Service learning as a catalyst for sustainable change in Ecuador

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Abstract

The student chapter of Engineers Without Borders at Tufts University allows students the opportunity of service learning while exploring sustainable solutions to real world problems. Interdisciplinary teams research potential technologies and propose implementation strategies, conduct laboratory research at the university on performance trade-offs, and then gain field experience by traveling to the target community to develop personal relationships which support sustainable social change. One such investigation has focused on water quality in the highlands of northern Ecuador with student teams responsible for evaluating local conditions, providing education to local stakeholders, and assessing the impact of the project on both the community and the team members involved in the project. Communication of survey results helped the village to identify municipal project priorities that would unify the community. This social process, initiated by the student visit, resulted in successful attainment of a grant to construct a water filtration facility for the community based on the water quality sampling test results and on a pilot-scale technology demonstration of slow sand filtration.

Introduction

The Tufts University chapter of Engineers-Without-Borders (EWB)[1-3] was founded with two primary goals: to develop sustainable engineering projects in communities and to cultivate the skills of group members to be more effective active citizens. The interdisciplinary group is comprised of undergraduate students from across the university who perform engineering investigations. Within the School of Engineering, the chapter encourages service learning as not only a compliment to traditional education, but as an integrated part of the curriculum.[2-3] Technical guidance is provided by graduate students, alumni, and faculty. One investigation has focused on water quality in the highlands of northern Ecuador.

The Ecuador project exemplifies the chapter's need for an interdisciplinary team. Group members found that when dealing with real world situations, the problems cannot be reduced to mathematical equations; instead, they have to incorporate all political and cultural circumstances in their decision-making process. With this appreciation for all aspects of development, the group was able to work on a service learning project that shows evidence of sustainable change.

Background and Project Description

A supportive non-governmental organization (NGO) is invaluable in identifying local needs and placement as well as facilitating communication with the remote region. In August 2006 a team of five students and a professor traveled to the highlands of northern Ecuador to work with Fundación Brethren y Unida (FBU), an Ecuadorian NGO. Working with the local NGO, the group was able to explore the applicability of green technologies in rural environments. Using the NGO's farm, the Hacienda Picalqui, as a base, the students constructed a bio-gas unit converting animal excrement to methanol gas which can be used to fuel a stove. FBU put the group in contact with a local community in need. The students traveled by bus to visit the community of El Cristal to meet local leaders and get a feel for some of the problems faced by people living in rural Ecuador. The August 2006 trip resulted in identification of a target community where initial meetings indicated an interest in community health issues surrounding the town's potable water supply.

The following academic year was spent in preparation for a return visit. Students researched rainwater collection, storage, and filtration systems to prepare for implementation at the Hacienda. The filtration group researched various designs to handle the constraints of an individual system where the water is filtered on a batch-by-batch basis. After researching the trade-offs of desalinization units, biosand filters, and ceramic filters, the group decided to focus on biosand filters. In comparison, this unit was the most suitable because of its serviceability during Ecuador's rainy and dry seasons and the availability of its materials in remote regions. Designs were based on filters previously implemented in developing countries.[4-5] To better understand the methodology, three full-size batch filters were built and monitored on campus. By maintaining the filters, students learned operation techniques and water quality testing procedures.

Among the students researching and testing on campus, a traveling group was chosen for their different specialties ranging from community health to water quality. Fluency in Spanish was to be critical to our ability to communicate effectively with the community during the health survey process. The travel team of six students returned to Ecuador in August 2007 with a professor.

At the Hacienda, a biosand demonstration unit and educational materials were set up. Utilizing the knowledge of water collection and storage, the team designed a back-up storage system to be used as a contingency water supply when the domestic water supply is interrupted.

At El Cristal, students familiarized themselves with the region. The main plaza of the village lies on the crest of a mountain and the community extends over several adjacent ridgelines. As a result of the extensive layout of the town, there are four main water systems serving the one-hundred and thirty families of El Cristal. Only one of the water systems has a trained operator that performs regular maintenance tasks on the holding tanks. The other systems are managed by inexperienced villagers. To better understand the terrain, students explored and used GPS to map the key locations. Local guides led students to the water sources and the holding tanks where students performed preliminary water quality testing. Coliform was found in all tanks of the four water systems. In three of these systems E. coli was also present. These findings validate the use of boiling as a treatment alternative. Unfortunately, only a few families practiced this labor intensive process and many of the children drank directly from the tap when their parents were not looking.

In order to assess the priorities of the community, students drafted surveys that were vetted using the Institutional Review Board (IRB) review process. These surveys were used to gauge local perspectives regarding economics, communication, water quality and health. Health questions concentrated on the issues of illnesses, diet, and hygiene. Other than providing insight into the community's way of life, these surveys establish metrics through which the group can monitor success. Early assessment interviews provide a benchmark to which post filter investigations are to be compared.

The responses of individuals helped identify five major collective goals. They were: creation of a community center, improving public education, construction of public bathrooms, improving water quality, and providing wastewater treatment. When presented with these potential projects at the final community meeting, the village leaders led a discussion on the potential role for EWB in working with the community. As part of this meeting, students provided examples of typical results from the water quality testing. Community members learned about the principles of water testing and the detrimental effects of bacteria on the body. During this time they also examined charts compiled from health data showing the most prevalent maladies and the percentage of people experiencing them. As a community they formulated connections between the water quality and health conditions and recognized a potential to collaborate with EWB to investigate community alternatives. The outcome of this assessment, as identified by the community, was the idea of initiating a future project regarding water filtration.

As a first step, the student team replicated the design of the Hacienda demonstration unit with materials taken from the local environment in order to produce a working biosand filtration unit. One of the community leaders volunteered to pilot the project. He and his family participated in the preparation of the materials and the construction of the filter. As a liaison to FBU, he arranged for a representative to film the construction. Students provided a commentary in English and Spanish explaining the function of each component and the maintenance procedures. FBU planned to use the video to show leaders from other communities the feasibility for application of this technology in rural Ecuador.

After returning to the United States the EWB group analyzed the layout of the water systems, assessed the water testing data and evaluated the advantages and disadvantages of implementing a community filter or multiple individual units. At the same time, armed with the preliminary water quality test results and inspired by the success of the biosand filter, the community applied to the regional government for funding to build a slow-sand filter for the main water system that serves over seventy families.

A group of three students traveled to Ecuador in January 2008 to perform additional testing to quantify seasonal variation in water quality. When students arrived they learned that the pilot biosand filter was still operational. Residents report that although there was an initial change in taste, the filter has become a part of the family's morning routine and all water intended for drinking passes through it. The students also learned about the successful grant application and inspected the slow-sand filter under construction. With two other principal water systems without filtration, each serving nearly thirty families, the students focused the water testing on the sources, holding tanks and house taps of these systems with the hope of providing enough data for the community to apply for more funds from the municipal government.

Student reflections

The following is a reflection from Daniel McGee (Civil engineering, Tufts '07)

> "I think that we successfully taught a community to fish instead of just feeding them a meal. By showing them the problems with their water and by offering solutions, we allowed them to take ownership of the project and therefore take ownership of a solution. In that sense, I think that the project is sustainable, because the solution will continue without an EWB presence.
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> There is always more to sustainability than just technology. That's the point of sustainability. Technology, culture, and economics are all included in something being sustainable. In order for a project, a house, an idea to be sustainable, people need to adopt it with all of the attached conditions that go along with it. [Questions, such as] is it culturally acceptable, is it economically accessible, is the technology readily accessible all have to be taken into account."

The following is a reflection from Nicole Lane (Community Health, Tufts '09)

> "Discussion with individuals allowed our group to get a better understanding of community issues and therefore enabled us to have a more productive community meeting. Introducing the idea of a household sand filter sparked enough interest in the community for them to want to take matters into their own hands and build a community filter. This is especially important, because in the past, the community has had problems uniting behind a project, but our partnership with them fostered a sense of unity within the community."

The following is a reflection from Jennifer Crawford (Physics, Tufts '07) Ecuador group leader

> "There is absolutely more to sustainability than just technology; in fact a successful technology that doesn't break plays a minor role. For a project to be sustainable, the maintenance regiment

> has to be understandable, trouble-shooting must be manageable, materials must be readily available so that it is reproducible, etc. Even further removed from the technology, however, is acceptance. This can often be the hardest but most necessary part of sustainability. A community could reject a project because it doesn't fit in with their daily schedules;… it wasn't helping them. In other instances, a community might stop using a sand filter because a layer of grime (the schmutzdecke) forms and makes it look dirty; who would drink that? Also, a community scale system won't ever work unless it is supported politically within the community; there needs to be some sort of organization within the community to support it."

Discussion

A sustainable project is achieved by empowering people to make informed decisions. Technology alone is not sustainable. The process necessary to develop a sustainable endeavor was realized in the Ecuador project. In the preliminary stages, the mission was exclusively technical. Students researched components of green building and acquired practical experience through service learning. As the project progressed and the relationship with the community evolved the necessity of education became apparent. The explanation of how the filter operates is ineffectual if the person does not recognize the need for it in the first place. Through informative plaques, community meetings, individual conversations, and the FBU video, the group spread awareness about what bacteria is, the importance of boiling water, and how a filter functions. Through this education, people became invested. In the case of the Ecuador project, community leaders became advocates of the mission when they realized that a better quality of life was attainable. At this point, the relationship between the community and the group changed. Community leaders proactively applied for funds and students accepted the supportive role of performing water quality testing to facilitate in acquiring more grants.

Acceptance of a technology is dependent not only on the support of the leaders but of the entire community. As explained above, the geography is part of the reason that there are many divisions in priorities and interest. Having to choose one of two systems with equally poor water quality would have created political and social divides in the community. Uniting the village behind a common objective and allowing them to formulate an acceptable plan made the project possible. In recent years the community had solicited funds for other projects that were not realized because differences in priorities directed the finances to other issues. Also, village leaders complained that other groups "had come in before to test our water for some study, but the results never got back to us." Being involved from beginning to end, the villagers felt confident in trusting what they had learned as part of the community education meetings. The presence of our group and the promise of our return created a sense of obligation. This commitment compelled the community to take action. Thus, by educating and promoting ideas, our group was a catalyst for their achievement. The development and successful execution of an idea is contingent on a driving force to initiate it and a unified society to support it.

Our commitment was established through forming relationships with community members. Collaboration is built on trust, which is developed through personal connections. Students engaged in conversations in the plaza, visited the schools, discovered local agricultural techniques while washing clothes, and learned card games after dinner. Even students with little or no knowledge of Spanish fostered ways of communicating with their host families. Through these simple interactions the mutual confidence and respect necessary for accomplishing larger initiatives formed. In addition to developing a relationship with the community, the trip also provides the travelers with an opportunity of self-cultivation. New environments and unpredictable difficulties pose real world challenges to the students.

Conclusions

1. Sustainability is more than a technical implementation; it is a social process to change the perspective of a community through education and collaboration. This process is achieved by creating a partnership with the community and establishing trust.
2. The involvement of all community members in this social process is essential to having a unified goal and successful project. Although village leaders are invaluable resources, all community members need to be involved in the education and decision making.
3. Student groups can accomplish sustainable service learning projects. This achievement is conditional on the ability to communicate directly to individuals within the village. Overcoming language barriers, illiteracy, and cultural barriers to education is the basis of a sustainable project.
4. Conducting assessment surveys allows the group to benchmark and subsequently monitor the impact of the project on the community; maintaining relationship assures sustainability.

The success of the Ecuador project has reinforced several aspects of sustainability to our chapter of EWB. A well-built technology is not enough to make a project sustainable because sustainability is based on a social change. In this way, engineering investigations are reliant on interdisciplinary teams to implement projects that impart positive impact.

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