**BLUElab India Project (BLIP) DOW Progress Report**

**Executive Summary**
Over the course of the 2016-2017 academic year, we worked on validating and improving upon our sustainable solutions to the two design challenges that the team and community identified during the needs assessment trip in May 2014. During this time we were also preparing for the upcoming needs assessment.

The first project is to improve upon the stove design widely used in Dolatpura, which has been our partner community for the past three years. We aim to reduce the amount of smoke that comes in contact with the cook and increase the efficiency of the stove. The second project is to work on a toilet system that the community is comfortable using.

The stove project has entered an expansion phase where our partner family is working with other families in different communities to teach the skill of constructing this technology. Our toilets project is in a purely validation state where we will continue to collect, analyze, and validate the data of the toilet to ensure it is functioning properly. While the improvement of both of these designs remain a goal to us, the team expanded into a new community to work with this May. A thorough needs assessment was conducted to identify a potential third project.

The team is also requesting an additional $7,000 to cover major expenses during the Winter Break trip detailed in our proposed budget.

![Image](image_url)

*Photo 1: A conversation between BLUElab India members, Sumitraben, and a Setco representative.*

**Toilets May 2017**

**May 2017 Goals**
We went into the May trip hoping to execute the protocol we had developed for validating our prototype, ensure the proper functioning of the prototype, gauge the condition and usage of the toilet, and reinforce positive relations with our partner family.
Our primary goal was to begin validating the prototype that was finished last June. Our validation protocol consists of 6 tests: user interviews, vector observations, water sampling, durability testing, temperature and humidity sensor installation and data collection, and bin contents measurement.

On this trip, we completed user interviews and vector observations. For water sampling and durability, we carried out baseline measurements to be compared with measurements taken on future trips. For data collection, we planned to install three sensors inside the bins and teach someone at Setco to collect the data, so we can receive and analyze data throughout the year. We also opened the bins and measured the volume of the contents inside, which will be repeated on each trip.

Our other major goal was to make necessary modifications to the toilet. Shortly before our departure, we learned from Viral, one of our key contacts at the Setco Foundation, that there were some issues with the functioning of the prototype. Chatrasinha, a member of the partner family, reported that there were bugs coming out of the husk pipes, toilet pan, and ventilation pipes, as well as a strong odor. He also mentioned that it was difficult to clean the toilet pan since we told the family not to use acidic cleaners that would disrupt the composting process. Lastly, he noted that when they cleaned the floor of the outhouse, the dirty water pooled up underneath the drain pipe and was a nuisance to them. We planned to resolve all of these problems during the trip, and to clarify the process for communicating with the partner family so that it will easier for them to report such issues in the future.

May 2017 Trip Progress
Repairs and Solutions
Our first priority for the Toilets Subteam on the trip was to implement solutions to the problems reported by the partner family. We began by having conversations with the partner family, which confirmed and elaborated on the issues as described above. We also learned more about the family’s use of the toilet: they began using the toilet after the 2016 Winter Break trip, problems with bugs and odor began a month afterward, and they stopped using the toilet around 20 days before our arrival due to these issues.

To remedy these problems, we worked with a contractor affiliated with the Setco Foundation who previously worked on other toilets projects for them. By the end of the trip, all of the repairs below were completed, and the toilet was ready to be used again by the partner family. To monitor the effectiveness of these repairs, we have asked our collaborators at Setco’s Research & Development (R&D) Team, Vidhi and Parth, to check in with the partner family and ask if there are any issues when they visit the prototype to collect sensor data.

Validation
Water Testing
Since the water filter surrounding the bins is a central component of our design, it is important that we evaluate the quality of the water that flows out of this filter and into the surrounding environment. We initially extracted water samples from the ground outside the filter and test them for levels of coliform bacteria. However, we concluded that the water table is too far below ground at this time of year for us to obtain such samples. Soil samples were also considered, but were not informative because uncontaminated soil naturally contains varying levels of coliform bacteria.

The remaining option was to test the community’s water supply. We learned from interviewing community members that the water supplied to Dolatpura is extracted from the ground by a bore well located in front of
Chatrasinhbhai’s house, around 25 feet from the toilet bins. While most literature places this outside the radius affected by the effluent, a few more conservative guidelines place this within the area of concern. We decided to monitor the quality of this water, taking any increase in bacterial levels as evidence of a failure in our design, and the absence of such change as some level of validation.

We contacted a company called Hitech Healthcare Laboratory, and placed an order for a representative to collect water samples to be tested for E. Coli and total coliform levels, both by most probable number. A few weeks after the trip, we received results to these tests, stating that coliform bacteria were present and E. Coli were absent.

Sensor Installation & Data Collection
We installed two Decagon RT-1 temperature probes (one in each bin) and one Decagon GS-1 humidity probe (in the bin which is currently collecting waste), as well as a Decagon Em5b logger which stores the data from all three of these probes. Throughout this process, we were in communication with Vidhi and Parth, our collaborators at Setco R&D. We left them detailed instructions on how to download data from the logger and send it to us, and requested that they carry out this task approximately monthly. Our initial data collection, gathered at the end of the month, shows a temperature of around 88°F (31°C) in both bins.

Bin Contents Measurement
In order to measure the volume of waste collected by the toilet, we arranged for the contractor to open both bins by breaking the concrete slabs over the openings. While it was clear which bin was being used, the contents were minimal, occupying a small area estimated at around 1ft x 2ft. We have found in previous research that we need at least 1m³ of waste for composting to occur.

Durability Testing
During literature review, we found that the durability of a structure can be determined, in part, by the amount it shifts relative to the ground over time. In order to assess the durability of the outhouse structure, we measured the angle of each wall using a level and protractor, and will compare these measurements over time.

User Interviews & Vector Observations
For the results of these tests to be valid, the toilet must be in regular use when the tests are performed. This is because the toilet is likely to attract more vectors while it is in use, and because users are able to report their experiences more accurately while they are regularly using the prototype. Because the toilet was unused for the duration of our trip due to the problems and repairs previously described, we decided to postpone these two tests until the December 2017 trip.

Photo 2: Team members investigate repairs and improvements for the composting toilet.
Stoves May 2017

May 2017 Goals
Following the 2016 Winter Break trip, with the development of the Expansion Plan Roadmap, expansion of the chulha project was driven primarily by the Setco Foundation. The main goal for the Stoves team over the May 2017 trip was to monitor the expansion process of our design. This included asking Sumitraben, our stove-building partner, for feedback on her experience building the stoves within her community, feedback on the design itself, and her level of comfort with traveling to neighboring communities to teach others to build our design. Additionally, we wanted to begin the training process of new stove-builders for expansion. Finally, we gauged the possibility of in-country validation by contacting the Global Alliance for Clean Cookstoves-associated labs in New Delhi.

May 2017 Trip Progress
In order to expand stove technology to a new community, Setco Foundation and BLIP continued to inform people of the dangers of smoke inhalation associated with traditional chulhas, and give them opportunity to learn how to build a safer version of the technology. The Setco Foundation had goals to do both an additional Indoor Air Pollution Educational Presentation and a stove-building training session in Medapur, a community near Dolatpura where we had previously presented our Indoor Air Pollution Educational Presentation over Winter Break. Before setting specific dates, the team wanted to ensure that our stove-building partner, Sumitraben, was comfortable traveling to Medapur from Dolatpura. We had an in-depth discussion in which we confirmed her continuing interest in helping us build and deliver our chulha to more people both within and beyond her community.

Following our discussion with Sumitraben, we moved forward with the Indoor Air Pollution Educational Presentation in Medapur. Organized by the Setco Foundation, a large group of 30 women gathered, not including the various children sitting in their mothers’ laps. The audience paid rapt attention during the presentation. When it ended, we had added an additional 15 names to the list of women who wanted the BLUElab stove built for them and their families. However, besides the two volunteers from the 2016 Winter Break trip, there was no further interest in learning to build our design.

The following week, the Setco Foundation organized a training event for Sumitraben to teach the two interested stove builders in Medapur how to make the BLUElab stove. Despite the lack of interest previously shown for being dedicated stove builders, there were approximately 20 women watching the training session. The benefactor, the woman whose kitchen the stove was being built in, was helping Sumitraben by mixing the mati (mixture of mud, hay, and water) outside. Meanwhile, Sumitraben showed her trainees how she built the stove.

We also collaborated with the Setco Foundation to organize an Indoor Air Pollution Educational presentation in Barola, where we conducted our latest Needs Assessment, in conjunction with our formal introductory presentation. We decided to expand the Stoves project into Barola to address some of the needs we saw, and help maintain and further develop the relationships BLUElab India Project and Setco Foundation initiated throughout the process of the Needs Assessment. The Setco Foundation will be coordinating the majority of the Stoves expansion process in Barola.
Needs Assessment May 2017

Week 1: Engaging with Community

Community Selection
Our team was initially presented with seven communities from which we would have to choose one that we would seek to work with on future projects. These communities were: Alindra, Barola, Taravda, Jetpur, Medapur, Namra, and Katol.

Initial Filtration Process
Out of the seven communities that were initially presented to our team, we visited and conducted unstructured interviews in four communities: Alindra, Barola, Jetpur, and Taravda. These four communities were selected from the initial seven after an initial filtering process. Medapur, Namra, and Katol were eliminated as potential communities prior to visiting the communities. For Medapur and Namra, both communities are located approximately thirty minutes away by car from the Setco office, making it much more inaccessible both to our team and for Setco representatives. Katol was eliminated as a potential option since Setco is already running several projects in the community, since an initial criteria for an ideal community was limited outside involvement or ongoing projects in the community. Finally, there are twelve *faliyas* in Katol, which would make it extremely difficult to conduct a comprehensive Needs Assessment and to develop a technology that would be able to meet the needs of most of the community.

After conducting unstructured interviews in Alindra, Barola, Jetpur, and Taravda, the four communities were evaluated on a Pugh chart based on five criteria: value of children, no other/limited outside NGO presence, non-segmented communities, quality of interaction, no evidence of recent distress in community/safety. The community with the highest score on the chart, Barola, is the community that our team has decided to work with.

Week 2 and 3: Mapping and Structured Interviews

Needs Assessment Data Collection

Structured Interviews
The purpose of the structured interviews with different community members was to better develop an understanding of the different issues that community members face in their day-to-day lives. This process was critical because it provided us the opportunity to ask detailed questions and follow-up questions. A key
component of the interview protocol was the Daily Activity Scheduling during which the interviewee described their daily schedule in detail (see Appendix 8 for interview notes).

**Focus Groups**
A focus group is a division of a large population assembled to participate into similar groups of people in a guided discussion in order to discuss and answer questions about their daily lives which is meant to identify problems that they experience. During the May 2017 needs assessment, we held several focus groups with community members in Barola based solely off of gender. We noticed that these discussions helped us not only reach and interact with a larger part of the community, but also allowed us to obtain information from those that we did not have time to individually interview. Our women’s focus group drew an impressive crowd of over 20 women and almost the same number of kids. Nisha asked some broad questions to get people thinking about their daily habits and the resources in their community. We learned about their frustrations with access to drinking water and health care.

**Community Mapping**
During these focus groups, we conducted a community mapping exercise in order to determine which groups identify similar or different kinds of issues. To properly assess the area of the community as a whole, both groups, men and women, were asked to draw out a map of everything in the community. They were consequently tasked with identifying what places they frequent, how often, on what days, and if they like that place or not. Community mapping not only showed which places are significant to community members, but also made it easier for us to build rapport with multiple community members as quickly as possible. Additionally, through the information we gathered, we were able to create a map of Barola that details where everyone lives (see Appendix 8 for pictures of maps)

**Week 4: Need(s) Selection**
**Needs Filtering**
From the interviews and focus groups, we developed problem statements. A problem statement is a clear, concise description of an undesirable situation that is currently occurring. These were generated in order to create concise lists of the problems that were identified by the community members and by the BLUElab travel team in Barola. A needs statement identifies the underlying change in outcome that is needed in the community to solve the existing problems they face. These statements should not be solution-based, but rather should present the need that any potential solution will strive to ameliorate.

In understanding the constraints of BLUElab India Project, the team cannot tackle all of the needs that were discovered. In order to limit this list down to more feasible projects for the team, a needs filtering protocol was created. The process began with determining which criteria were most important to the India Project while taking the Setco Foundation into consideration and putting a heavy emphasis on the community. The criteria were then separated by weight piecing together which is the most valuable to the least valuable category. Each criterion was assigned a definition from 0 to 5, 0 representing that the need does not share any similarities with the criterion and 5 representing that it embodies it wholeheartedly. The needs were then ranked with each of these categories in mind and the numerical definitions and criteria weight were multiplied and summed together to yield the quantitative value for the need. This process was carried out for every need,
and needs that scored above 150 qualified for the second round of needs filtering, which will be conducted in the United States. The needs filtering occurred during the third week of the trip which gave us enough information to conduct interviews that had a specific scope tailored to those needs.

**2017-2018 Plan**

**Toilets Subteam**
The Toilets Subteam will become the new technology team. This subteam plans to continue validation of the toilet prototype, which will be a multi-year process due to the time required for composting. This validation includes analyzing the sensor data we receive from Setco R&D; re-testing the borewell water, taking durability assessment measurements, and we intend on measuring bin contents each time we return to the community; and completing the User Interviews and Vector Observations on upcoming trips. We also plan to maintain contact with the partner family (Chatrasinhbhai’s family) and continue to address any issues with the prototype that may arise. While there are no current plans for the construction of additional toilets, we plan to learn as much as possible from our existing prototype while ensuring the safety and effectiveness of the toilet we built.

**Stoves Subteam**
The Stoves Subteam plans to continue a robust validation process in collaboration with the Global Alliance for Clean Cookstoves India Institute of Technology lab in New Delhi, determining the minimum and maximum geometric constraints of the design for it to work properly and achieve full combustion. During the trip, members of the community did express changes that they would like to see in those designs which the Stoves Subteam will work towards incorporating in a newer version. The team will continue to act as a resource for Setco as they expand this technology into rural communities that they have adopted.

**New Technology Subteam**
The New Technology Subteam will heavily focus on deriving one need for the team to investigate thoroughly and evaluate all possible solutions. The subteam will work hand-in-hand with the Education Subteam to develop a Village Action Plan. A Village Action Plan describes the best way for our team to co-design a solution to the need. The team has also filtered down to four needs since the May trip:

- A need to decrease the time and effort required to obtain drinking water for residents of Barola year-round
- A need to reduce the time and effort required to transport water to storage for residents of Barola
- A need to reduce the amount of water and time required for residents of Barola to do laundry
- Need to reduce the difficulty (skin irritation, extremely tall crop) associated with harvesting millet for farmers in the Barola area

**Team Skill Gaps/Plans to Fix**

BLUELab India Project (BLIP) is a fantastic team that strives to produce the best results possible for the communities with whom we work. Although this is true, our project does have a few skill gaps which we are actively working to fill. The first is that we lack members with a financial and marketing background. We
have the Business Subteam which does excellent work ensuring that our finances are in order, reaching out and applying to more funding sources, and increasing our public exposure. However, we have identified that we need to increase the size of this team by recruiting both business and industrial engineering students who have great business acumen and can help to steer the team to a more sustainable financial model. We also have identified that we are in need of strong students on our Education Subteam. This team works to create a full understanding of the Indian culture and the people with whom we work in Gujarat, India. Those members ensure that the rest of BLIP stay human-centered in our design approach, constantly taking into account the needs, lifestyle, and culture of the Indian residents. We would like to also recruit and pursue strong talent to grow this team and strengthen it.

Team Progress Timelines

**Summer Timeline**

June: Meetings with Setco, Team-wide online call for May Trip Debrief  
July: May Travelers Draft up Trip Report  
August: Trip Report Distributed to Team and Literature Review Begins  

We have formed a timeline for our team moving forward since the completion of our May trip to India. During this past summer from June 2017-August 2017 we have moved our work forward in a various ways. First, we have monthly meetings with our NGO partner: Setco Foundation. This has been done in order to ensure adequate communication and collaboration between both BLUELab India Project (BLIP) and the foundation for the future technology project. We have prepared material for the community as well to ensure our presence with Anganwadi (community center) workers and the local government. Furthermore, a comprehensive trip report was created in order to document the work done during the May trip to maintain notes and observations of the needs assessment conducted. The last and very important event of the summer has been a literature review performed in order to narrow down our list of 9 community needs to finally choosing 1 need. This literature review was performed by the team co-leads, those who travelled in May, and the other New Tech Subteam lead who did not travel. We have now reached a comprehensive list of four needs but require general members input to truly decide the one.

**Fall Semester Timeline**

September: New Member Recruitment, New Need Discussion, Stove Iteration Process, Design Modules  
October: New Need Identified, Stove Iteration continues, Village Action Plan  
November: Design Discussions and Prototyping, Stove Validation  
December: Winter Trip Prepping and Actual Trip  

From our summer progress, we will move into our fall semester timeline. September will begin with recruiting new team members to join the team. Once the two weeks of recruitment ends, the first new team wide meeting will focus on new members understanding the team’s mission and our two projects: Stoves and New Technology. From there members will get the chance to choose which team sparks their interest most. The stove team will go over community feedback and begin making iterations to the current design. The New
Technology team will have a discussion on what new need should be tackled. By the following week, new technology team members will vote on which need they feel should be addressed based on prior’s meeting discussion and data. Then during the first week of October, the new need will be identified. This is when the process of researching and brainstorming will begin to start forming a technology solution to the problem. In November, design discussions will occur but emphasize prototyping with the partner family or community. During this time we will be developing a village action plan to determine who in Barola we should work with. Lastly, during December, selected travelers will go to India to build the improved stove and also find a partner family to start designing a solution to the need identified. In total, our next big expenditures consist of our winter trip which will entail partner finding, prototyping, and validation.

Success Benchmarks

**Stoves Iteration and Validation**

We have created benchmarks to evaluate the success of our winter trip project. During September and October, we will share the design process with all of the new members and work on stove iterations based on feedback from the community of users. Then, in November we will validate the current design through testing in a lab similar to the one in Delhi and continue expansion into Medapur and Jetpur community. During the month of December, we will determine the plan to implement the new stoves iteration.

**New Technology**

We have created success benchmarks for the new technology, which will be chosen after needs filtering once consensus among team members has been reached. We first will debrief the team on the four needs we currently have and discuss the pros and cons of each need. The project co-leads will then discuss which need will be chosen based on the members’ inputs and also the research conducted from the literature review.

**Education**

Develop a module to inform members on the gate design process through an interactive medium during the month of September. Work with new technology to develop a Village Action Plan that determines the best course of action to determine a partner family or families during October and November. Inform general members on key individuals in Barola through a community spotlight to educate Winter 2017 travelers.
Team Budgets

We are requesting $7,000 of additional funding from DOW. Below are our team budgets detailing how we plan to spend team money.

### Dow Budget

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**TOTAL STUDENT EXPENSES**

| $ 2,692.70 | $ 7,938.10 |

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**TOTAL BUDGET**

$7,163.10

**TOTAL Dow REQUEST**

$7,000.00
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