BESONGABANG WATER SUPPLY

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Executive Summary

Groundwork Institute is working with United Action for Children (UAC) on affordable housing for villagers in Southwest Cameroon starting with Besongabang, a village of approximately 5,286 people. One important element of this is ensuring a clean and reliable water source for the village. The project, which began in February 2014, has been completed in multiple phases. The team in Besongabang began by collecting information on the water sources, primarily private wells, in the village. Information including depth of well, depth of water and owner complaints about the water was gathered on 145 wells. Next the team used 3M Petrifilm tests to check for coliform and *E. coli* in the water sources, which unfortunately turned out to be extremely contaminated and unsafe for drinking. The team worked together with villagers to carry out testing and review results with each well owner. *E. coli* and coliform were present in every well tested by the team. We also mapped and surveyed 48 latrines throughout the village.The ground water table is shallow at 5.2-11.5 meters during the dry season and probably almost at the surface during rainy season. Latrines are an average of 10.8 meters deep, most of them penetrating the water table. It was evident that the latrines were contaminating the water supply. We outlined multiple solutions to this problem. We were able to provide a simple and low cost solution that was feasible for all families in the village and that could be implemented immediately. This solution uses household bleach to disinfect the water and 3 buckets for treatment and safe storage. The most complex solution uses an electric pump to a storage tank with a chlorine injector with water piped into the house. We have also used the information collected to educate the village on the importance of treating water. We are

Figure 1.Takor Pauline Takang pulling water from her well with bucket on a rope. This is the most common way of getting water from the well. Only a few wells in the village have pumps.

beginning a village wide water education campaign to show simple methods of treating and handling water and encourage behavior change in relation to water. The first part of the behavior change campaign has begun with lessons in all of the village's primary schools.

Village Overview

Groundwork Institute is working with United Action for Children (UAC) on affordable housing for villagers in Southwest Cameroon. One important element of this is ensuring a clean and reliable water supply for the village. The first project is being started in Besongabang, a village in the Manyu Division of the Southwest Region. While no official population statistics exist, estimates from the council state that there are 5,286 people[i] living in Besongabang, making it the most populated chiefdom in the Mamfe sub-division. From aerial mapping we counted 443 buildings, but not all were homes, some may have been missed and new ones have been constructed since the aerial photos were taken. Byangi people make up 95% of the population and Ejagham make up the other 5%. The average family has 4-12 children. There are 7 quarters in Besongabang: Nserong, Besenge, Nsebanya, ObenEbanga, Nkpot, Mbefang, and Tetokonok. There is a mix of people living in each quarter, not any specific group.

Besongabang is known for its oil mill that produces palm oil. It is also known for having an army base. The base was originally used by British soldiers, but when they left in the 1960s, the Cameroonian gendarmerie took over the base. Today, it is used by the Cameroonian army. There is also an airport in Besongabang with one airstrip that is used infrequently by the army.

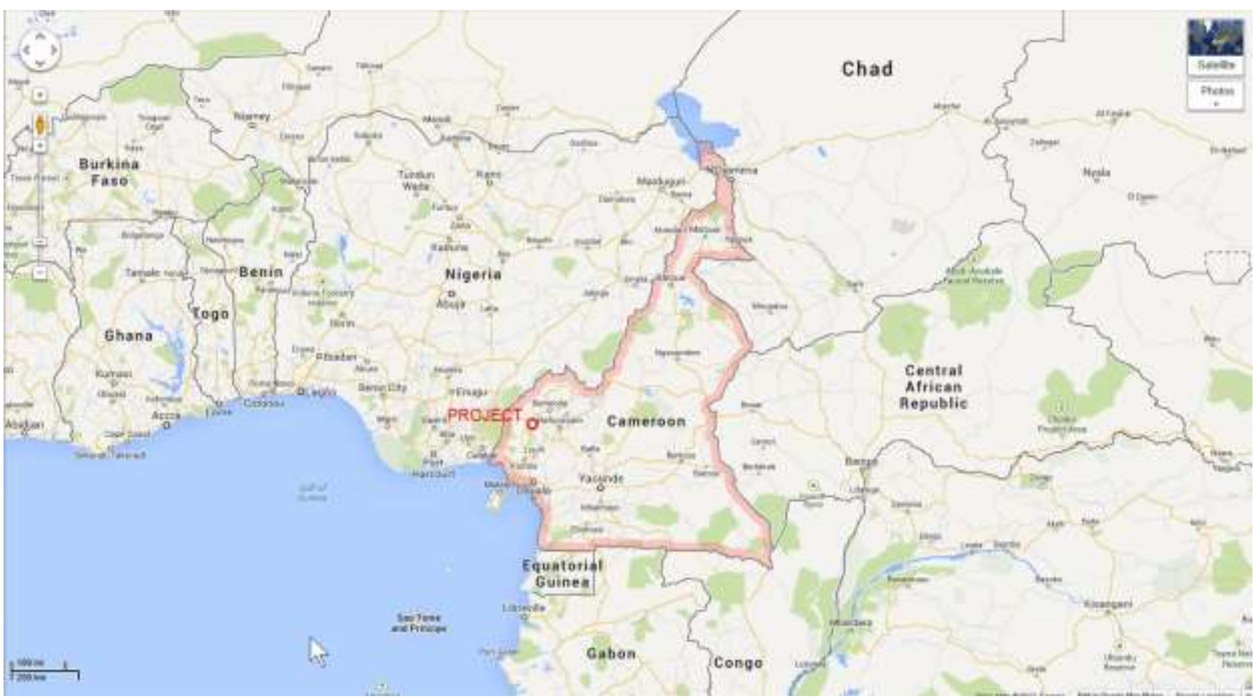

Figure 2. Project location in Southwest Cameroon

The leadership of Besongabang is made up of the chief at the highest level with 7 quarter heads and 7 assistant quarter heads below him. The quarter heads are responsible for solving any issues in their assigned quarter and for maintaining peace in the village. There is also a traditional council made up of three members from each quarter plus the quarter head of each quarter. There is also the chief and two council secretaries, which brings the total traditional council membership to 31. The traditional council is responsible for planning and development of the village as well as handling village disputes. All disputes are first taken to the traditional council and if they cannot be handled there, then they are recommended to the courts and legal system in Mamfe Town by the village chief. The traditional council does not give out formal land titles (this must be done with the Land Consultative Board in Mamfe Town), but the council knows everyone's land and therefore can handle land disputes in the village. While a formal land titling system exists, villages tend to default to their more traditional system without titles, where everyone relies on their neighbors and the traditional council to protect their land rights.

The route into and out of Besongabang is the Mamfe Ekok road, which was paved within the last couple of years by the Chinese, making it passable year round. The road comes from Bamenda and continues on to Nigeria. Besongabang is the first village on this road after Mamfe so much of the traffic passing through Besongabang is going to nearby villages. Neighboring villages and towns include Egbekaw, Mamfe, Ntenako, Ndekwai and Nchang. Besongabang is only a few minutes from Mamfe town and is about two and a half hours from Bamenda. It takes about two hours to reach the border with Nigeria from Besongabang.

Water and Sanitation in Besongabang

The people of Besongabang collect their water from springs or from private wells, no one has running water. Many people have dug wells near their homes and it is a personal decision whether or not the

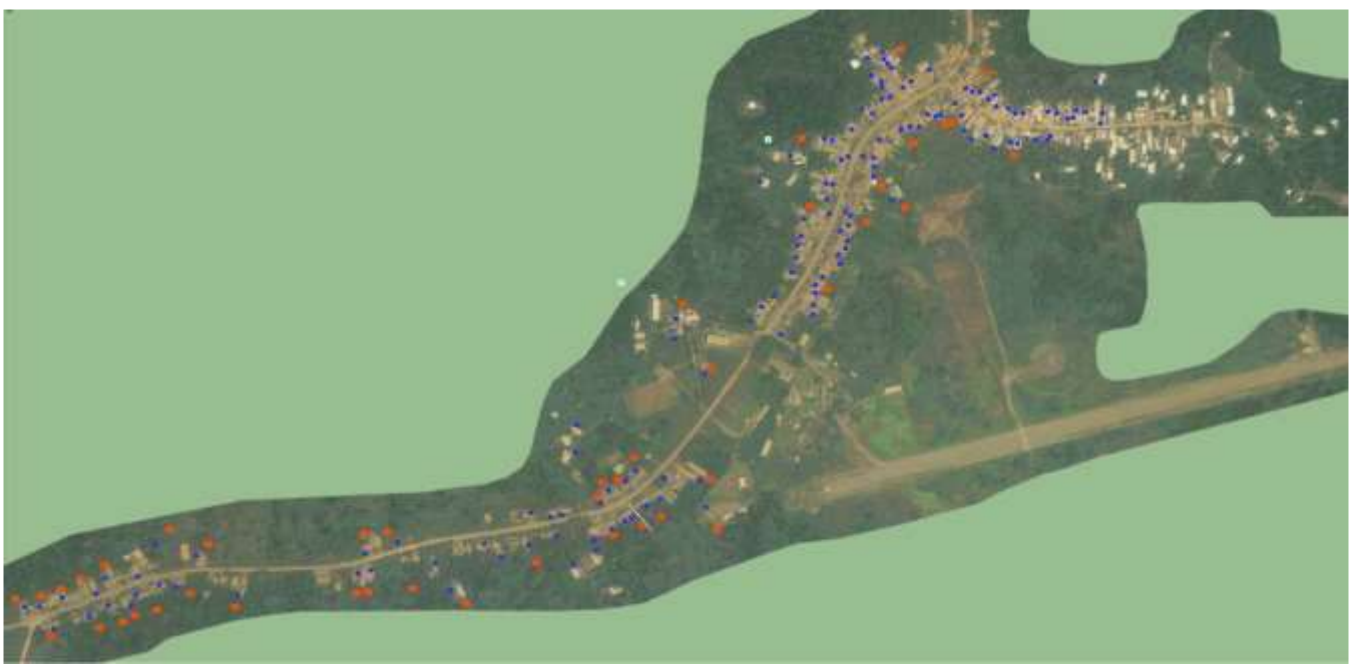

Figure 3. Map of Besongabang showing wells and latrines. Wells are marked with blue circles and latrines are marked with red squares. All well have been mapped (145). About 1/3 of the latrines (45) had been mapped as of March 2015.

owner shares the well with his or her neighbors. We have collected information on 145 wells. We believe these wells are shared between 500-700 households.

Wells serve 1-7 families, with an average of 3.6 families using each well, according to our data collection. It varies household to household whether or not the well users drink the water; some only use their well water for cleaning and bathing. For those who do not drink from their wells, they collect drinking water at one of the springs or streams located throughout the village. Anyone can use the water in the streams. People do not have to pay for the water in Besongabang.

Figure 4. Typical well showing concrete skirt around the well and cover.

Water quality in the village is poor. We see high coliform counts and *E. coli* in all tests to date. It seems most likely that the pit latrines are contaminating ground water. The ground water table is shallow at 5.2-11.5 meters during the dry season and probably almost at the surface during rainy season. Latrines are an average of 10.8 meters deep, most of them penetrating the water table.

Figure 5. Very basic well. Often villagers will begin construction before they have all the money, so wells will look like this until they can afford to add a concrete skirt and cover.

There are water shortages during dry season. 30% of wells in Besongabang dry up during the dry season and some of the streams do too. The average depth of water in wells that do not dry up during dry season is just 2 meters. People will dig further in their well in order to find water during dry season. A few people in the village have elevated water storage tanks that are filled by pipes and an electric pump in the well.

Figure 6. Nicer well with a place to hang the bucket.

Figure 7. The Monien Ebhe Spring does not have a single owner, it is property of the whole village. It has a concrete catchment. At time of testing, no E. Coli was found at the source, only in the spring water stored in houses.

Figure 8. Amigo at his spring. This spring is piped. At the time of testing, there were 2,700 total coliform colony forming units per 100 mL of spring water.

Latrines are the primary sanitation means in Besongabang. There are no latrines available in public spaces. Most households have a latrine somewhere separate from the house. Some households have shared latrines. The latrines vary in quality from well-constructed sheds to uncovered holes in the ground. Some people lack latrines and go in the fields.

Figure 9. Typical latrines from worst (upper left) to best (lower left). Typical interior of one of the better latrines (lower right). Although almost all people use pit latrines a very few homes

Most people in Besongabang dig a hole in the forest to put their trash in. When the hole is full, they burn it.

Besongabang has community cleaning days, "Keep Clean Day,"on the first Thursday of each month. Each person is responsible for cleaning up his or her yard and everyone works together to clean the public spaces.

Investigation of Existing Conditions

Groundwork undertook to determine existing conditions and gather necessary information for the design of a healthy water and sanitation system. The work in Besongabang has been carried out in multiple phases. Each phase has added to and built upon previous knowledge of the water in Besongabang.

The first phase of the project was aimed at collecting information on the available water sources and to map the water table in the village. During the initial investigation, the team went to each well in the village to measure the depth of the well, the depth of the water and the diameter of the well. We took photographs of the well and well surroundings to help identify any possible sources of contamination. Each well was plotted on the village map. In total, data was collected on 145 wells in Besongabang (Appendix A). The team spoke to each well owner to collect the following information:

1. Name of well owner
2. Depth of well
3. Depth of water
4. Diameter of the well
5. Does the well go dry? If so, when?
6. What is the highest the water gets, presumably during rainy season?
7. Is the well hand dug?
8. Type of casing
9. How does your household handle human waste?
10. How many people use this latrine?
11. Distance from latrine to well
12. Do you have any concerns about the quality of water in your well? Odor? Taste? Color? Clarity?
13. Do you have any health problems you attribute to water? Diarrhea? Other?
14. What do you use your water for: drinking, cooking, washing utensils, bathing, washing clothes, irrigation?
15. Do you use water to irrigate anything around your house? If so, what? And what water source do you use?
16. What do you do with gray water?

The team also went to each spring and stream that is used by people in Besongabang. The team measured the spring if possible and plotted the spring on the map. In total, 6 springs were mapped and surveyed. The following information was collected at each spring:

1. Spring name/how users refer to it
2. Description of spring, spring box, cover, spigot, plumbing, etc.
3. Drainage. Where does water drain toward the spring? Where is that water coming from? Are there any potential contaminants that could be washed into the spring?

Figure 10. Cary writing down measurements of a well.

Figure 11, Rogerio and Takor measuring the depth of a well (after a rock on a string was dropped into the well).

technique.Figure 21. Rogerio and Takor measuring depth of water in well during rainy season.

Figure 12. Rogerio, Takor and Clinic Groundskeeper examining the spring catchment at the Presbyterian Health Clinic. The water is pumped up to the storage tanks

Water Quality Tests (i.e. phase 2)

During the second phase of the project, the team began testing the water sources using 3M Petrifilm coliform *E. coli* plates and Charm Sciences e-colite bags. Instructions for using 3M Petrifilm plates can be found in Appendix B. We found the wells throughout Besongabang to be extremely contaminated. The actual level of contamination varied slightly and can be attributed to things such as when the test was done, distance of well to latrine, etc. We found coliform and *E. coli*present in all the wells we tested, leading us to believe the latrines are contaminating ground water.

Plates were incubated for 48 hours in a room in one of the houses in the village. The temperature varied during each round of testing, but was an average of 79.6 degrees Fahrenheit (26.4 degrees Celsius). The plates are supposed to be incubated at 35 degrees Celsius. 3M did studies of incubation in ????and showed that results were reasonably accurate. While our results are not 100% accurate, we believe that they are a valuable source of information.

Figure 13. Home of Ngasu Simon (nicknamed "Dodo" in the village). Dodo provided a room which served as our lab for incubating coliform test plates.

Figure 14. Inside the "lab" where our test plates were stored for the 48 hour incubation period.

Well Test Results

The table below shows results of the 3M Petrifilm test wells that were tested both at the source and at point of use, usually well water stored in a container inside the house or kitchen. 24 wells were tested for *E. coli* and total coliform, 36 wells were tested for total coliform. Full data can be found in Appendix C. Below is the average *E. coli* and total coliform colony forming units (CFU) per 100 mL for well water and stored point of use water.

	***E. coli*CFU/100 mL**	**Total Coliform CFU/100 ML**
Well	1,861	9,417
Point of Use	819	12,664

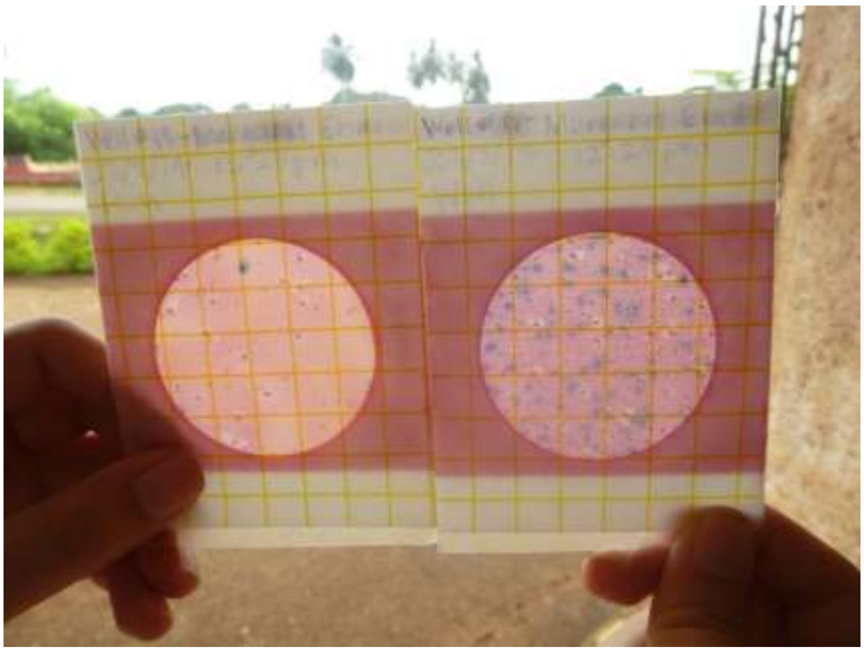

Figure 15. Example 3M Petrifilm test results from Well 18. Exact counts for this and other welds can be found in Appendix C.

Spring Test Results

We found slightly better results in our tests of the springs. Only slight contamination was found in the springs, most likely from surface contamination. However in all of the spring water that was stored in houses and tested at random, we found *E. coli*. This can most likely be attributed to contaminated containers that were cleaned with well water prior to storing the spring water.

The table below shows the results of 3M Petrifilm tests for 3 springs tested at the source and at stored points of use in homes throughout the village. Average *E. coli* and total coliform colony forming units (CFU) per 100 mL are shown below:

	***E. coli*CFU/100 mL**	**Total Coliform CFU/100 mL**
Source	0	975
Stored	480	3040

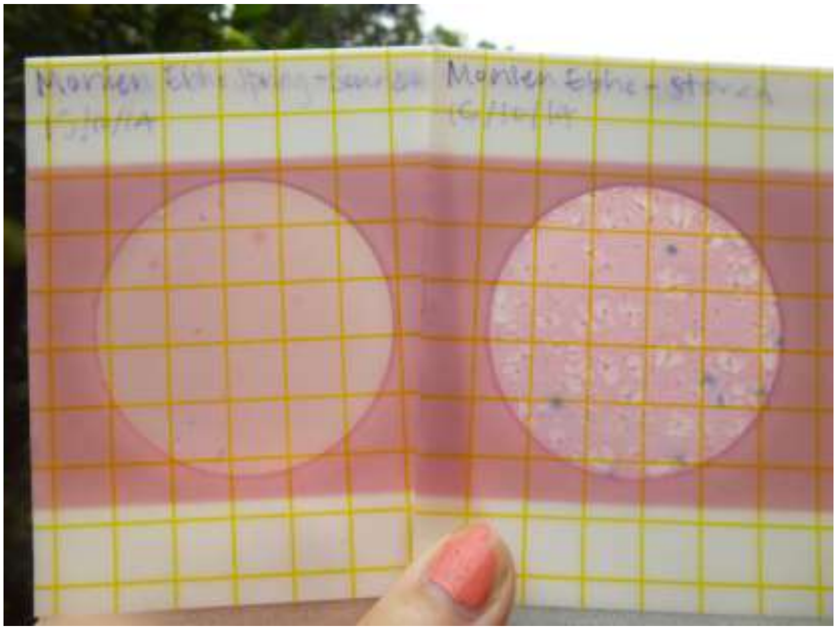

Figure 16. 3M Petrifilm test results of Monien Ebhe Spring. Results from the source are on the left and from stored water on the right.

Mapping Latrines (i.e phase 3)

Figure 17. Inside one of the better latrines.

As a third phase of the project, the team began mapping and surveying latrines that corresponded to each well. We measured the distance between each well and corresponding latrine (of the same owner) and surveyed the owners to find the depth of the latrine at the time of digging. Many of the depths were just estimates as the owners had forgotten the exact depth. We plotted each latrine on the map.

Pit latrines and most low cost sewage treatment solutions such as septic leach fields impact ground water. Typically these systems must be located at some distance from the ground water. For example, a rule of thumb is that the bottom of pit latrines must be at least one meter above the ground water. It was therefore important for us to know where the ground water is. By measuring the depth of the water in the village wells we could get good information on the location of the groundwater.

Of the 48 pit latrines we have data on, the latrines range in depth from 2.5-21 meters, but are an average of 10.8 meters deep and penetrate the water table which is an average of 7.1 meters in the dry season and 1 meter in the rainy season. The latrines are between 10-100 meters from wells, averaging 33 meters in distance from the nearest water source. However there are other latrines, not just the latrine that belongs to the owner of the well. The quality of water in wells is affected by all nearby wells, soil permeability, time, and water movement. At this time, we do not have enough information to draw conclusions on the correlation between latrines and water contamination in the wells. We can assume that the contamination is coming from the latrines as we find *E.coli* present in all the wells we have tested. However at this time we do not know enough details about the direction or speed of water flow in the ground water table to know the effect of the distance and depths of latrines on the nearby wells.

Figure 18. Group of latrines for a large compound serving multiple units.

Health Problems Related to Water

As an important part of our team's research on water quality and health in Besongabang, we worked with the local health center to compile a list of parasites that are common in the area. Common parasites in stool include Amoeba, TrichurisTrichuria, Hook worm, Ascarislumbricoides, Ankylostoma duodenal, Tape worm, TricomonasHominis, GadiaLumdia, Entamaeba Coli,EntamaebaHistolytica, andEndolimax Nana. The most common parasite in water is Schistosoma haemasolorium.

Common water related health complaints include diarrhea ("runny stomach" or "belly bite" in local terms), dysentery, cholera, and typhoid. 24% of survey respondents said they had health concerns related to water, although this number is most likely higher. Many residents of Besongabang do not know that dysentery, cholera, and typhoid are diseases related to dirty water. Many people also do not attribute diarrhea to contaminated water as it is not usually immediate after drinking water that they have diarrhea.

Water Disinfection

When giving the well test results to each well owner, the team taught well users how to disinfect the water so it is safe for drinking, cooking, and washing dishes and water storage containers. Groundwork Institute's team of water experts decided it was best to use household bleach, called "eau de javel" or "parasol" locally, for disinfection as it is fairly cheap and readily available in the village. Chlorine also leaves a residual in the water to reduce risk of recontamination over time. When added to water, chlorine forms hydrochloric acid, which will react with microorganisms and kill them.

Figure 19. Takor shares 3M Petrifilm test results with well owners and users.

Using the Centre for Affordable Water and Sanitation Technology's *Technical Brief: Chlorine Disinfection of Drinking Water*, we were able to calculate the amount of bleach that must be added to water for disinfection. The most common brand of bleach used in Southwest Cameroon is La Croix Eau de Javel, with a chlorine content of 2.4%. CAWST recommends having an initial chlorine concentration of 5mg/L. Our calculations were as follows:

1. Calculate how much <u>chlorine</u> is in 1 L of bleach:

    1 L bleach = 1,000 mL bleach = 1,000 g bleach = 1,000,000 mg bleach

    Out of every 1 L (or 1,000,000 mg) of bleach, 2.4% is chlorine:
    =0.024 x 1,000,000 mg = 24,000 mg of chlorine

Therefore in ever liter of bleach we have:

    24,000 mg of chlorine = 24,000 mg/L chlorine

2. Calculate the total amount of <u>chlorine</u> we need to add to 20 L of the source water to have an active (initial) chlorine concentration of 5 mg/L:

    =20 L x 5 mg/L
    =100 mg chlorine is needed (amount of chlorine, not bleach, that needs to be added)

3. Calculate what volume of bleach contains 100 mg of chlorine (how much <u>bleach</u> to add to 20 L water):

    =amount of chlorine we need (100 mg) / amount of chlorine in 1L of bleach
    =100 mg / 24,000 mg/L
    =0.00417 L bleach

    =0.00417 L x 1000mL/L
    =4.17 mL bleach

Therefore, 4.17 mL of 2.4% bleach solution must be added to 20 L of water to have an active (initial) chlorine content of 5 mg/L. This usually gives a free residual chlorine (FRC) concentration of about 0.5 mg/L after contact time of 30 minutes, depending on the amount of contamination, turbidity, temperature, pH, and the amount of organic matter in the water. The FRC helps to prevent recontamination, as it is available to kill new pathogens that enter the water.

Based upon these calculations, the team has been advising village members of Besongabang to disinfect their water using household bleach. A common water bottle found in Cameroon, *Tangui*, has a standard lid size of about 4 milliliters, so we advise villagers to add one *Tangui*cap full of bleach to every 20 liters of well water, and that they leave this water sit for 30 minutes before consuming it. We also recommend that they store the water in a container with a cover.

Solutions to the Water Problems in Besongabang

As Groundwork Institute's model is to provide expertise to problems facing communities, we have come up with various solutions at different cost levels to provide a solution for every person in the village, no matter their economic status.

The most basic solution is the "three bucket system." This solution is a series of 3 buckets with covers, one of which has a tap installed. The first bucket is used to treat water with bleach. The second bucket, the one with the tap, is used to store treated water that is ready to be used. The tap makes it convenient to access the water as well as helps avoid recontamination from dipping dirty cups or hands into the bucket. The last bucket in the system is used to hold waste water before it is all thrown outside into the garden. It is important that all buckets have a cover to prevent mosquitoes from breeding in the open water. This is the option that is most accessible to the villagers in Besongabang.

More complex solutions are available and are variations of a system using a pump to a storage tank. The simplest system is pumping the water to a storage tank that has a tap, either with an electric or a hand pump, where users will still have to disinfect the water with bleach, ideally using the three bucket system. More complex versions of this include a chlorine injector in the tank to disinfect the water automatically and plumbing so the water can flow directly into the house.

Behavior Change

The greatest challenge the team has been faced with during this project is encouraging behavior change. This public health problem worldwide is no different in Cameroon. Older members of the village who have been drinking from the well for their entire lives do not see a reason to change now. It is our mission to change this behavior.

Our initial attempt at behavior change was teaching villagers about how to treat their water with household bleach while we were giving them the results of their well water tests. People were shocked to find that *E. coli*, which comes from human feces, was found in their water. They seemed eager and interested to learn how they could treat their water to avoid drinking these contaminants. However despite showing them a simple and inexpensive option, most of the village was not treating their water.

As behavior change is a challenge, we thought focusing on young children who are still learning and building habits was an effective way to encourage behavior change. Thus, the on the ground team of Carybeth Reddy, Takor Tambe and Timothy Tabe began teaching water, hygiene and sanitation classes in the primary schools in Besongabang. The classes focused on teaching about the water cycle to demonstrate how the water sources, specifically the wells, in Besongabang have become contaminated from the latrines. This was used as motivation to encourage students to treat all of their drinking water in their homes. As an important addition to water disinfection, we also taught students about hand washing, as it goes together with maintaining good water health and hygiene.

Figure 20. The on the ground team of Carybeth Reddy, Takor Tambe and Timothy Tabe teach students from the Government Primary School Besongabang about water, hygiene and sanitation at the UAC/FIFA Football for Hope Center

School 1 – Government Primary School Besongabang
Classes were carried out at the Government Primary School Besongabang on February 23 and 25 and March 2 and 4, 2015. A total of 136 students ages 6-11 participated in the classes. Each grade level had a total of one hour and 30 minutes of class time divided between two days. The participant breakdown is as follows:

		Participants		
Grade Level	**Age (years)**	**Boys**	**Girls**	**Total**
1	6	14	11	25
2	7	13	16	29
3	8	9	8	17
4	9	11	14	25
5	10	13	10	23
6	11	10	7	17
	TOTAL	70	66	**136**

School 2 – Government Bilingual Primary School Besongabang
Classes were carried out at the Government Primary School Besongabang on March 18, 20, 24 and 26, 2015. A total of 135 students ages 6-11 participated in the classes. Each grade level had a total of one hour and 30 minutes of class time divided between two days. The participant breakdown is as follows:

		Participants		
Grade Level	**Age (years)**	**Boys**	**Girls**	**Total**
1	6	10	7	17
2	7	11	12	23
3	8	18	11	29
4	9	11	11	22
5	10	12	8	20
6	11	10	14	24
	TOTAL	72	63	**135**

A participant practices disinfecting water using household bleach.

A participant uses 3M Petrifilm to test Besongabang well water for coliform and e-Coli.

Participants show 3M Petrifilm tests of well water and water disinfected with bleach

Facilitators demonstrate proper hand washing

Appendix A
Well and Spring Data

For the well survey click here: Besongabang Well Survey
(BesongabangWellSurvey10-21-14.pdf)

Appendix B
Instructions for Using 3M Petrifilm Test Plates

Procedure for water testing:

1. Collect water from the source (for our project, this meant pulling a bucket of water from the well and using water from the bucket of stored water in the house)
2. Use a new dropper or clean dropper before each use
    a. Suck up ethanol into the dropper or sterilize it (kill any bacteria left from previous sample)
    b. Shake ethanol in dropper
    c. Suck up water into dropper to rinse out ethanol
    d. Shake water in dropper and squirt out water
    e. Repeat water rinse a few times
3. Mark test plate in the open space on the back with date, time, well number, owner's name and owner's signature/initials
4. Open flap on test plate
5. With the dropper, suck up 1 milliliter of water from the source
6. With the dropper perpendicular to the test plate, put 1 milliliter of water on the red circle on the test plate
7. Carefully roll the film down to avoid trapping air bubbles. Do not just drop the film.
8. With the flat side down, place the spreader over the test plate and gently apply pressure to distribute water over circular area. Do not twist or slide the spreader.
9. Wait at least one minute for the gel to solidify before moving the test plate.
10. Place test plates in "incubator space." (Note: ideal conditions are 35 degrees Celsius). You can stack up to 20 test plates.
11. Leave samples for 48 hours to incubate.
12. Take a picture of each sample and count the number of growing colonies, differentiating between blue colonies, colonies with gas and colonies without gas. Detailed information about how to count colonies can be found in 3M's Interpretation Guide.
13. Bring results to the owner of each water source, explaining any resulting contamination.

Appendix C
Water Test Results

Number	Source	Date of Results (MM/DD/YY)	Room Temperature at reading (F)	Total coliform colonies per 100 mL	*E. coli* colonies per 100 mL	pH
Spring 1	Point of Use	04/04/14	85.5	3,300		
Spring 1	Spring	04/04/14	85.5	2,700		
Well 2	Well	04/04/14	85.5	40,000		
Well 12	Point of Use	04/04/14	85.5	10,700		
Well 12	Well	04/04/14	85.5	11,700		
Well 92	Point of Use	04/04/14	85.5	25,200		
Well 92	Well	04/04/14	85.5	8,500		
Well 92	Well	05/08/14	75	7,400	4,300	less than 6.8
Well 87	Point of Use	02/05/14	85.5	178,667		
Well 87	Well	02/05/14	85.5	15,900		
Well 87	Well	05/08/14	75	2,000	200	less than 6.8
Well 80	Point of Use	02/05/14	unknown	11,900		
Well 80	Well	02/05/14	unknown	10,400		
Well 99	Point of Use	02/05/14	unknown	2,500		
Well 99	Point of Use	05/08/14	75	2,800	300	
Well 99	Well	02/05/14	unknown	8,700		
Well 99	Well	05/08/14	75	3,800	200	less than 6.8
Well 39	Point of Use	02/05/14	unknown	5,200		
Well 39	Well	02/05/14	unknown	8,000		
Well 63	Point of Use	02/05/14	unknown	700		
Well 63	Well	02/05/14	unknown	16,100		
Well 56	Point of Use	22/05/14	unknown	3,400		
Well 56	Well	22/05/14	unknown	1,700		
Well 57	Point of Use	22/05/14	unknown	16,667		
Well 57	Well	22/05/14	unknown	4,100		
Well 107	Point of Use	22/05/14	unknown	19,333		
Well 107	Well	22/05/14	unknown	2,700		
Well 94	Point of Use	22/05/14	unknown	1,400		
Well 94	Well	22/05/14	unknown	1,200		
Well 94	Well	05/08/14	75	4,600	1,000	less than 6.8
Well 19	Point of Use	25/07/14	77	7,600	2,600	
Well 19	Well	25/07/14	77	24,667	12,667	less than 6.8
Well 23	Point of Use	25/07/14	77	700	100	
Well 23	Well	25/07/14	77	6,800	5,700	less than 6.8
Well 7	Point of Use	25/07/14	77	1,300	0	
Well 7	Well	25/07/14	77	1,400	200	less than 6.8
Well 18	Point of Use	25/07/14	77	1,700	100	

Well 18	Well	25/07/14	77	10,700	5,900	less than 6.8
Rain Water	Open Bucket	08/10/14	81	0	0	6.8
Rain Water	Stored	08/10/14	81	1,300	0	6.8
Rain Water	Stored	08/10/14	81	600	0	6.8
Well 121	Well	08/10/14	81	13,700	1,400	less than 6.8
Well 119	Well	08/10/14	81	6,700	2,500	less than 6.8
Spring 1	Spring	17/10/14	79	100	0	less than 6.8
Spring 1	Stored	17/10/14	79	1,200	300	less than 6.8
Spring 6	Spring	17/10/14	79	500	0	less than 6.8
Spring 6	Stored	17/10/14	79	8,600	800	less than 6.8
Spring 5	Spring	17/10/14	79	600	0	less than 6.8
Spring 5	Stored	17/10/14	79	3,500	1,300	less than 6.8
Well 20	Point of Use	17/10/14	79	8,100	3,400	less than 6.8
Well 20	Well	17/10/14	79	16,400	7,900	less than 6.8
Well 60	Point of Use	17/10/14	79	2,100	300	less than 6.8
Well 60	Well	17/10/14	79	2,500	600	less than 6.8
Well 124	Point of Use	05/11/14	79	1,900	200	less than 6.8
Well 124	Well	05/11/14	79	2,900	100	less than 6.8
Well 122	Point of Use	05/11/14	79	6,300	200	less than 6.8
Well 122	Well	05/11/14	79	3,700	500	less than 6.8
Well 127	Well	05/11/14	79	15,000	1,000	less than 6.8
Well 135	Well	05/11/14	79	1,000	0	less than 6.8
Well 139	Point of Use	05/11/14	79	1,900	0	less than 6.8
Well 139	Well	05/11/14	79	52,667	0	less than 6.8
Well 143	Point of Use	05/11/14	79	3,500	0	less than 6.8
Well 143	Well	05/11/14	79	600	0	less than 6.8
Well 125	Point of Use	05/11/14	79	1,800	0	less than 6.8
Well 125	Well	05/11/14	79	900	0	less than 6.8
Well 126	Point of Use	05/11/14	79	1,600	800	less than 6.8
Well 126	Well	05/11/14	79	1,700	100	less than 6.8
Well 128	Point of Use	05/11/14	79	700	0	less than 6.8
Well 128	Well	05/11/14	79	900	400	less than 6.8
Well 136	Point of Use	05/11/14	79	22,900	4,900	less than 6.8
Well 136	Well	05/11/14	79	100	0	less than 6.8
Well 140	Well	05/11/14	79	1,400	0	less than 6.8
Well 142	Point of Use	05/11/14	79	900	200	less than 6.8
Well 142	Well	05/11/14	79	300	0	less than 6.8

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[i] Population estimates range from 2500 to over 5000. There is no accurate census. From aerial photos we counted 443 buildings. We may have missed some portions of the village. There are new buildings built since those aerial photos. Most of these would be homes, some with more than one household. Some would be commercial. We are told typical family size is 6-10 persons. We counted 145 wells with an average of 4 families using each well that would be 580 families. That would be 5800 population on the high side. 440 houses with average of 8 persons would give a lower estimate of 3520 population.