Summer Practicum Report

Water, Sanitation and Hygiene (WASH) Project for Bwama Primary School in Southwestern Uganda

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This is a summer practicum project report prepared by Anit Koirala who is a professional master's student in Global Civil Engineering at the Mortensen Center for Global Engineering Program (MCGE). It is an engineering graduate program at the University of Colorado Boulder. This report is based on the school water, sanitation and hygiene (WASH) project with the focus on drinking water for Bwama Primary School in Southwestern Uganda. Anit worked on this summer practicum project alongside his colleague, Kalley Matnez, who is also in the same master's program at MCGE. Due to travel restrictions from school related to COVID-19, their summer practicum had to be done virtually. The host organization of the summer practicum is Global Livingston Institute (GLI). It was through the partnership between MCGE and GLI and the collaborative effort between GLI and the host community in Southwestern Uganda that this practicum was made possible.

Description of the Partner/Partner Organization

The Global Livingston Institute (GLI) is a non-profit organization based in Denver, Colorado. GLI is named after a visionary entrepreneur and philanthropist from Colorado named Johnston R. Livingston. It was founded in 2009 by Jamie Van Leeuwen after he travelled to Uganda and Rwanda as a part of the Livingston Fellowship. Twelve years later, GLI has been involved in various sustainable development projects throughout East Africa mainly in the areas of health, economic development, and the environment. GLI also hosts immersion programs for U.S. students and educators from primary school to universities in Uganda. This program allows them to have an immersive cross cultural experience and learn about sustainable development through dialogue and interaction with the locals. However, GLI is widely known for hosting free music festivals in various parts of East Africa to promote and provide health services such as HIV testing, cervical cancer screenings and family planning. Here is a brief overview of the organization from GLI staff:

"The Global Livingston Institute (GLI) is an education and research-based institute that works with students and community leaders to educate current and future changemakers, change the dialogue about sustainable development, and create empowering jobs. Since its founding in 2009, the GLI has recruited motivated students and leaders in East Africa to work together to reframe how we approach sustainable development and improve communities globally.

"In addition to work on increasing health services in East Africa through free concerts and music festivals, GLI opened Entusi Resort and Retreat Center in 2013. Located in Kabale, Uganda, it serves as a meeting place for people of all backgrounds to come together in order to discuss, and question the way we handle complex social issues from the local, national, and global perspective.

"GLI's mantra and animating philosophy is 'Listen. Think. Act.' This is emblematic of the organization's goal to move away from the mentality that involves trying to 'fix' communities and instead move toward a better understanding of and ability to listen to communities before proposing solutions. The mission of the GLI is to facilitate strategic and innovative approaches to international development while stimulating awareness, harnessing collaboration, and encouraging personal growth."

Description of the Community/Region

Our summer practicum was based in Bwama Primary School that sits on one of the islands of Lake Bunyonyi in southwestern Uganda. Lake Bunyonyi is surrounded by evergreen hills where many villages. and communities lie and the primary means of transportation is by boat. The regional spoken language is Ruchiga, which is derived from the Great Lakes Bantu language. Chrisitianty is the main religion in this region with churches located all around the villages and majority of the community people attend Sunday schools. It is easy to see the influence of the British colony in religion and culture even in the rural parts of Uganda like Lake Bunyonyi. The main source of the economy in this lake region is farming, and most residents identify as small-scale farmers. The most common types of crops grown in this region are irish potatoes, sorghum and beans. There are limited employment opportunities around the lake due to geographic isolation, and the average income is under $2/day. There is a local community market that opens every once a week on the bay of the lake, and people from different communities come to shop and sell different commodities there via boats. Kabale is the closest town from Lake Bunyonyi, accessible by substandard road with 30-45 mins drive. This town is also close to the Rwanda border and is closer to Kigali (capital of Rwanda) than Kampala. Due to the many tourist attractions in and around the lake, there have been many developments of resorts in recent years. The tourist activities include hiking the volcanic landscapes, canoeing, and birdwatching, etc. These resorts can be seen bright at night as the surrounding villages turn dark. This is because the villages are not connected to the power grid because of the geographic barriers. The main sources of lighting in the villages are paraffin, kerosene and candles. In addition, firewood is commonly used for cooking purposes. There are several government funded primary and secondary schools around the lake, but they are not accessible by foot for all students, thus many students take boats to go to school. There is also a small health center located on one of the islands of the lake.

Most residents fetch drinking water from the lake in jerry cans (20L containers), and the main treatment method they use is boiling. However, the residents don’t always boil water as it takes time and consumes firewood. Fetching water from the lake is also time consuming and labor intensive because many houses are on the hills adjacent to the lake. For sanitation, most households have a separate squat toilet built with a hole in the ground a few meters away from the house. The structure around the hole is not sturdy and mainly built from the branches. And as the hole gets filled, they dig another hole nearby and the cycle continues. Since soap is costly, hand hygiene is not prioritized. We couldn't assess whether there is a gender role in fetching water but that’s an important area of study. In general, WASH services in the villages around the lake are lacking.

Practicum Scope of Work (SOW)

Based on the need-based analysis and preliminary WASH research, the most pressing issues of lack of WASH were found in primary and secondary schools around the villages. Thus, GLI is working with Bwama Primary School to fund water treatment as well as sanitation and hygiene projects to address the issues related to lack of WASH services. There are 370 students, 12 staff and 9 classrooms in this school. Currently, drinking water and hand hygiene services are not available in this school. Students take turns fetching water in 60-liter buckets from the lake downhill and boil the water for drinking for the whole school. This practice is not just unsustainable, it doesn't ensure the water is safe to drink. Moreover, students miss class to fetch water from the lake, and not all students have access to boiled water. And, when the school is over, students can be seen drinking water directly from the lake as they go home. For hygiene, students don't have access to soap and water to wash their hands after the use of toilets. The improved and gender-separated latrines are available in the school. It was a GLI funded project built by the community people. Perhaps the most pressing concern related to sanitation and hygiene deals with the lack of menstruation hygiene management in the school. There are a number of female students in this primary school who are above the age 12. During the parent teacher meetings, we learned that during the menstruation cycle, female students go down to the lake to wash their menstruation discharge. This is very demeaning and a direct threat to the safety and dignity of female students. Sustainable Development Goal 4 calls for "inclusive and equitable quality education" opportunities for all by the year 2030. This goal can not be achieved without addressing the lack of WASH services and gender inequality in schools. Hence, GLI is committed to working with the Bwama Primary School and community members to carry out WASH interventions that are most appropriate for this school setting.

To effectively address WASH challenges in Bwama Primary School, GLI partnered with MCGE and selected two global engineering master's students to oversee the WASH project as a part of their summer practicum. I have been working on other sustainable development projects with GLI in this region, thus I got the opportunity to work with my colleague on this WASH project as I know the community well. Our practicum was virtual due to COVID-19 travel restrictions from school. The timeline for the practicum was from June through September of 2021. GLI gave us several key tasks to work on for our practicum and they are as follow:

1) Work with community members on the design of the water treatment facility that is culturally appropriate and accessible for everyone.

2) Research the behavior of students and their households towards WASH, long-term financing for WASH projects, and monitoring and evaluation of the project.
3) Conduct research on sanitation and hand hygiene services, and develop recommendations for best solutions and practices.
4) Submit a coherent WASH project report to GLI by the end of the practicum, so that GLI can move forward with the implementation of the project, which will be led by the community experts.

How SOW was accomplished

Due to the virtual state of our practicum, we were not able to accomplish all the tasks. Not being in the field to engage with the community members, collect real time data and do field study of the school were especially challenging. However, this situation encouraged us to be creative and discover new ways to do the traditional research and data collection. We put out flyers and social media posts for the internship opportunity with the help from Entusi Resort Center. We were able to find two local interns to help us with community engagement and data collections. These interns are namely Mwesiga Ivan and Tulyatunga Fulgence, both college students at the Kable University in Uganda. They know the community, understand the culture, speak the language (Rukiga) and are well aware of the WASH challenges in schools and communities where they reside. We also applied for a practicum grant through MCGE to support the interns. We received a grant of $1,500 which was used to cover the costs for locals to participate in meetings, their transit and food costs, and support local engagement in our evaluation efforts. Having the interns on the team to support us with our practicum was extremely helpful and we wouldn't have done it without them. They helped us with the following tasks:

1) Meet with the school staff and families of the students to discuss the WASH project in detail and collect their inputs.

We conducted three separate meetings with the school staff, students and parents together at the Entusi Resort Center to discuss the importance and urgency of the WASH project in Bwama Primary School. Due to COVID-19 restriction, these meetings were limited to less than 25 participants. The interns facilitated these meetings by engaging participants in conversations around lack of WASH services in school and how that has affected students. Students shared their experiences with drinking water from the lake, not having handwashing facilities in school and lack of menstruation hygiene management. Parents and teachers showed strong support in having basic WASH facilities in school for the safety of their

students and engaged in discussion about WASH interventions suitable for this school and how to potentially expand that to household level.

2) Interview households about the WASH practices at home

We worked together with interns to formulate a set of questions to ask during the meetings to learn more about the WASH practices at home and in school. This provided us with information about behaviour of students and households towards WASH and concerns of lack of WASH at home and school, especially among female students. It was evident that basic WASH services are not prioritized as much as other needs because of lack of knowledge and resources. Upon reflecting on the health risks of drinking unclean water, the households showed more interest in learning about the affordable products that are available in the Ugandan market for water treatment.

3) Demonstrate the ceramic filters and handwashing stations as viable solutions for school WASH challenges

One of the ideas for WASH intervention discussed in the meeting was to place a ceramic water filter inside each classroom and two handwashing stations, one near each gender toilet. This would effectively and readily address ongoing WASH challenges in the school and help prevent the spread of COVID-19. Our interns presented images and videos of ceramic filters explaining the functionality, affordability and benefits of using filters rather than boiling water. This presentation was very engaging, and the participants were interested in learning more about the products, using them firsthand and purchasing them for household use.

Key Findings

When researching the appropriate WASH interventions for Bwama Primary School we looked at the structural condition of the school first to identify how much investment should be made. Moreover, we analysed water treatment technologies that are available in the Ugandan market and not something entirely different from what the students and locals are used to for easier adaptability purposes. The classrooms of the school are in fragile condition, and there has been no renovation or reconstruction done in years due to lack of funding. So, investing a large sum of money in longer term water treatments solutions like biosand or reverse osmosis filtration systems did not seem feasible. Based on our research on best water treatment methods for low resources setting in Uganda, we found that the ceramic filtration

was a popular choice given its effectiveness and affordability. A ceramic filter is a combination of a bucket and a ceramic pot. The pot goes inside the bucket and there is some space for water collection between the base of the pot and base of the bucket. Water is then poured into the pot to filter by gravity and collect in the lower container, which is equipped with an outlet for distribution. It is widely used even in urban settings where there is a piped water supply because of poor water quality and lack of trust. Since the ceramic filters are portable and easy to clean, they are appealing to customers in rural areas. Below are suggestions for WASH project in Bwama Primary School based on our research and interaction with the community, ranked in order of high to low priorities:

1. Ceramic Water Filter (high priority)

After extensive research, we found that the for-profit/social enterprise based in Kampala, Uganda called “SPOUTS of Water" manufactures and sells best-in-class ceramic water filters. They have three different models of ceramic filters under the brand name “Purifaaya.” They have distributed Purifaaya filters to schools, health centers, refugee camps, and settlements in Uganda and across East Africa. They also have a direct partnership with aid organizations and NGOs such as UNHCR, USAID, and OXFAM, etc. As of 2021, they have distributed more than 18,000 units and impacted over 640,000 people [1]. The base Purifayaa model comes with 20L capacity and 3-4 L/h filtration rate. It costs $25 and has a 2-year warranty but it can last up to 5 years [1]. The specifications of all three models are given in the appendix.

The Purifaaya filters provide enough protection from bacteria and pathogens and limited protection from viruses. The ceramic pot is coated with colloidal silver to avoid pathogen growth in the pot, and it works for all kinds of water (lake, river, well, tap, rain, etc.). The filters are easy to install, operate and maintain; the maintenance can be done by “cleaning the pot every two weeks with a piece of cloth and water, as well as the bucket with water and soap”[3]. In addition, the filters are culturally accepted because the locals already store their water in buckets and clay pots, and since there is no chemical input in the filters the taste of water is natural.

The water quality testing done by the Ugandan Ministry of Water and Environment showed the water from Purifaaya filters is 99.9% safe [2]. The Tanzania Ministry of Water, Rwanda Standards Board and World Health Organizations also certified the use of Purifaaya filters for water treatment.

2. Hand Washing Station (high priority)

SPOUTS of Water also manufactures and sells handwashing stations that they call HandiClean. It is a water storage tank with the 100L capacity that comes with a stand and a foot pedal. Water comes through the tap in the container when the pedal is pressed by a foot. This is to prevent the spread of germs and viruses when the tap is touched by hands. SPOUTS aims to introduce HandiClean to communities to promote health and sanitation and to schools so that students can practice hand hygiene, especially in the COVID-19 pandemic. They also provide three months warranty on the fixtures and do regular check up on the maintenance on the facilities. There also needs to be liquid soaps available in order to make the best use of HandiClean and ensure good hygiene. Having two HandiCleans in Bwama Primary School is essential for students to safely return to school post COVID-19 closure.

<u>Note from the CEO of SPOUTS of Water</u>

We met with the CEO of SPOUTS of Water, Daniel Yin, a few times to discuss the services that they provide to their customers. He was very emphatic that their organization is focused more on the social impact than profitability. They don't just sell the product, their staff members train their customers first on how to use and maintain it, and explain the value propositions. Because of these services the user ratings as well as the repayment rate is over 90%. He further added that SPOUTS of Water also provides a complimentary RPG stove and helps install it when a household purchases a ceramic filter. This will give households extra motivation to buy a filter. It also helps cut down on firewood used for cooking by more than 50% and lasts for up to 10 years.

3. Solar Pump *(optional)*

One of the main components of the water treatment project is a water pump. Since the school is situated on a hill, a water pump is required to pump water from the lake to the school. This provides easier access to water for the students as well as ensuring students do not have to toil and miss class to fetch water from the lake.

If the ceramic filters and hand washing stations are proven to be serviceable based on the monitoring and evaluation, then GLI should invest in a solar pump after six months. Our research indicated that FuturePump is the best solar enterprise in east Africa. They design and manufacture solar-powered pumps that are both "robust and portable" and offer a "cheaper, cleaner and more sustainable alternative to costly

and polluting petrol or diesel pumps" [4]. Their latest model is called SF2, which is a high-efficiency surface water pump designed to be used for small-scale irrigation of 1-2 acre farms by smallholder farmers [4]. This pump presents a suitable option for drawing the lake water to school for drinking and sanitation purposes. The technical speciation of the SF2 pump is given in the appendix.

4. Storage Tank (*optional)*

If the solar pump is installed for pumping water from the lake, it is important to also place a storage tank in the school to store water. This is especially helpful in the winter when there is not enough sunlight to power the solar pump. Based on our research, Steel & Tube Industries Ltd based in Kampala, Uganda manufactures water storage tanks (Smart Tanks) from stainless steel that can last up to 50 years [5]. The smart tanks are lightweight, easy to install, and come in different volumes [5]. Based on the school size and student populations, having a 450L tank is sufficient to address the need for drinking water. There is no urgent need for a pump in school but this is a good alternative to consider for the future. The costs of the Smart Tanks are not available on their website, but the specifications are provided in the appendix.

5. Financing

The cost of the WASH project in Bwama Primary School should be covered by GLI through fundraising and donations. The total estimated cost for nine ceramic filters (one for each classroom) and two handwashing stations (one for each toilet) will come out to be $935. This cost is for the base models only. Although the total cost could be covered by collecting small fees from parents, the willingness-to-pay is not very positive. According to the school principal, it is extremely hard to even collect necessary fees for students' uniforms and lunch from their parents. They either say that they are in financial hardship or that they will pay later. Hence, financing the WASH projects in school, understandably, is not on the priority list for parents due to financial hardship and also due to behavior determinants. Boiling water for drinking is a common practice around the lake region, thus it is not easy to explain the negative effects of untreated water.

To sustain the WASH project in this school for a long period, it is essential to have continuous funding sources available. GLI should consider partnering with Spouts of Water and become a distributor of ceramic filters in the lake Bunyonyi region. This would allow GLI to sell ceramic water filters to households and use the revenue to sustain the WASH projects in this school. It would also allow GLI to slowly carry out WASH interventions at the household level, which is important in obtaining optimal

WASH benefits for children. The households can either buy the filters for cash or use a loan if they can't make the full payment. GLI has introduced a flexible financing method for buying solar panels and it has worked successfully with a repayment rate of 96%. This financing method lets customers make a 30 percent down payment and pay the remaining cost in installments for three months at zero interest. The same financing method can be applied for buying ceramic filters as well. The table in the appendix shows the costs of different ceramic filters for household use and the estimated profit margin.

6. Monitoring & Evaluation (M&E)

M&E will be conducted by local Entusi staff along with school staff. They will simply measure the water volume in the ceramic filters by the end of the school day to observe if the students are drinking water from filters. Similar measurement will be done in the handwashing stations to observe if the students are washing hands. This measurement will be carried out on a daily basis for at least a month. Moreover, school staff will inspect whether the students are adapting to the new WASH practices and report to GLI monthly. We have not formultated M&E plan for WASH interventions at the household level at this time. If the school WASH project shows promising results and households want to buy ceramic filters and handwashing stations then GLI should prepare a M&E survey for households focusing on health and economic benefits.

Next Steps

GLI will review this report and proceed with the next steps. Although we believe that the WASH intervention in Bwama Primary school is a matter of urgency due to the COVID-19 pandemic, we also believe that it is important to do additional assessment of our project proposal before the implementation. As mentioned previously, we were not able to complete all tasks required for the project implementation and having students in the field to further access our project specification would be helpful. Thus, GLI will present this opportunity to two public health students to travel to the region to do further assessment on the WASH project before finalizing the implementation. We expect the WASH project to be implemented by the end of December 2021 after the field assessment. These students will work on the following responsibilities:

- Coordinate with community members, school staff, and students to ensure the proposed WASH solution is appropriate for this school setting, accessible for everyone, financially feasible, and sustainable.

- Work with the school staff to incorporate WASH into the school curriculum.
- Develop recommendations on how to expand the WASH project to household levels.
- Research best solutions and practices for menstruation hygiene management.

Pass on the Information

I believe that the vision of MCGE and GLI are closely aligned as they both strive to teach college students about sustainable global development through education, research partnership, immersive experience, and innovative solutions. This practicum is just one example of the sustainable development impact the two organizations can make if they work together. The WASH project in Bwama Primary School would provide WASH services to 370 students and possibly to many households around the lake. As GLI is expanding their sustainability initiatives around the lake, I believe that the MCGE students can best contribute their knowledge and expertise to these initiatives in the near future.

Conclusion

The sustainable development goals 4 calls for "clean water and sanitation for all" by the year 2030. Clean water and sanitation is key to healthy human lives and it is crucial for the wellbeing of school childrens. Children spend most of their day time from morning to evening in schools and the WASH services in schools are determined factors for their academic and personal growth and success. If they have proper WASH services in school, they are likely to remain healthy and safe from waterborne diseases and continue to attend school. Moreover, they are likely to influence the same WASH policies and practices they learn in school at home too. That is why WASH in school is so important, especially when we are trying to reach everyone with clean water and sanitation.

WASH project in Bwama Primary School is crucial and in need of immediate implementation given the current practices and impacts of COVID-19. Partnership with Spouts of Water can help bring affordable ceramic water filters to every classroom and handwashing stations in this school. Furthermore, there is an opportunity to expand this project to households level through different financing options and outreach programs. It is Important to have basic WASH services available in both schools and homes, so that children can be safe in both environments.

Two important tasks could not be completed because of the virtual state of practicum. First, the lack of menstruation hygiene management needs immediate attention and action to protect the safety and dignity

of female students as well as to promote gender equality in education. Second, the school needs to integrate WASH into the school curriculum to teach students about the importance of drinking clean water and personal hygiene. The changes in behavior need to be taught in school and home, so that children can apply them in practice.

References

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3. The United Nations Children's Fund. (2020). *Household Water Treatment Filters Product Guide.* https://www.unicef.org/supply/media/5221/file/%20household-water-treatment-filters-product-guide.pdf

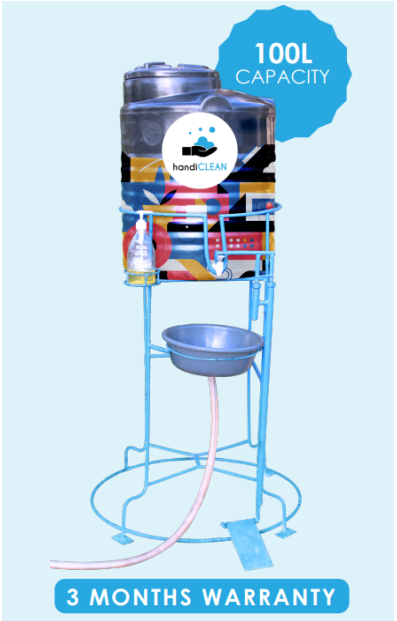
4. Futurepump. (2021, September 28). *Solar water pumps for farmers in the Tropics*. Futurepump. Retrieved October 1, 2021, from https://futurepump.com/.

5. *Stainless steel tanks – steel and tube*. Steel and Tube - Industries. (2020, September 16). Retrieved October 1, 2021, from https://stil.co.ug/smart-tanks/.

Appendix

Purifaaya filters

HandiClean



Products cost and profit margins

Products	Purifaaya	Viva Purifaaya	Purifaaya XL	HandiClean
Wholesale	UGX 75,000	UGX 120,000	UGX 280,000	UGX 330,000
Retail	UGX 90,000	UGX 150,000	UGX 300,000	UGX 350,000
Margin	17%	20%	7%	6%

Solar pump (SF2) specifications

Type		
Pump		
Max. Total dynamic head (TDH)	[m]	15
Suction capacity at sea level (vertical meters)[1]	[m]	7
Max. Flow rate	[l/hr]	3,500
Pump type	[]	Positive displacement piston pump
Horizontal discharge	[m]	500
Peak system efficiency	[%]	70
Electrical /Mechanical		
Maximum pump voltage	[V_{DC}]	60
Maximum motor current	[A_{DC}]	5
Piston diameter	[mm]	104
Inlet/Outlets	[mm]	32
Displacement volume per stroke	[cm^3]	150
Normal flywheel RPM range	[rpm]	100 - 250
Large pulley	[mm]	90
Small pulley	[mm]	50
Weight and dimensions		
Pump weight	[kg]	19.5
Pump dimensions	[mm]	L 520mm x H 530mm x W 200mm
Weight	[kg]	14

SmartTank specifications

- 50 years lifespan.
- Stainless steel – Grade 304
- Rust free and fire resistant.
- Free from fungus, algae, insects and water contamination.
- Heat resistant and a solid body.
- Base discharge point enables easy to drain sludge and residue.
- Lightweight and easy to install.
- Affordable and a worthwhile long term investment.
- Tank Uses: residential, hospitals, hotels, commercial, schools, factories.