Water Testing Analysis and Appraisal

at a rural village in Siem Reap, Cambodia

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Abstract

We assessed the water conditions and water quality in Cambodia. During the 'dry' season, approximately between the months October to April, water was scarce in the villages. Due to the shortage of water, villagers use or store every drop they get from various water sources.

Our believe is that the reason why many villagers fall ill, are from water-borne diseases, found from their daily water use. To reiterate, the villagers used water from various sources. For example, many villagers were found drinking highly turbid water, taken from wells, small streams or from their rain collection jars (large ceramic containers used to store collected rain water).

Upon testing, we found that there was a high microbial count in those water sources. Microbes included E. coli that are found in human faeces and are one of the deadliest causes of water-borne diseases.

Therefore, the following pages consist of information from our project, dedicated to understand the relationship between the environmental issues and the water quality in Cambodia.

Picture 2.1 .Picture of a house in the village in Cambodia

Contents

Introduction

Many Cambodians do not have access to safe drinking water. 80% of deaths in Cambodia are due to water borne illness. The infant mortality rate of children under 5 years old is 14% and dirty drinking water is the cause of 20% of these deaths. Most of these diseases can be cured but medical treatment is not readily available in the many rural parts of Cambodia.

When we were informed about this, we were inspired to search for a way to alleviate the Cambodians from this everyday tragedy. We were to propose a method to help improve the water quality of the Cambodians.

To aid us in this task, we were sent for 8 lessons of an Advance Elective Module (AEM), Water Quality and Pollution over a course of 6 weeks. These lessons included lectures, field trips, laboratory sessions as well as project presentation. Through the course of these 6 weeks, we learnt about several water quality perimeters like dissolved oxygen, turbidity, salinity, pH, etc. and how all these factors affect water quality.

Armed with data sensors and our knowledge of water quality, we went to Cambodia to gather some data to help us in the design of our project.

Approach/ Methods- Experimental aspects of the project

Assumption

As temperature is an important parameter to aquatic life as it affects the solubility of oxygen in water, growth of bacteria and organisms that are sensitive to temperature, due to the high temperature in Cambodia. We assume that there the level of dissolved oxygen in the water is low. Therefore, growth of aerobic bacteria in water will decrease. Organisms that are sensitive to high temperatures will die as it unable to adapt to its surroundings well enough to survive. Also, we believe that there will be a low salinity level as Sarsadam is not located near the oceans. We believe that the turbidity of the water will be high as there is a high possibility that large amounts of loose sand and sediments will settle into water bodies.

Methods of data collection

Firstly, we surveyed the villagers through an interpreter. (As seen from Table 1.4)From the questions asked and results obtained, we could find out the location of the villagers water source and the location of their storage water. In addition, we also found out their daily habits such as whether they filter their water before consumption. Having known the water source, we were able to collect water samples directly from the source to minimise contamination.

Picture 5.1. Students surveying a villager.

Consequently, we went to the houses we have surveyed to collect their source water, stored water (if any) and filtered water (if any). Next, we tested the water temperature, pH, dissolved oxygen, turbidity and salinity for the various water samples that we have collected from the villagers. (As seen from Table 1.2 and Table 1.3)

Picture 5.2. Picture of a well(water source)

Also, we also brought back some water samples from the villagers, mainly stored water, bio sand filtered water, rain water and source water. We tested for bacterial count for these samples in different concentrations in the school's laboratory. (As seen from Table 1.1)

Data Analysis

Firstly, we compared the temperature, pH, electrical conductivity, dissolved oxygen and turbidity between the different water samples collected at each site. This enabled us to spot trends amongst the water quality of different kinds of sources (e.g. stored water, well water, filtered water etc). (Refer to Table 1.2 and Table 1.3)

Secondly, we analysed these results and trends with the surveys we took. We compared the households with and without the bio sand filter to see if there's any significant health improvement with the bio sand filter.

Thirdly, we tested the water samples (source water, stored water, rain water, bio sand filter) at different concentrations that we brought back for bacteria (E. coli), to see which samples contained the lowest bacterial count. We compared the results against a control set up, using distilled water instead of sample water. (Refer to Table 1.1)

Apparatus

During the Advance Elective Module:

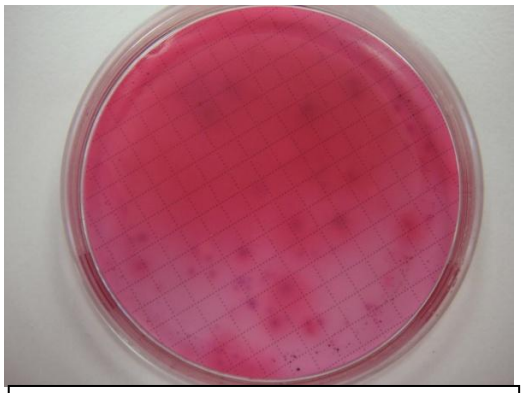
To do on-site testing, we used a data logger consisting of,

1. Temperature probe
2. pH probe
3. Electrical conductivity probe
4. Dissolved oxygen probe
5. Turbidity sensor

Picture 5.3. Students collecting water samples and testing waters.

To test for bacterial count for the water samples collected, we used,

1. Micropipette
2. Petri dishes
3. Test tubes



Picture 5.4. Picture of bacterial growth on agar plate

In Cambodia:

To do on-site testing, we used a data logger consisting of,

1. Temperature probe
2. pH probe
3. Electrical conductivity probe
4. Dissolved oxygen probe
5. Turbidity sensor

Picture 5.5. Students testing water samples with probes

Back at the school's laboratory:

To test for bacterial counts for the water sample brought back from Cambodia, we used,

1. Micropipette
2. Petri Dishes
3. Bacterial spreader

Procedures

In Cambodia, when testing on-sites:

1. Pour the water sample into beakers.
2. Attach the pH probe into the data logger and place probe into the beaker with water sample.
3. Record readings displayed on data logger.
4. Repeat steps 2 – 3 for each probe.
5. Record final readings in a table. (Refer to Table 1.2 and 1.3)

Picture 5.6. Picture of a student testing water sample and another recording the results

In Cambodia when trying to find out more about the villagers through surveys:

1. Greeted the villagers.
2. Gave the children food.
3. Interpreter interviewed the villagers.
4. Record the results.
5. Organise results into table form. (Refer to Table 1.4)

Back in school:

After testing the water samples, we brought water samples back to carry out further test for bacteria count. Other than testing the water quality, we also visited households to survey them about the water usage.

1. We placed the different concentrations of the different water samples into separate agar dishes.
2. Spread the water samples on the agar dish thoroughly.
3. Seal the agar dishes.
4. Incubate the agar dishes at 37 degrees for a week.
5. Count the number of colonies to determine bacterial count.
6. Record results in a table. (Refer to Table 1.1)

Results

After testing the collected samples, our results are as follows:

Water Sample	Control	Undiluted			10^2 dilution			10^4 dilution			Actual count cfu/ml
		1	2	Avg	1	2	Avg	1	2	Avg	
Source water	0	TMTC	TMTC	-	5	5	5	0	0	0	5000
Rain water	0	TMTC	TMTC	-	19	14	16.5	0	0	0	16500
Bio-sand filtered	0	TMTC	TMTC	-	43	43	45.5	1	0	0.5	45500
Stored well water	0	TMTC	TMTC	-	13	6	9.5	2	1	1.5	9500

Table 1.1 Bacterial count of collected samples

From these results we can see that water that was collected from the neighbouring wells, or written as Source Water in the table above has a high microbial count, following the Water Quality Standards of a 100 cfu/ml. Although it has a high microbial count for safe drinking water, compared to the other samples, it is relatively low.

These water samples are collected from water collection points or storage areas that the villagers in Sarsadam, Cambodia uses. Perhaps, after these results changes can be made to improve the quality of their drinking water.

Site 1 house

Table 1.2 Analysis of Water Quality in Site 1

	Source water(well)	Filtered water	Stored water(jar)
Water temperature /(^{0}C)	31.5	32.3	32.6
pH	6.00	6.87	6.78
Dissolved oxygen/(mg/L)	1.00	1.03	1.10
Turbidity /NTU	16.1	13.9	11.8
Salinity/ (ppt)	0	0	0

Picture 6.1.Picture of Site 1's house

Site 2 house

Table 1.3 Analysis of Water Quality in Site 2

	Source water (well)	Source water(pond)	Stored water(jar)
Water temperature /(^{0}C)	31.3	33.3	31.4
pH	6.70	NA	7.5
Dissolved oxygen/(mg/L)	0.65	0.43	0.92
Turbidity /NTU	70.9	200	139.2
Salinity/ (ppt)	0	0	0

Picture 6.2Picture of Site 2's Broken pump

Surveys of site 1 & 2 houses

Questions	Site 1	Site 2
Where do you get your water from?	Common well opposite the family's house. (Picture 6.1 shows the picture of the family's house)	Water from well at rice field which is 150 m away as the house water pipe is broken. (Picture 6.2 shows the broken pipe which used to supply water to the residents.)(Picture 5.2 shows their current water source)
What do you usually use water for?	Cooking, drinking, irrigate the rice fields.	
Approximately how much water do you use a day?	35 liters per person.	30litres per person.
How many family members do you have?	1 old lady , 5 small boys	1 middle aged men, 1 middle aged women, 4 children, 1 old men.
How frequent is your water supply? Is it sufficient for your family usage?	Water collected from the well is not enough for the family of 6 hence they rarely bathe.	Water collected from the well is not enough for the family of 7 hence they rarely bathe. In addition, during the dry season, there will be a shortage of drinking water from the well; hence they have to dry the murky pond water.
Do you have a water filter?	Yes.	No.
Do you boil your water before drinking it?	Water is not boiled as they have a biomass filter.	Water is not boiled or filtered.
Are you willing to continue using whatever water you have or do you hope for a change?	Willing to have clean and potable water.	
What changes would you	Hopes for the well to be	Clean and potable water in a

hope to see?	closer to house as it is quite far away from her house. She has to walk around 500m to obtain water.	constant and regular supply. In addition, they hope that their pump may be fixed.
How many people in your family fall sick due to drinking the filtered water? Mainly what illness	Usually the children fall sick once or twice a month, usually from diarrhea.	

Table 1.4 Survey results of both sites 1 and 2

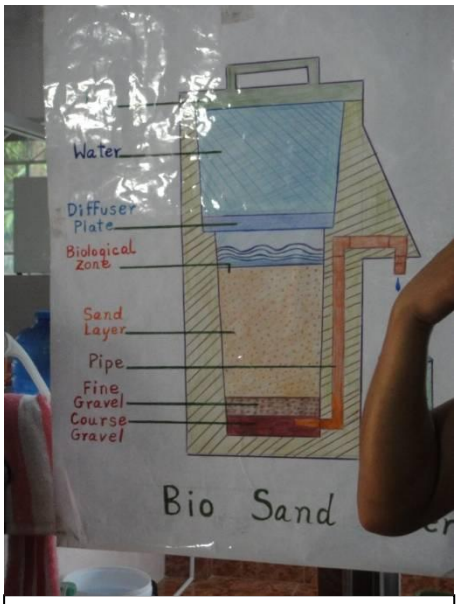
Discussion

We have observed that households with water filters still fall sick due to diarrhoea as often as households that do not have water filter. This could be due to the improper storage of filtered water's observed in Cambodia, where families pour the filtered water back into the same vat where the unfiltered water was obtained. The vat could have microorganisms or bacteria, hence contaminating the filtered water again. As the relationships between the families are strained, families are not willing to share their filter, therefore, this results in lesser families having filtered water.

The families surveyed do not have enough water for consumption. This could be due the dry season when the well is dried up. Also, it could be because the houses are far away from the well. As the villagers are mostly populated by young children and the elderly, they do not have enough strength to collect large amounts of water. This results in families bathing only once or twice a month to conserve water for other purposes such as drinking, washing and cooking. A family even commented that if they do not wake up at 3am during the dry season to get water from the well, they will not have any water for the whole day.

Families do not boil their water to drink as they feel that the filtered water is clean enough or because they feel there is no need to. The families feel that clean water is important and hopes to get easily accessible and constant water supply.

Picture 7.1.Picture of the filter



Picture 7.2.Picture of the components of the filter

Conclusion

During the timeframe from 4th May – 9th May, we went to Sarsadam village in Cambodia with our equipment to perform series of on-site experiments and surveys. We tabulated the results and it can be seen that water that was collected from the neighbouring wells, or written as Source Water in the table above has a high microbial count, according to the Water Quality Standards of a 100 cfu/ml. Although it has a high microbial count for safe drinking water, compared to the other samples, it is relatively low. On the other hand, the bio-sand filters had relative high microbial count, which is quite unfit for human consumption.

In order to verify with our results, we conducted various surveys, taking into consideration and noting down where their direct source of water were and collecting water samples, and hence, tabulating the above results.

We also had to do some assumptions and that was too, also stated in the earlier part of the report. We took into consideration and assume that due to the high and extreme temperature, contributed to the turbidity and the growth of bacteria. However, some of the bacteria was killed, hence, decreasing the number of bacteria and microbial count, the ph of the water, the electrical conductivity, which may trigger the rise of the salinity and hence, this could have contributed to the inconsistencies of the results.

In conclusion, we hope that through the above results and experiments which we took on-site and conducted various experiments back at our own laboratories would serve as a

yardstick, which will help gauge and improve the lifestyles and the water conditions of the people in Cambodia.

Picture of 8.1. Picture taken of us with a family

Reference

1. http://www.rdic.org/waterstart.htm
2. http://www.waterforcambodia.org/