 70 liters | cubic meter | 14 | 200 | Php14 |
| Gravel | Body and media | 40 liters | cubic meter | 25 | 475 | Php19 |
| Plastic Pipe | discharge tube | 150m | 1 ft | 150 | 900 | Php6 |
| 1/2" Plywood | lid | 1 sq ft | 8'x4' sheet | 32 | 500 | Php16 |
| Good Lumber | lid | 1 foot | 1x1x8' | 8 | 75 | Php9 |
| 16 GA GI Plain Sheet | diffuser | 1 sq ft | 8'x3' | 24 | 360 | Php15 |
| Tie Wire | diffuser | 1 kg | | 50 | 50 | Php1 |
| Duct Tape | hold tube in place | 1/4 Roll | roll | 20 | 78 | Php4 |
| Oil or lard | mold prep | 1 gallon | 1/2 liter | 8 | 263 | Php33 |
| Nail | lid | 1/8 kg | kg | 16 | 44 | Php3 |
| | | | | MATERIALS TOTAL | | Php214 |

## Variable Costs Others

| | | Quantity | Standard Unit | No. of Filters/Unit | Price/Unit | Cost/Filter |
|---|---|---|---|---|---|---|
| Labor Estimated | | 1.6 | manday | 0.625 | 200 | Php320 |
| Labor includes: | Gravel Washing | | | | | |
| | Sand Washing | | | | | |
| | Mold Preparation | | | | | |
| | Filter Pouring | | | | | |
| | Filter Extraction | | | | | |
| | Installation Material Preparation | | | | | |
| | Travel to installation | | | | | |
| | Installation and Education | | | | | |
| Transportation | Materials to Construction Site | | | | | |
| | Filters to Installation Sites | | estimate 50P/filter | | | Php50 |
| | Filter Technicians to Sites | | estimate 5 filter/day 2 mer | | 0.4 | Php80 |
| | | | | | TOTAL | Php450 |

## Fixed Costs

| | Item | Quantity | Standard Unit | No. of Filters/Unit | Unit Cost | Cost/Filter |
|---|---|---|---|---|---|---|
| Mold not amortized | | | | | | PHP 0 |
| Permanent Tools not amortized | | | | | | PHP 0 |
| Consumable Tools | Rubber Mallets | 1 | Mallet | 3 | 150 | PHP 50 |
| | Sieve Mesh - 1/8" | 1 | m^2 | 10 | 85 | PHP 9 |
| | Sieve Mesh - 1/4" | 1 | | 10 | 85 | PHP 9 |
| | Sieve Mesh - 1/2" | 1 | | 20 | 42 | PHP 2 |
| | Sieve Wood 2x2 | 1 | 2x2x12' | 10 | 34 | PHP 3 |
| | Sieve Wood 2x1/2 | 1 | 2x1/2x12' | 10 | 45 | PHP 5 |
| | Tabo | 1 | dipper | 10 | 70 | PHP 7 |
| | Bucket | 1 | bucket | 20 | 45 | PHP 2 |
| Facility Rental | | | | | | PHP 0 |
| Utility costs power/water/phone | | | | | | PHP 0 |
| Admin Costs ie. Project implementation team labor, paper, mail | | | | | | PHP 0 |
| PHILAM LOGO | | | | | | PHP 150 |
| IEC costs ie. Materials, meeting place rentals, food etc for meetings | | | | | | PHP 100 |
| Training Costs for technicians and community stewards | | | | | | |
| | | | | | TOTAL | Php336 |

| | |
|---|---|
| **SUSTAINABLE FILTER COST** | **Php1,000** |
| **FILTER WITH 10% Safety** | **Php1,100** |
| **SOLD AT** | **Php1,400** |
| **PROFIT** | **Php300** |

**APPENDIX 8: BSF Water Testing in San Joaquin**

*Total Bacterial Count (TBC) Water Testing for Biosand Filter*

SAN JOAQUIN, ILOILO PHILIPPINES

Summary: After the installation of approximately 20 Biosand Filters (BSF) within the Municipality of San Joaquin, U.S. Peace Corps Volunteer Ian Maycumber was interested in conducting water tests to demonstrate the filter's effectiveness at removing bacteria. He solicited the help of the University of the Philippines, Visayas in the neighboring town of Miagao. It was here that Mr. Maycumber was introduced to Associate Professor Dr. Philip Padilla and Medical Technologist Tess Go from the Division of Biological Sciences. They were both very interested in helping Mr. Maycumber test the BSF in San Joaquin pending funds for another project of the Iloilo River. Mr. Maycumber proceeded to identify two Biosand Filter owners in San Joaquin who were satisfied with the BSF performance and claimed their water was not potable for drinking before using the BSF. These two owners were Mr. Jose Rodelio Sedantes and Ma. Cleta Gaite whose homes were both located in barangay Purok 5, Poblacion. The purpose of the testing was to gather a sample both before (directly from household source) and after passing through the BSF to determine exactly how much bacteria was removed.

**Figure 15: Water testing at University of Philippines Visayas**

It was agreed that testing would be conducted on March 3, 2008. Bottles used for collecting the samples were first sterilized at the lab and then labeled accordingly (A1: *Source 1*, B1: *BSF 1*, A2: *Source 2*, B2: *BSF 2*). Mr. Maycumber then proceeded to collect the first samples A1 and B1 at the home of Mr. Sedantes followed by the second set at the home of Ma. Cleta Gaite. Both sources were deep wells and water was collected from the pumps directly. For collection of the BSF samples, water from the well was poured into the filter and then collected directly from the BSF spout. Care was taken to ensure none of the samples were contaminated during collection. The samples were then taken back to the laboratory at the UPV campus. Tess Go proceeded to conduct the lab testing for Total Bacterial Count in accordance with the Lab Manual (see Total Bacterial Count Lab Procedure).

Results: After the respective Petri dishes were allowed to incubate for 48 hours colonies were counted for each of the diluted samples. The results are displayed in Table 4 below. Figures 14 and 15 on the following page further demonstrate how effective the BSF filtered bacteria from the first source.

**Table 4: Results of total bacterial count**

| Sample | Sample Dilutions | Colonies Counted | Multiplied By | Product | Average Dilution Count/mL | % of BSF Bacterial Removal |
|---|---|---|---|---|---|---|
| A1 (Source 1) | $10^0$ | 575 | x1 | 575 | 518 | 99% |
| | $10^1$ | 58 | x10 | 580 | | |
| | $10^2$ | 4 | x100 | 400 | | |
| B1 (BSF 1) | $10^0$ | 4 | x1 | 4 | 4 | |
| | $10^1$ | 0 | x10 | 0 | | |
| | $10^2$ | 0 | x100 | 0 | | |
| A2 (Source 2) | $10^0$ | 48 | x1 | 48 | 59 | 95% |
| | $10^1$ | 7 | x10 | 70 | | |
| | $10^2$ | 0 | x100 | 0 | | |
| B2 (BSF 2) | $10^0$ | 3 | x1 | 3 | 3 | |
| | $10^1$ | 0 | x10 | 0 | | |
| | $10^2$ | 0 | x100 | 0 | | |

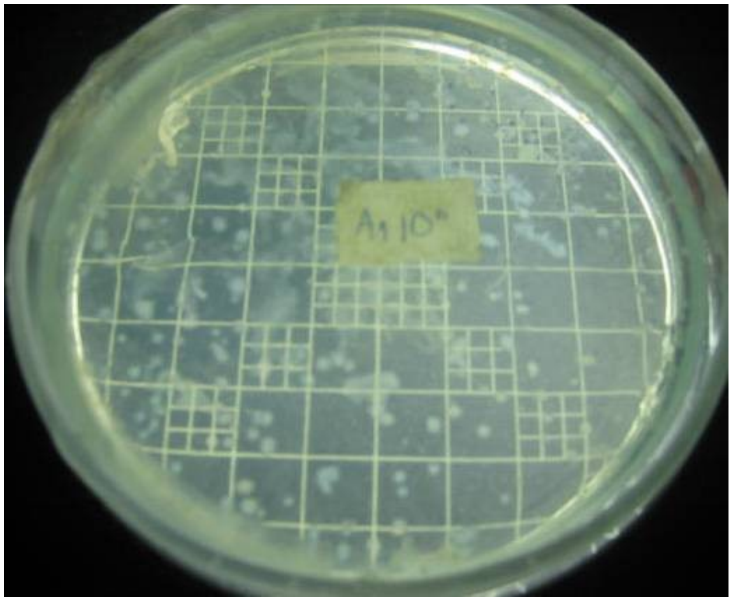


**Figure 16: Sample A1 $10^0$ (Non-diluted) Source 1**

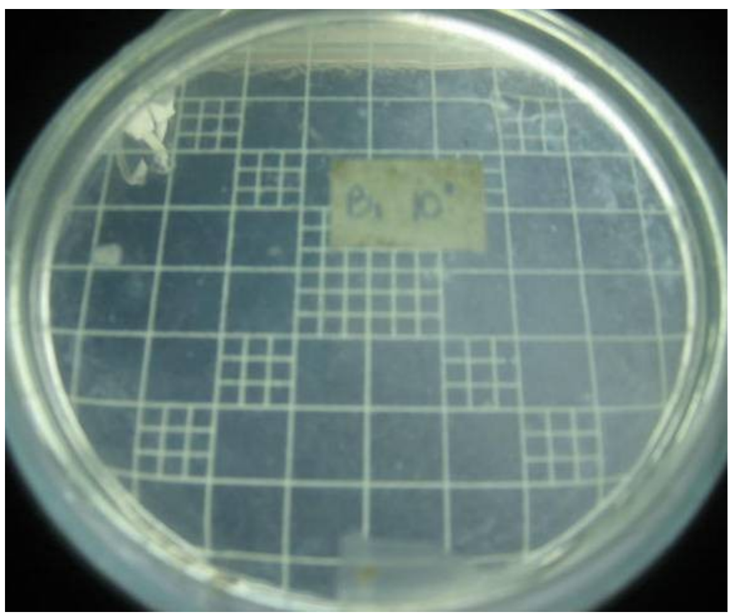


**Figure 17: Sample B1 $10^0$ (Non-diluted) BSF 1**

Conclusion: The local water testing conducted on the BSF in San Joaquin coincided with international water testing that demonstrates the filter's effectiveness at removing bacteria. Although this was a fairly simple test and small sample size based on a limited budget, the results still convey the capabilities of the BSF.

## APPENDIX 9: BSF Brochure for San Joaquin (English and Kinaray-a)

### Frequently Asked Question's

**1. Does the BioSand Filter (BSF) kill all the bacteria?**

Typically the BSF will remove over 90% of bacteria if installed and used properly. Often, the amount of bacteria left alive will not be enough to make someone sick. However, disinfection using chlorine, or solar rays from the sun, can be done if there is concern of people with low immune systems (infants or elderly).

**2. Will the BioSand Filter (BSF) take out parasites?**

Yes, typically 100% of parasites are removed if the BSF is properly installed and used. It is important to note that most parasites are highly resistant to chlorine disinfection, so the best way to treat drinking water for parasites is to filter them out.

**3. Will the BioSand Filter (BSF) remove the dirt in the water?**

Yes, the BSF removes over 95% of the dirt (suspended solids or turbidity) in the water. If the water is very dirty, it should be allowed to settle until it is clear and/or filtered through a fine-woven cloth (folded over many times) to remove most of the dirt before pouring it through the filter.

**4. Does the BSF remove salt from sea water? What about pesticides, industrial contaminants or other chemicals?**

The BSF does not remove the salt in sea water. Nor does it remove chemical contaminants such as pesticides, industrial contaminants, or fluoride dissolved in the water. Chemical and other contaminants can only be determined through water testing.

**5. How often can I run water through the filter?**

The filter can be used continually. You can add water anytime there is sufficient room in the top of the filter, although normally the filter is not run at night to allow a pause period.

**6. What do I do if my filter dries out?**

This may happen if the filter is left unused for a long period of time or if there is a leak. The water level must be re-established by filling the filter through the pipe (using the spout) so that the water rises from the bottom up preventing air from becoming trapped in the sand. This can be accomplished in the same way that the initial sanitation of the pipe is done. The Filter Technician or Community Steward should do this.

### Do's and Do Not's

***Do*** use the filter daily – this will maintain the water level 5 cm above the sand (measured during the pause period) and keep the bio-layer alive.

***Do*** ensure water quality is from the best possible source. Always use the same source if possible.

***Do*** ensure the receiving container is clean.

***Do*** keep animals away from the filter

***Do*** use the filtered water for drinking, cooking, cleaning, and bathing.

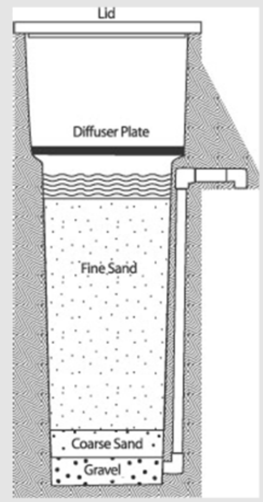
***Do Not*** put food inside the filter.

***Do Not*** attach a valve on the spout. This keeps the water level too high and prevents oxygen from reaching the bio-layer.

***Do Not*** add a hose to the end of the spout. This will create a siphon and completely drain the water in the filter.

***Do Not*** add chlorine to the top of the filter. This will kill the bio-layer at the top of the filter.

CONGRATULATIONS!
YOU ARE THE OWNER
OF A BIOSAND FILTER




Proven to effectively remove:

- More than 90% of fecal coli form
- 100% of protozoa and helminths
- 50-90% of organic and inorganic toxicants
- up to 67% of iron and manganese
- 95% of suspended sediments

**Figure 18: San Joaquin English BSF brochure (front and back cover)**

## How Does it Remove Contaminants?

When water is poured into the top of the filter, the organic material it is carrying is trapped at the surface of the sand, forming a biological layer or 'schmutzdecke'.

Over a period of one to three weeks, micro-organisms colonize the bio-layer, where they find food (the organic material) and oxygen supplied by the water.

Four processes remove pathogens and other contaminants in this filter:

***Predation:*** The schmutzdecke micro-organisms eat bacteria and other pathogens found in the water.

***Natural death:*** Pathogens die because there is not enough food and oxygen to sustain them all.

***Adsorption:*** Viruses are adsorbed (become attached) to the sand grains. Once attached, they are metabolized by the cells or are inactivated by antiviral chemicals produced by the organisms in the filter. Certain organic compounds are also adsorbed to the sand and therefore removed from the water.

***Mechanical trapping:*** Sediments, cysts and worms are removed from the water by becoming trapped in the spaces between the sand grains. The filter can also remove some inorganic compounds and metals from the water when they are precipitated into solid form.

## Operation

- Slowly pour raw (untreated) water into the filter daily (at least 20 litres, twice per day)
- The diffuser must always be in place when pouring water into the filter – never pour water directly onto the sand layer
- The lid should always be kept on the filter
- Use a designated bucket for fetching raw water
- Use a designated safe storage container to hold the treated water. This container should have a tap or spigot and a small opening to prevent contamination.
- Place the receiving container as close to the spout as possible (i.e. place it on a block) to reduce dripping noise and prevent recontamination

MUNICIPALITY OF SAN JOAQUIN
COMMUNITY DEVELOPMENT
ILOILO

For further information regarding the BSF please visit the Municipal Health Office or Municipal Planning and Development Office. Salamat Gid.

## Maintenance

- Clean the spout with soap or chlorine as it will become contaminated during normal use via dirty hands, animals, or insects.
- Wash the receiving container with soap and water or a chlorine cleaning solution as needed.
- The entire filter should be cleaned regularly (lid, diffuser, outside surfaces)

**What if the flow from the filter is very slow?**

This means that the top layer of sand in the filter is plugged with dirt. This material should be removed using the **'swirl & dump' technique:**

1. Remove the lid to the filter; remove the diffuser
2. "Swirl" your hand or use an appropriate tool (5cm deep), around the surface of the sand at least 5 times. You will disturb the surface of the sand but don't mix the surface layer below the top 5cm of sand. The water above the sand will become dirty.
3. Scoop out dirty water with small container (i.e. cup or tabo) Avoid scooping out sand.
4. Throw out the dirty water outside the house in an appropriate location.
5. Repeat this until all the water has been removed from the filter
6. Replace diffuser
7. Add 20 litres or 5 gallons of water – replace lid
8. Check flow rate
9. Repeat if flow rate is still low

- The sand should never need to be changed. It is cleaned by the **'swirl & dump'** technique described above.

**Figure 19: San Joaquin English BSF brochure (inside)**

## Pag-mintenar

- Tinluan ang spout kang habon ukon chlorine.
- Tinluan man ang surudlan kang nasara nga tubig ka-habon ukon chlorine cleaning solution.
- Tinluan ang filter (diffuser, sa sagwa, pero wara ti chlo-rine sa sulod)

**Paano bala kon tama gid kahinay ang tubud kang filter?**

Dya nagakahulugan nga may nagsupon nga higku sa ibabaw nga layer kang baras sa filter. Makakas dya nga higku pinaagi sa sa paggamit kang **'swirl & dump' technique:**

1. Hukson ang taklub sa filter, hukson ang diffuser plate.
2. "Swirl" (labugayon) ka lima ukon magamit kang stick (5cm ang kadalumon) ang naibabaw nga ba-hin kang baras hasta lima ka beses. Indi pagdalu-mun asta sa 5cm kang baras. Ang tubig magalubog.
3. Sarukon pagwa ang higko nga tubig (usaran kang baso ukon tabo). Indi pagdar-on ang baras.
4. Ihaboy ang mahigko nga tubig sa gwa kang balay.
5. Liwan-liwanon tubtub nga mabuol ang tanan nga tubig sa filter.
6. Ibalik ang diffuser
7. Dugangan ti mga 20 ka litros nga tubig.
8. Lantawon ang panubud kang tubig
9. Liwanon ang paglimpyo kon mahinay sa gihapon ang pagtubud kang filter.

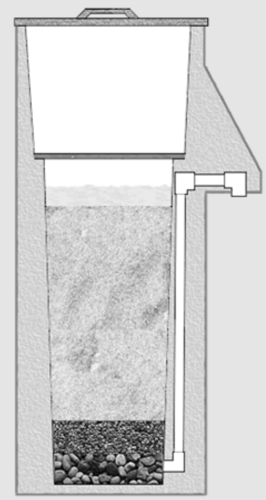
- Ang baras indi kinahanglan nga islan. Dapat usaron lang ang **'swirl & dump'** technique.

## Pag-gamit

- Ibubo ti mahinay ang tubig sa filter (mga 20 litros ukon sobra, darwa ka beses kada adlaw)
- Kinahanglan ang diffuser rigyan permi sa lugar kon mag-bubo kang tubig sa filter. Indi magdiretso bubo kon wara ti diffuser.
- Siguruhon nga may taklub pirmi ang filter
- Magamit kang sangka balde nga para lang gid sa filter.
- Magamit kang surudlan nga purunduhan kang tubig nga nasara. Ang surudlan kinahanglan may gripo ukon gamay nga bukas kag may taklub agud malikawan ang pagsulod kang higko.
- Ibutang ang surudlan kang tubig marapit sa baba kang sarayluhan kang tubig agud malikawan ang recontami-nasyon.

For further information regarding the BSF please visit the Municipal Health Office or contact Lloyd Mamauag at 09274810011

## PANGINBULAHAN SAIMO PAG-ANGKON KANG BIOSAND FILTER



Napamatud-an nga makakakas kang:

- Masobra 90% nga fecal coli form
- +99% nga protozoa kag lugay
- 50-90% nga organic kag inorganic toxicants
- tubtub 67% nga iron kag manga-nese
- 95% nga suspended sediments

**Figure 20: San Joaquin Kinaray-a BSF brochure (front and back cover)**

## APPENDIX 10:  Adam Lebow's "Mr. Sandman" BSF Brochure (Tagalog)


**Figure 21:  Page one of Adam's brochure**

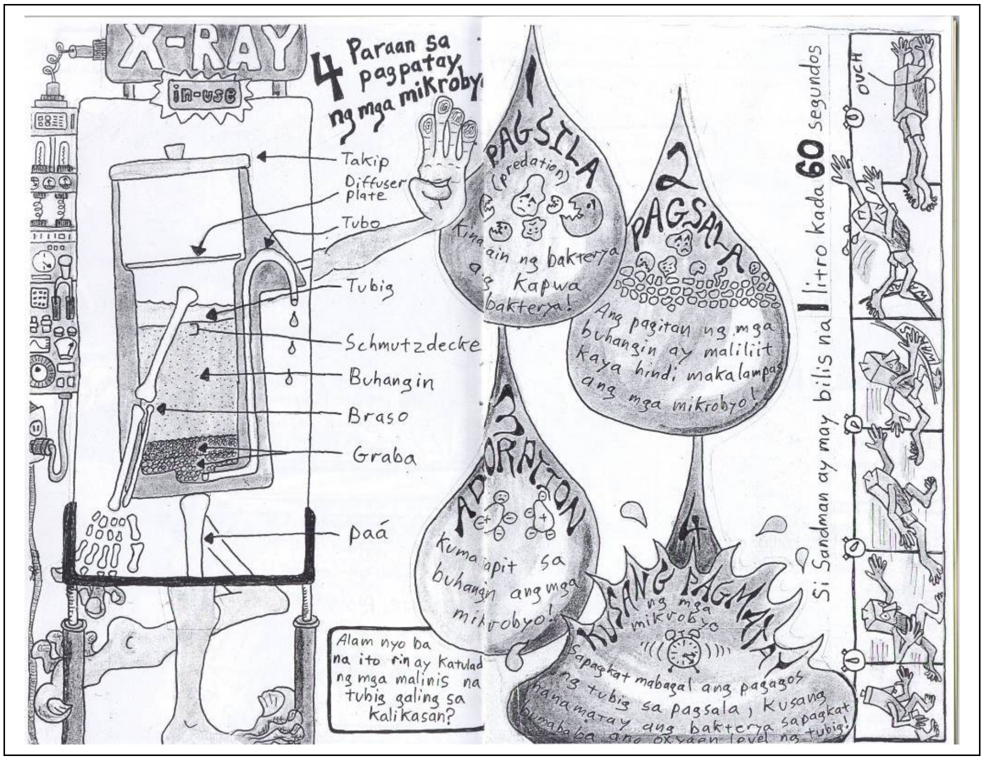



**Figure 22: Page two explaining four treatment processes**

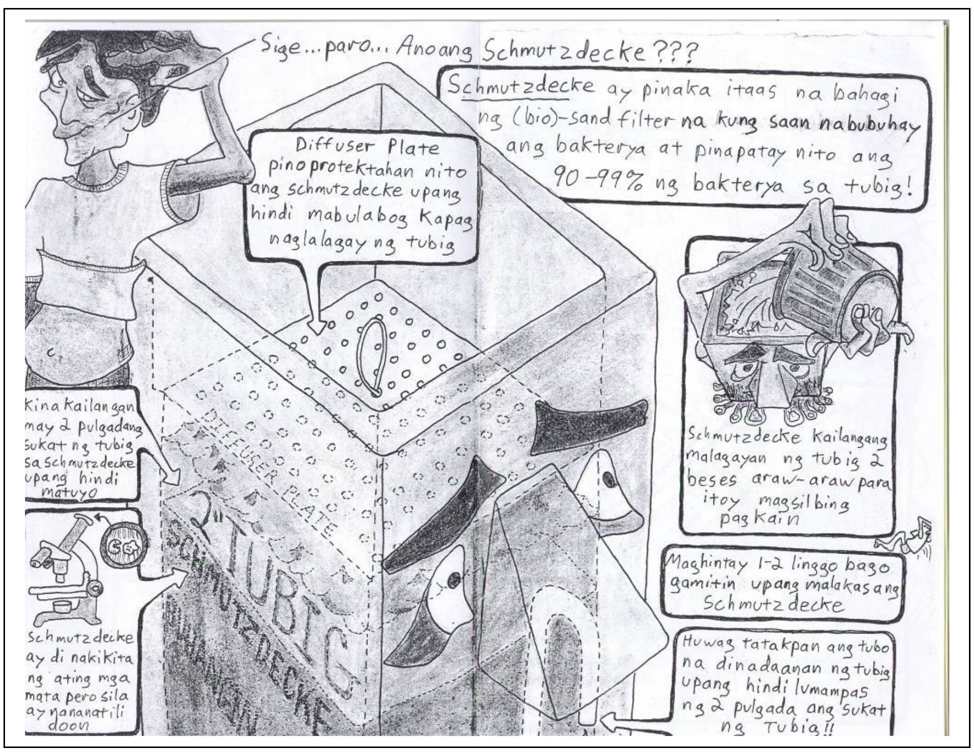



**Figure 23: Page 3 explaining the schmutzdecke**

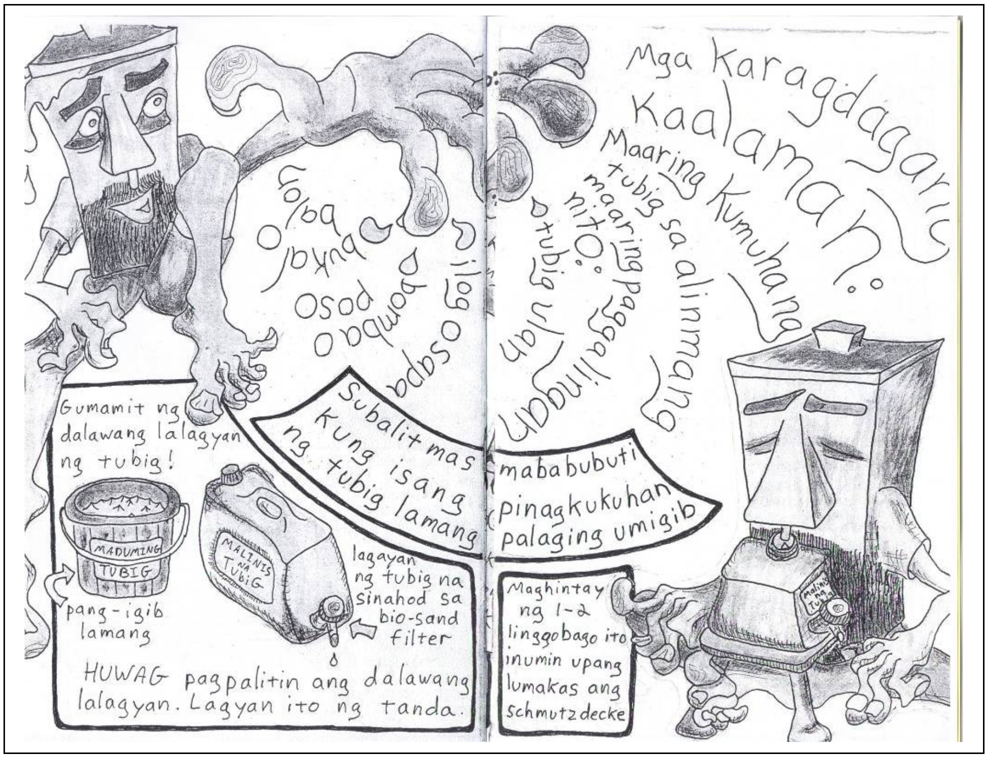



**Figure 24: Page 4 explaining the storage container**

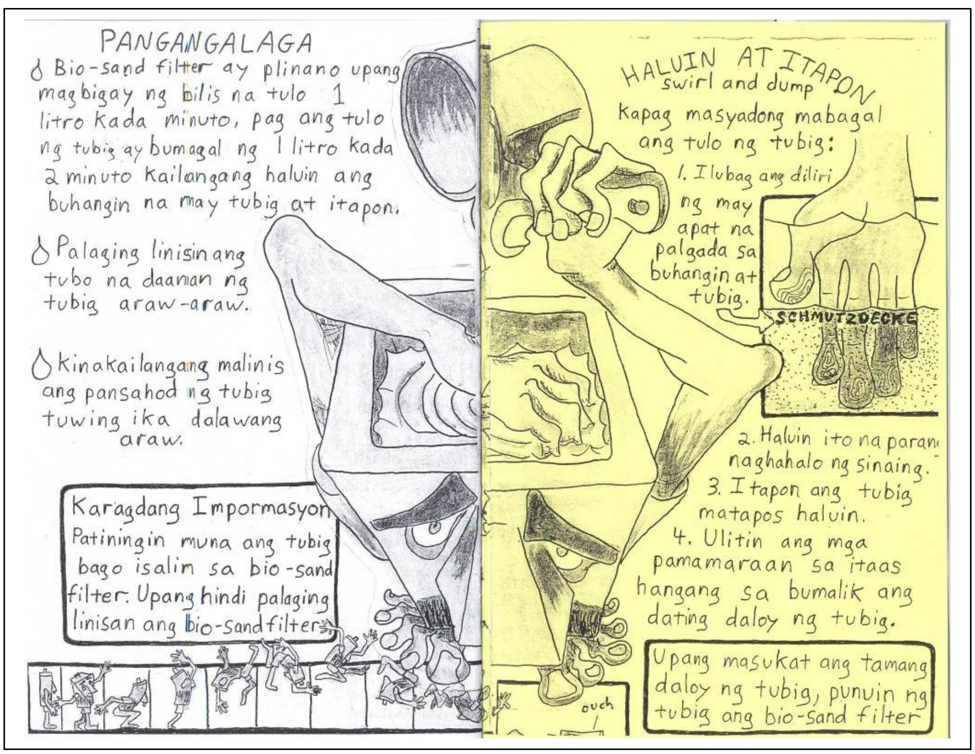



**Figure 25: Page 5 explaining maintenance and the 'swirl and dump' method**

**APPENDIX 11: CAWST BSF Poster**


**Figure 26: CAWST BSF poster demonstrating the 'swirl and dump' maintenance** (CAWST[1], 2006)

## APPENDIX 12: Follow-up Evaluation of UNICEF-Albay BSF Project

*UNICEF ALBAY BSF PROJECT*
*Follow Up*

*Feb 12-15 2008*

*Albay*

**Figure 27: Beneficiaries of UNICEF/Albay project**

Facilitated by:

Gemma Bulos

Annabelle Barquilla

A Single Drop for Safe Water Inc.

Puerto Princesa, Palawan

Republic of Philippines

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### 1. Summary

In March 2007, UNICEF sponsored a BSF training and implementation scheme in Albay in response to typhoon damage in the Bicol Area. The Project Cooperation Agreement (PCA) required the following outputs:

- BSF Training for Albay Disaster Relief Network (ADRN)
- 100 filters to be produced and installed into identified evacuation sites and rural heath units in the surrounding area
- IEC for all filter installation sites
- All filters produced and installed by June 14, 2007

### 2. Project Results

This scheme resulted in the installation of

- 79 filters in 19 schools
- 10 filters in 10 RHUs
- 10 filters at Taysan Relocation Area
- 1 filter at Camalig Parish

## Installation Challenges

1) Time constraint:  Installing 100 filters two months was very difficult the manpower they had and he lack of labor costs. Most of the time was spent building and installing filters.
2) No time for community introduction: It requires 1 1/2 mandays just to build one filter, so there was no community introduction to the filter and the beneficiaries were not prepared to receive the filter.
3) No labor costs:  ADRN, Aquinis University and US Peace Corp Volunteers offered the labor for counterpart, however, it was difficult to maintain the heavy workload without labor fees. So these local partners were forced to build additional filters to sell to the community to cover the labor costs for the donated filters implemented into the schools/evac centers.
4) No time for advocacy and IEC – All BSF installations require a proper introduction of the filter to the main beneficiaries and the assignment of one or two caretakers of the filter. However, when the implementers arrived, it was often the first meeting with the beneficiaries, and there was little time to support a full introduction of the filter and elicit a firm commitment from the caretakers.
5) Distance – many of the centers were quite a distance away and there has not been enough funding to travel back to those sites for a monitoring and evaluation visit.
6) Lack of funding and manpower for follow-up/monitoring and evaluation
7) ADRN, the implementing organization has no legal framework which created challenges in coordinating efforts and financial matters
8) ASDSW, the trainer and project manager, was not able to be present on site for the entirety of the implementation

Difficulties were encountered with follow-up and monitoring and evaluation.  The following is a report on a Monitoring and Evaluation Visit conducted from Feb 12-15, 2008 by ASDSW.

1. Schedule
2. Overview of BSF Use
3. Observations
4. Recommendations
5. Contact Information and Support

1**. Schedule**

1.1 Location

- Albay BSF Evac/School Sites

1.2 Reporters

- Gemma Bulos, "A Single Drop for Safe Water inc."

- Annabelle Barquila "A Single Drop for Safe Water inc."

1.3 Primary Sponsors for M&E

- ASDSW

1.4 Final Schedule

**Feb 12, 2008 (Gemma Bulos)**

Schools Visited:

- Binitayan ES, Daraga
- Tagas ES, Daraga
- Baligang ES, Daraga
- Bagumbayan Central ES, Legaspi

**Feb 14, 2008 (Gemma Bulos and Annabelle Barquilla)**

Sites Visited and/or reporting:

- Bariw HS, Camalig
- Bariw ES, Camalig
- Baligang ES, Camalig
- Bikal HS, Santo Domingo
- Bikal ES, Santo Domingo
- Salvacion ES, Santo Domingo
- MORMS, Guinobatan
- Binogsacan ES, Guinobatan
- \Taysan, Legazpi

**Feb 15, 2008 (Gemma Bulos and Annabelle Barquilla)**

Schools Visited and/or reporting:

- Misibis ES, Tiwi
- Cale ES, Tiwi
- Libjo ES, Tiwi
- San Antonio ES, Tabaco
- San Lorenzo ES, Tabaco
- Malilipot Central ES, Malilipot
- Bacacay East Central ES, Bacacay

**2. <u>Overview of BSF Use</u>**

Reporting on 100 filters

- 19 filters used
- 27 filters dormant/unused
- 28 filters requiring reinstallation
- 2 filters destroyed
- 5 filters not installed
- 19 filters not evaluated

**3. <u>Observations</u>**

- Reasons for continual BSF Use
    a. prior orientation visit to introduce filter to key beneficiaries
    b. unsafe water source
    c. provides clean water supplybeneficiaries valued the benefits (even when they had access to "clean" district water)
    d. teachers and/or principals championed filter
    e. responsible BSF caretakers assigned
    f. community members also use filters
    g. effective user scheme involving teachers and students
    h. BSF placement in convenient and safe places

- Reasons for non-use of BSF
    a. No prior orientation visit to introduce filter to key beneficiaries and caretakers
    b. Access to District Water (clean)
    c. Beneficiaries did not request or want
    d. Children can afford to bring their own water
    e. Some teachers and principals do not support the technology
    f. Bad placement of filters
    g. No clear understanding of use or benefits
    h. Evacuees were either never present at site, or left before BSF was installed
    i. Looks like a garbage can when placed outside
    j. Inappropriate timing for installation (some were installed during school vacation, so no orientation conducted

- Reasons for reinstallation of filters
    a. Filter was moved for better protection and/or convenience
    b. Mishandling of filter
    c. Media was removed

- Reasons for destruction
    a. Not aware of benefits of filter or use
    b. Youth rebellion

- Reasons for non-installation
    a. Site did not have sufficient water supply

- Reasons for not evaluating remaining filters
    a. No time
    b. Location of filters not clear

## 4. Recommendations

1) Reorientation for all schools focusing on safe storage, use and maintenance, frequency of use, same water source etc.
2) Revisit and M&E BSF sites that have not had follow-up
3) Rejuvenate dormant filters in schools that are interested in continuing after reorientation assessment
4) More IEC and printed materials for BSF use, "Dos & Donts", proper maintenance, benefits
5) Design a Evacuation BSF rejuvenation scheme for filters that are not used year round by the schools, but can be used for evacuations
6) Design a safe storage scheme for schools
7) Design a "Dos and Donts" handout
8) Design a Filter Use schedule for classrooms sharing filter
9) Offer community presentations in areas that are interested in purchasing filters
10) Design a vacation scheme, or rejuvenation scheme when school is out
11) MOAs for all caretakers with a list of maintenance and daily/monthly tasks and duties
12) At least 1 month follow up after every installation
13) In the cases of evacuees still residing at site, ensure that they have their own reorientation and assign a caretaker
14) Design scheme to ensure beneficiaries that filter is still usable after it was used as a garbage can
15) Remove filters from schools that don't require or want them
16) Introduce and install filters in schools/evac centers that are requesting them (Misibis, Putsang, Lourdes, Baligayang)
17) See UNICEF Albay Full Follow up for special recommendations for specific sites

## 5. Contact Information and Support

Gemma Bulos
Founding Director

Kevin Lee
Executive Director

A Single Drop for Safe Water inc.
Cnr Manalo Extension and Jacana Rd
Barangay Bancao Bancao
Puerto Princesa City 5300
Palawan
Republic of Philippines
www.asdforsafewater.org

**APPENDIX 13: BSF Certification Letter for Lloyd Mamauag**

Republic of the Philippines

Province of Iloilo

Municipality of San Joaquin

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May 12, 2008

To Whom It May Concern:

This letter is to act as certification that Lloyd Mamauag of Barangay Balabago, San Joaquin, Iloilo has successfully demonstrated competency in the construction, installation, and education of the Biosand Filter technology. I was first trained in the development of the Biosand Filter in September of 2006 by the NGO *A Single Drop for Safe Water*, along with approximately 30 other various Peace Corps Volunteers assigned throughout the Philippines. In May of 2007 I helped conduct a pilot project to produce 21 Biosand Filters working with the summer student employees hired by the Municipality of San Joaquin. Mr. Mamauag was trained by me personally in December of 2007 and has since demonstrated the capability of sustaining the Biosand Filter technology to provide safe and affordable drinking water for San Joaquin and the surrounding areas of southern Panay.

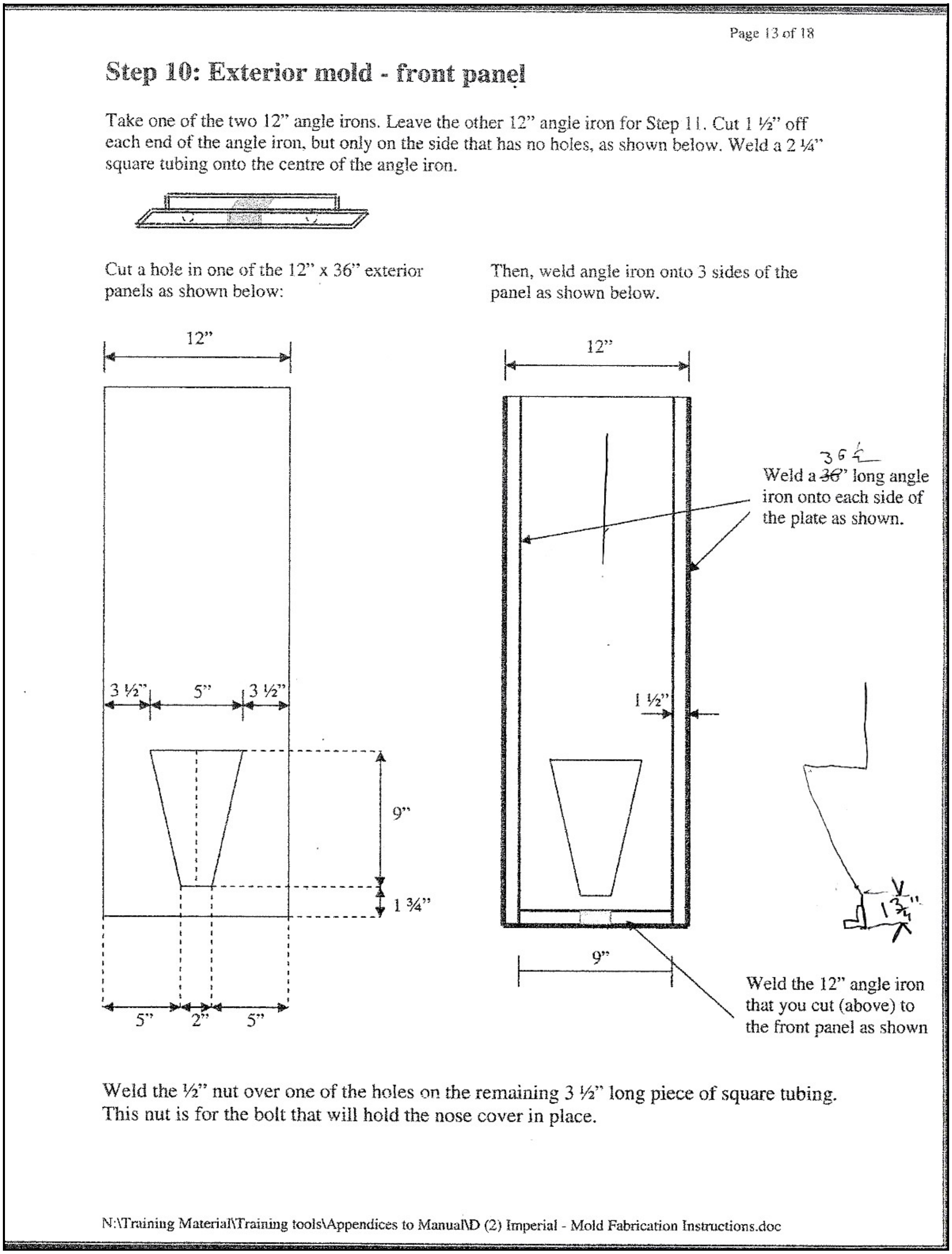
Sincerely,

IAN MAYCUMBER

U.S. Peace Corps Volunteer

San Joaquin, Iloilo 2006-2008

**APPENDIX 14: Kevin Lee's adjustments to Steel Mold**



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## Step 10: Exterior mold - front panel

Take one of the two 12" angle irons. Leave the other 12" angle iron for Step 11. Cut 1 ½" off each end of the angle iron, but only on the side that has no holes, as shown below. Weld a 2 ¼" square tubing onto the centre of the angle iron.

Cut a hole in one of the 12" x 36" exterior panels as shown below:



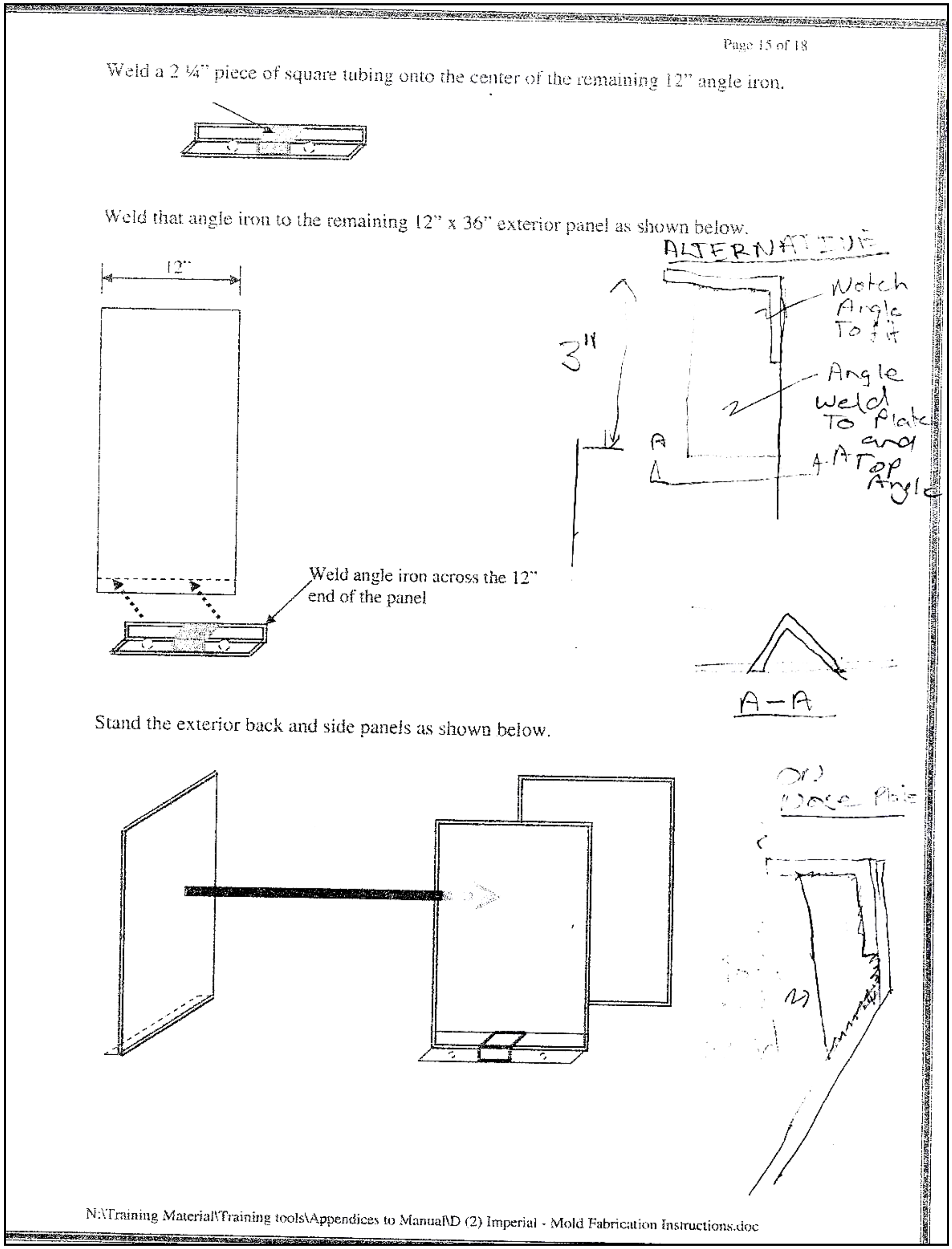
Then, weld angle iron onto 3 sides of the panel as shown below.



Weld the ½" nut over one of the holes on the remaining 3 ½" long piece of square tubing. This nut is for the bolt that will hold the nose cover in place.

N:\Training Material\Training tools\Appendices to Manual\D (2) Imperial - Mold Fabrication Instructions.doc

**Figure 28: Extending ½" to overall length of mold** (CAWST[1], 2006)





Weld a 2 ¼" piece of square tubing onto the center of the remaining 12" angle iron.

Weld that angle iron to the remaining 12" x 36" exterior panel as shown below.

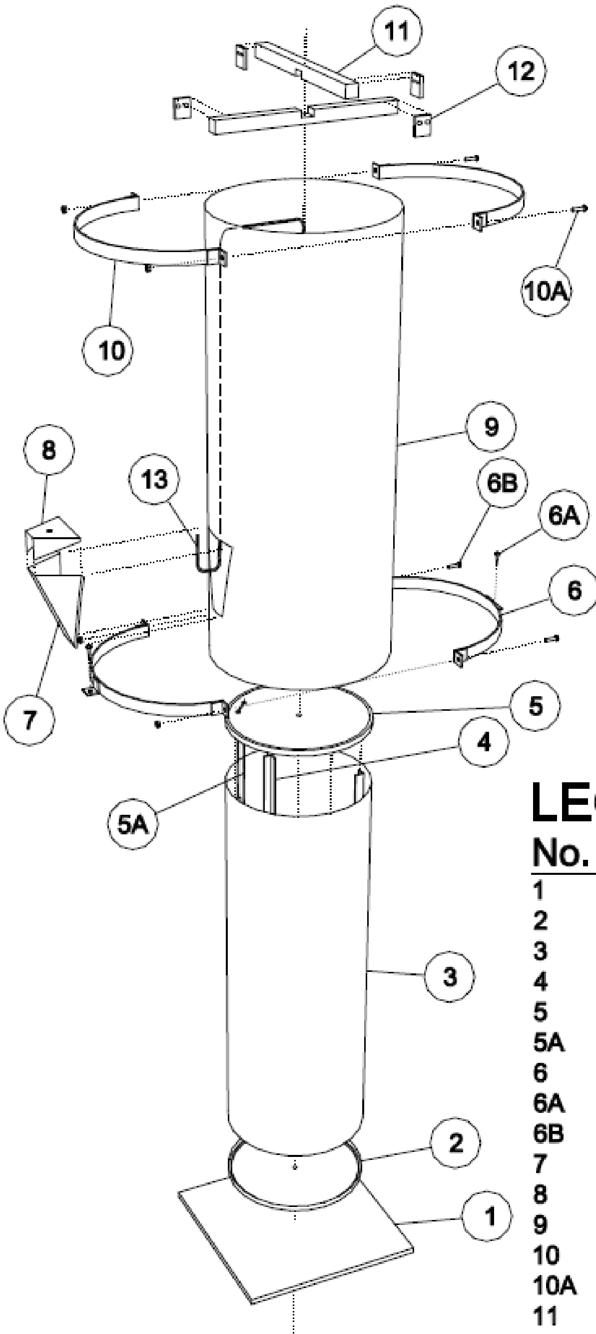


Stand the exterior back and side panels as shown below.



**Figure 29: Vertical angle supports (rather than square tubing) to mold** (CAWST[1], 2006)

**APPENDIX 15: Jerry Ohs sheet metal BSF mold design**




## PLEASE NOTE:

FOR FABRICATION PURPOSES, THE FILTER IS IN AN UPSIDE DOWN POSITION. AFTER THE CONCRETE IS POURED, THE ASSEMBLY WILL BE TURNED WITH THE FILTER UPRIGHT AND THEN THE FORMS WILL BE REMOVED.

## LEGEND

| No. | DESCRIPTION | REQ'D |
|---|---|---|
| 1 | BASE | 1 |
| 2 | INNER FORM RETAINER - LOWER | 1 |
| 3 | INNER FORM | 1 |
| 4 | SUPPORT FOR INNER FORM RETAINERS | 4 |
| 5 | INNER FORM RETAINER - UPPER | 1 |
| 5A | RETAINER EXTRACTION ROPE | 1 |
| 6 | OUTER FORM RETAINER - LOWER | 2 |
| 6A | SCREW | 2 |
| 6B | BOLT & NUT | 2 |
| 7 | NOSE FORM | 1 |
| 8 | NOSE FORM CAP | 1 |
| 9 | OUTER FORM | 1 |
| 10 | OUTER FORM RETAINER - UPPER | 2 |
| 10A | BOLT & NUT | 2 |
| 11 | FORM SPACER FRAME | 2 |
| 12 | FORM SPACER | 4 |
| 13 | SUPPLY TUBE | 1 |
| 14 | SHEET METAL SCREW (NOT SHOWN HERE) | 35 |
| 15 | CONCRETE (NOT SHOWN HERE) | |

## APPENDIX 16: Pamplona Follow-up Survey and Results

DATE: FILTER #: FILTER TECHNICIAN:

1. DO YOU USE YOUR FILTER EVERYDAY?
   ❑ YES ❑ NO

2. HOW MANY PEOPLE DRINK THE WATER FROM YOUR FILTER?
   ❑ 1-5 ❑ 6-10 ❑ 11-15 ❑ 15-25 ❑ 25+

3. WHAT DO YOU USE YOUR FILTER FOR:
   ❑ DRINKING ❑ BATHING ❑ FOOD PREP ❑ WASHING DISHES OTHER_______

4. DO YOU LIKE THE TASTE OF THE WATER?
   ❑ YES ❑ NO

5. WOULD YOU RECOMMEND THIS FILTER TO ANOTHER FAMILY?
   ❑ YES ❑ NO

6. WHAT IS YOUR SOURCE OF WATER?
   ❑ DEEP WELL ❑ SHALLOW WELL ❑ OPEN WELL ❑ SPRING ❑MUNICIPAL

OTHER_____________

SALAMAT PO!

DATE: FILTER #: FILTER TECHNICIAN:

1. GINAGAMIT MO BA ANG FILTER ARAW ARAW?
   ❑ YES ❑ NO

2. ILANG TAO ANG GUMAGAMIT NG FILTER?
   ❑ 1-5 ❑ 6-10 ❑ 11-15 ❑ 15-25 ❑ 25+

3. GINAGAMIT MO BA ANG FILTER SA SUMUSUNOD:
   ❑ DRINKING ❑ BATHING ❑ FOOD PREP ❑ WASHING DISHES ❑ OTHER

4. GUSTO MO BA ANG LASA NG TUBIG SA FILTER?
   ❑ YES ❑ NO

5. PWEDE MO BANG IREKOMENDA ANG FILTER SA IBANG PAMILYA?
   ❑ YES ❑ NO

6. ANO ANG SOURCE NG TUBIG MO?
   ❑ DEEP WELL ❑ SHALLOW WELL ❑ OPEN WELL ❑ SPRING ❑MUNICIPAL

OTHER___________________

| Questions: | Yes | No |
|---|---|---|
| 1. Do you use your filter every day? | 86 | 1 |
| 2. Do you like the taste of the water? | 87 | 0 |
| 3. Is the filter helpful to your family? | 19 | 0 |
| 4. Would you recommend this filter? | 68 | 0 |

**Table 5: Questions and Responses of Pamplona BSF Survey**

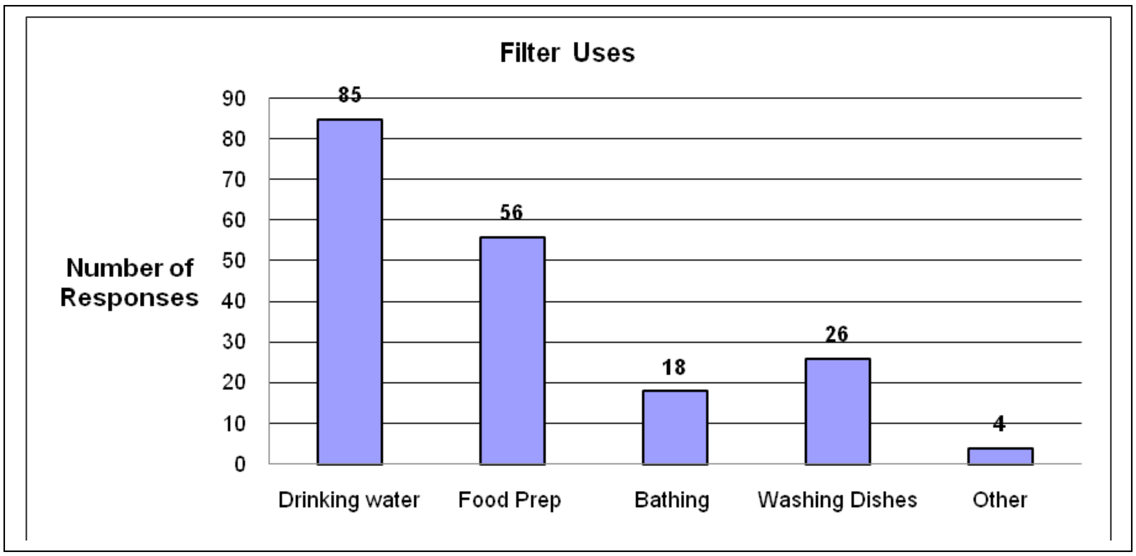



**Figure 30: Filter Uses in Pamplona**

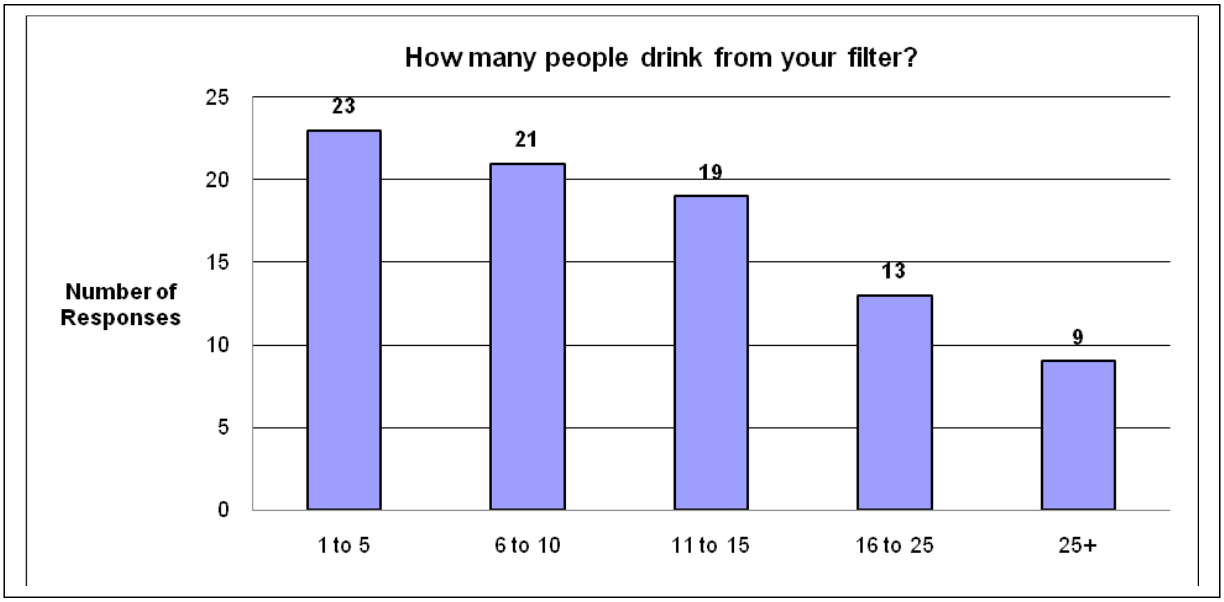



**Figure 31: Number of Users per filter in Pamplona**

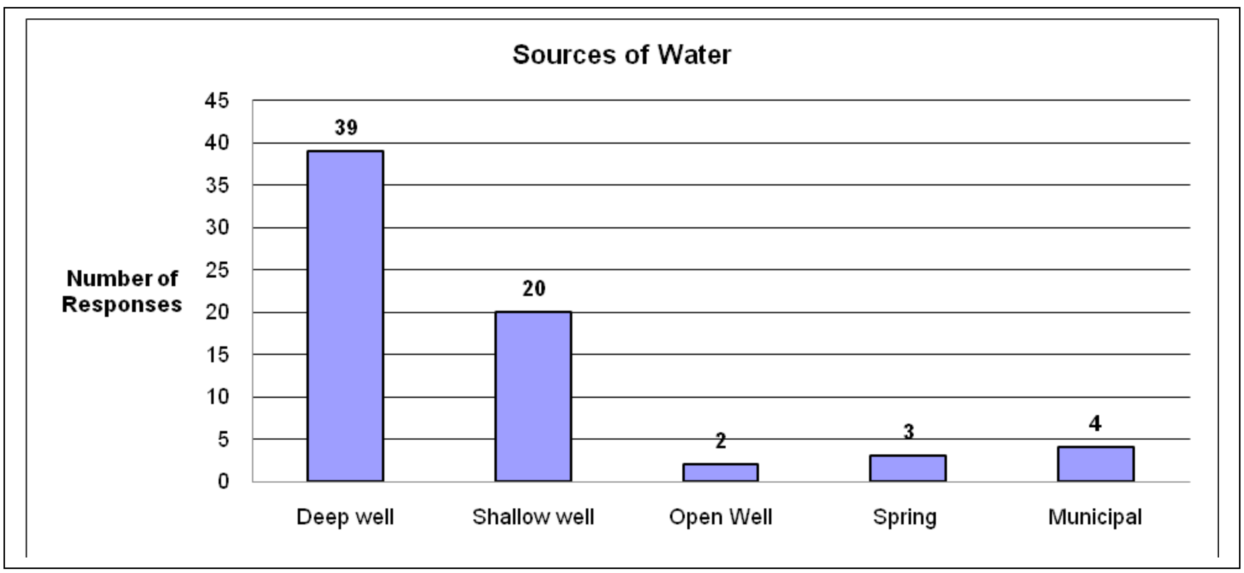



**Figure 32: Sources of water for BSFs in Pamplona**