



ENGINEERS WITHOUT BORDERS USA MASSACHUSETTS INSTITUTE OF TECHNOLOGY CHAPTER

NEWSLETTER

ewb.mit.edu | Editors: Amel Elawad and Chris Eschler | Volume 2 No.1 Fall 2018

EDITOR'S NOTE

By: Amel Elawad '21

We are happy to relaunch our newsletter and hope to continue to use it as a medium to share our progress.

This issue will talk about our journey as a chapter starting from Fall 2017. Hence, here you will find reports and recounts from both our Assessment Trip and Implementation Trip for the academic year 2017-2018, as well as our activities for Fall 2018.

We would like to thank everyone who has helped get the EWB-MIT Chapter this far. Thank you to our mentors and partners from the Boston Professional Chapter, our donors and our members. Thank you to everyone that helped get this newsletter together!

Enjoy the issue!

ACTIVITIES REPORT

By: Rahma Zakaria '19
Program Director

Preliminary Research Phase: Fall 2017

In fall of 2017, MIT EWB got in contact with the Boston Professional Chapter (BPC) of the national EWB organization in the hopes of starting a partnership and mentorship. BPC has worked on a number of initiatives since their inception in 2002, and among them was their water supply project in Mkutani, Tanzania. This is the project we ended up joining.



2016 Borehole

Mkutani reached out to the BPC in 2012 with a water supply issue. Mkutani is a village with a population of around 3,000. The locals mainly depend on subsistence farming, and very few have access to electricity. When the village reached out to EWB-Boston Professional Chapter (BPC) in 2012, they had three main sources of clean drinking water.

1. The river, which was polluted due to upstream dumping.
2. Neighboring farms: that locals could purchase water from at an unsustainable price;
3. or they could dig wells by hand, an arduous and dangerous task.
4. A borehole that BPC dug and installed a hand pump for in 2016.

Earlier conversations between BPC and Mkutani suggested that the community might be interested in having a solar irrigation system, which was the first option that BPC introduced to the MIT chapter when we began working together. This informed our agenda for the fall of 2017: learning about the community and their needs, and doing preliminary research that could inform decisions in planning and design. Hence, we split our members into different groups to explore the following topics:

1. **Water sources and treatment, Irrigation methods** (particularly those successful in regions with

weather and water conditions similar to those in Mkutani).

2. **Solar powered technologies** i.e. how they might be adaptable to an irrigation system.
3. **Mkutani** i.e. geography and weather, as well as Tanzanian lifestyle and culture.
4. **Problem-solving tools** (through role-plays and guest lectures from instructors from the MIT Development lab we became familiar with topics such as interviewing techniques and stakeholder analysis).

Assessment Trip: Fall 2017 - Winter 2018

The first step of any project through EWB-USA National Organization must be an Assessment Trip: a thorough evaluation of the community's needs that defines what project we would work on. Although the locals had demonstrated some interest in a possible solar irrigation project, it was necessary to gain more information about Mkutani's needs regarding irrigation and any other problems they were experiencing. Hence, the goal of this trip was to deepen our understanding of the daily challenges the locals in Mkutani faced and learn the best way our club could help.

In preparation for an Assessment Trip, our team wrote an Assessment Pre-Trip Plan, a formal write-up, which included:

1. **Project description**
2. **Assessment activities**
3. **Schedule**
4. **Go/no-go decision**
5. **Baseline monitoring data collection**

We had three objectives for the Assessment Trip:

1. Familiarize ourselves with BPC's previous work in the community.
2. Build a relationship with the community members and identify their needs.
3. Conduct an assessment of a river intake or beach well pumping system.

We worked with BPC to devise a schedule, and BPC revised and approved our plan before we submitted it to EWB-USA National Organization. Finally, after taking care of remaining trip preparations, two of our members, Liam Herndon and Magreth Kakoko, travelled to Mkutani with Bill Clunie, a member of BPC. It was a fruitful trip, and Liam and Magreth wrote up a Post-Trip Report and presented reflections to the group on their return.

Alternatives Analysis: Spring 2018

From the Assessment Trip, we learned that Mkutani was more interested in improved access to potable water than in the solar irrigation project. While the already installed mechanical hand pump was very helpful, the locals noted that pumping the well was physically demanding. Additionally, when the pump broke down, which happened frequently, the locals were often busy and did not have the time to fix it.

From there, there were still several ways in which we could pursue a water supply project.

Our alternatives were as follows:

1. **Hilltop Tank:** We could install a tank at the top of a hill near the hand-pump and create a distribution line directly to the village, a few kilometers away.
2. **Electric Pump:** We could install an electric pump that would be powered by either of:
 - a. A petrol generator
 - b. Gas generator
 - c. Solar system.

Thus, the next step was to conduct an Alternatives Analysis. With the guidance of BPC, we expanded on each of the possible alternatives, estimating the initial and operation costs, considering benefits and drawbacks, and describing their implementation, maintenance, and sustainability. We defined 10 criteria for comparison of the alternatives, including costs and material availability, and determined the weight each criterion had. Finally, we created a decision matrix by

assigning a score to each alternative for each criterion, and calculating the weighted total score of each alternative. We concluded that replacing the existing hand pump with a solar pump was the most valuable alternative: it lacked the recurring costs that a diesel or petrol generator would incur, and was more financially achievable in the immediate time frame than the hilltop tank. It was also an approach that Mkutani had shown their interest in during the Assessment Trip.

Implementation Preparation: Spring-Summer 2018



The solar powered pump and local tank

Once we settled on the solar pump approach, we had to prepare an Implementation Pre-Trip Report. This would be a much more technical report than the previous ones we had worked on. It included a description of design, construction and contingency plan, materials list, cost estimate, operation and maintenance, and sustainability considerations. To tackle the Implementation Report, we split the report sections between our chapter and BPC. In addition, we broke into three technical teams, focusing on **electrical**, **structural**, and **hydraulic** components. Each team was paired with a mentor from the Boston Professional Chapter for guidance.

The electrical team worked on putting the whole solar system together. They looked at the specifications for the pump, solar panels, and controller to find the best wiring configuration, and created wiring diagrams with all the interconnected parts. They also performed calculations on wire gauging and voltage drops to meet the requirements of the community. The Boston Professional Chapter provided mentorship in Application Engineering, teaching the team about wiring diagrams, electrical calculations, and solar panel considerations.

The structural team designed a stand for the water tank. The design had to support 10,000 liters of water, plus the tank itself—a total weight of 12.5 tons. They began by researching different possible structures and considering the local designs, and then participated and learned as BPC conducted the force analysis.

The water team worked with BPC to develop a head-loss model for water flow from the storage tank to the tap stand, then used the model to determine the tank height required for the desired flow rate. The water team's results were then used to inform the structural team of a minimum stand height requirement.

Finally, the two chapters worked together to write up the Implementation Pre-Trip Report for submission to the EWB-USA National Organization. In addition, BPC submitted a construction safety plan.

The Solar Education Project team used the summer to begin preliminary work on a Solar System Troubleshooting Manual. Tanzania's government has begun to place higher emphasis on solar-powered technology, in particular by subsidizing the costs of many parts involved in solar systems. In the last Assessment Trip, MIT-EWB met with the Mkutani region's senior technician, who noted that many Tanzanian engineers are not familiar with solar systems, and proposed that our chapter create a manual and workshop on operation, maintenance, and troubleshooting.

The Implementation Trip went as well as we could have hoped for. The traveling team included Vibha Agarwal, Milani Chatterji-Len and Diana Estrada from EWB-MIT, and Bill Clunie from EWB-BPC.



The solar pump installation was a success

ASSESSMENT TRIP

By: Magreth Kakoko '21 and Liam Herndon '21

Last January, we had the opportunity to travel to Mkutani, Tanzania with EWB Boston Professional Chapter (EWB-BPC) to assess the community's engineering needs and see how EWB could help. At the time, EWB-MIT was planning to design an irrigation system for the village. Therefore, most of the trip was focused on identifying potential water sources and speaking to farmers about their irrigation needs. Meanwhile, EWB-BPC learned about the community's water issues and made plans to install a solar pump at the local borehole. The community seemed enthusiastic about the pump, but indifferent at best about irrigation (they identified potential problems in allocating irrigated water), so EWB-MIT ultimately decided to join the Professional Chapter in its potable water project.

This assessment trip allowed us to understand the real-world context of our project. In our visits to the school, clinic, and various villagers' farms, we had the chance to learn about the residents' daily challenges. These discussions introduced us to the resources that are available to the community, as well as their highest priority water needs, both of which were key in assessing the feasibility of any ideas we proposed.

As a result of exploration and discussion, we concluded that upgrading the hand pump would be the best way for us to help the community in meeting their water demands. We immediately began pursuing the project: replacing the existing mechanically-powered hand pump with a solar-powered electric pump. Once we decided to pivot, our discussions focused on potential locations for components of the solar array. We were able to bring back to MIT our familiarity with the space they would occupy; more significantly, we had a better understanding of the community's needs and priorities, which allowed us to effectively plan the next steps in the project to pursue on campus.

Traveling to Mkutani was an amazing experience, as well as an important step in the development of our project.



Part of the IAP travel team meeting with Mkutani locals

IMPLEMENTATION TRIP, FALL 2018 AND FUTURE OUTLOOK

By: Vibha Agarwal '20
President

During our Implementation Trip, and after conversing with the locals to Mkutani and technicians of the Dodoma region, we have found a few more needs that we would like to address in the upcoming semester(s). This fall semester, we began responding to some of these needs.

Currently, the Dodoma technicians are not familiar enough with solar powered systems to be able to repair them without expensive outside contractors. However, they are highly adept at fixing diesel-powered systems, and are eager to learn about solar systems as well. The Dodoma district senior technician and his team have requested that MIT-EWB write a solar pump system manual that teaches them to operate, maintain, troubleshoot, and repair the solar pump system. This has been an exciting project for us this semester.

The Solar Education Project team lead by Liam Herndon, has worked on drafting the manual since summer 2018. The team is currently in communication with District Water Department's senior technician in order to review the manual before it can be finalized and translated. By January 2019, we plan to have a completed manual in both English and Swahili.

The Local projects team is a new team formed this semester that is exploring local engineering projects options. The team has brainstormed about the kinds of projects they are interested in and have identified "homelessness issues" and "underprivileged societies" as their primary interests. They are working with the PKG Center at MIT (Priscilla King Gray Public Service Center) to get in touch with local organizations.

The Documentation team has written and submitted the Post-Implementation Trip Report for our last Implementation Trip. The report has been approved.

Future plans for the club will center around further easing access to potable water in Mkutani. Since the borehole is located a burdensome distance away from the locals' homes, EWB-MIT and EWB-BPC plan to expand the system to include a tank at the top of a nearby hill that can power a distribution pipeline to the village center. In preparation for this, the current layout of the site has been planned in a way so that additional solar panels can be easily added to power the movement of water from the pump to the Hill Top Tank. We visited the proposed hill during the August Implementation Trip, but further assessment work has to be done to see if this is a viable and beneficial option.

Beyond that, we found a great lack of Mkutani girls' sanitation products during menstruation. More often than not, girls have to stay home during their periods and miss a week of school, which negatively impacts their studies and long-term goals. The women discussed with us the unhygienic methods used by the female locals to manage their periods, as well as privacy concerns about giving birth in the dispensary near sick people, particularly men. These are concerns that EWB-MIT hopes to learn more about so that we can collaborate with the women and girls of Mkutani to find the best solution to help to make them more comfortable.

MEMBERS' CORNER

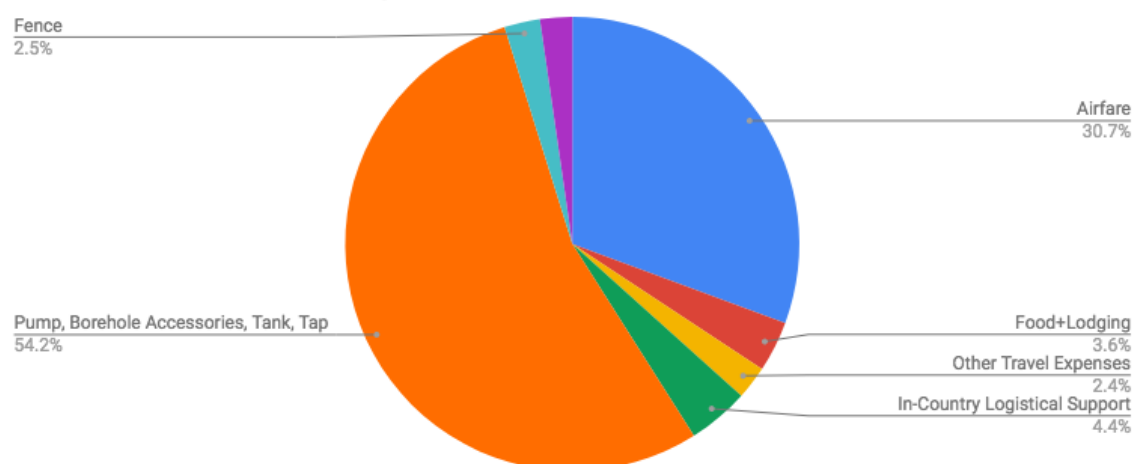
By: Abigail Frey '21
Fundraising Team Lead

When I waited in line to sign my name on the Engineers Without Borders interest list at the MIT Activities Fair, I had no idea how much impact the group would have on me and how much we would accomplish. Over the next year as our project grew, I grew with it. By taking on the extra responsibility of an exec position I was able to take ownership over a role which has given me an added sense of pride in the group's accomplishments. Furthermore, I could not have asked for a more supportive and passionate team to work with. They are with you through good days and bad, and we can always rely on each other to get work done. Lastly, I am very thankful to the Boston Professional Chapter for being amazing role models and team members. I am always proud to tell people I am a member of EWB!

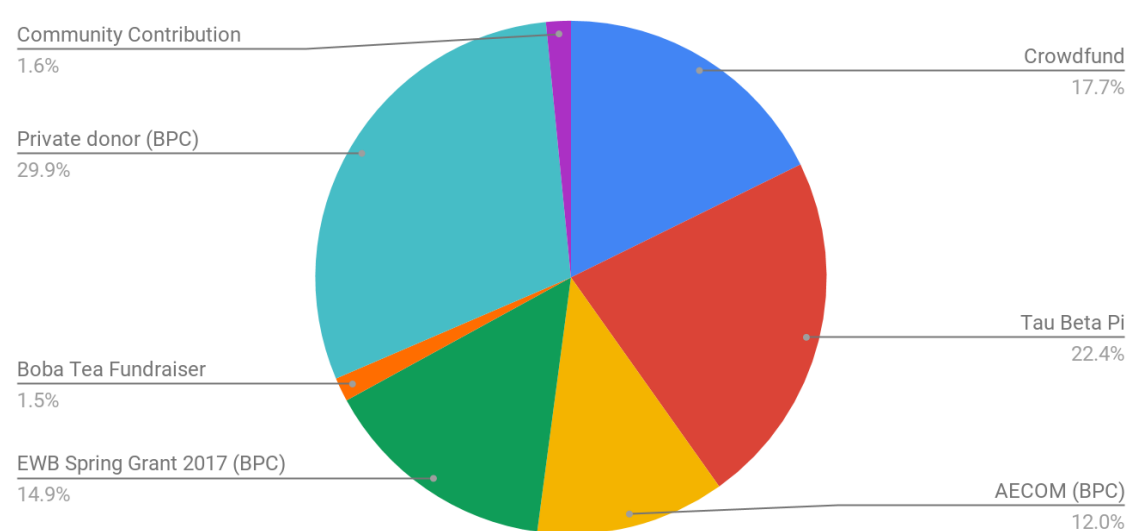
DONORS' CORNER

By: Abigail Frey '21
Fundraising Team Lead

How did we allocate funding?



Where did we get our funding?



The MIT Chapter of Engineers Without Borders would like to thank our donors for their generous contributions to our August Implementation Trip. It means so much to us to see such overwhelming support from the MIT alumni community and local companies. We feel very passionate about our project and are so happy that others share our motivation for making a difference in another community. We hope that this look into our journey through our newsletter shows you all what a difference you have made by contributing to our project!

Thank you to:

Tau Beta Pi

The MIT Alumni Community

AECOM

The MIT Undergraduate Community

MESSAGE FROM PRESIDENT FALL 2017-SUMMER 2018

By: Milani Chatterji-Len '19

I have had the pleasure of being the president of MIT's chapter of Engineers Without Borders through fall 2017- summer 2018. I would like to extend my personal thanks to those who have supported us this semester, from individual donors to student grants. Without your support, we would not have been able to reach the point we are now in our project. When I joined Engineers Without Borders during my freshman year in 2015, I never could have imagined that we would bring water to a village of 3,000 people through a collaboration with the Boston Professional Chapter.

Over the past semester, our group has come together to perform technical calculations, write reports and develop cultural awareness, all in preparation to install a solar-powered pumping system that provides a clean, reliable source of water throughout the year. Before the system was installed, locals resorted to drinking contaminated river water or paid hefty prices for water from other villages that were over a mile away. Thanks to the solar pump, they can now draw water from a nearby tap stand that can be operated by the simple opening of a valve. Plus, the solution we have helped them implement is sustainable as the pump is powered by an array of six solar panels at the site. Your support helped fund all of the system components, from the solar panels to the pump to a water storage tank. Moreover, it has helped inspire a talented, hardworking group of young engineers to come up with socially-responsible solutions to pressing global issues.

Finally, thank you to all our passionate, dedicated members, past and present, for being the driving force behind each project's success.

MESSAGE FROM PRESIDENT FALL 2018-

By: Vibha Agarwal '20

Helping lead MIT's EWB Chapter has been one of the most fulfilling experiences I have had this semester. When I joined the club as a young freshman, I could not have imagined how far we would progress as a chapter, and how much we would accomplish.

Over the past year, we have formed a strong relationship and partnership with the Boston Professional Chapter. Our project has developed from an idea of an irrigation project to an implementation of a pump project. This development came after conducting an assessment trip, reassessing the irrigation project and realizing the need to install a pump. We hence completed an alternatives analysis, helped design a solar-powered pump system, and successfully provided cheap, potable water to Mkutani, a Tanzanian village of 3,000 people, on the other side of the world. There were so many students, mentors, donors, and Mkutani residents involved in the project, and I appreciate everyone for helping make it happen.

Our club has a diverse set of students, from majors that range from Civil Engineering, Biological Engineering to Computer Science. My favorite aspect of the club has been seeing everyone come together to achieve a common goal. I am constantly impressed by our members taking initiative to lead a sub-team, start a crowdfund, spend extra time on paperwork, and just do what needs to be done to push the project further. I have loved seeing our members' dedication to the team and watching them grow closer as a result. Thank you all for being an amazing team to work with.

I would also like to thank the Boston Professional Chapter for all their support and guidance. It has been an amazing opportunity to get to meet and work with experienced engineers and devoted mentors.

Thank you to everyone who has supported Engineers Without Borders. We could not have installed the pump this summer without everyone's combined efforts, and I am incredibly proud to be a part of this organization.