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From Glassboro to The Gambia– A Collaborative Work with the University of the Gambia and a Winter Trip to the Gambia Villages

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Abstract

The Gambia is a small country located at the tip of West Africa. A team of Rowan University students has been working with the local people of the Gambia on various projects. In the fall of 2011, the Rowan team collaborated with a team from the University of the Gambia on three projects:

1) Develop an easy-to-follow technology to make fuel briquettes from peanut shells and to substitute firewood;
2) Survey local water supplies for a group of 8 villages in a remote area of the Gambia;
3) Inspect an important road connecting the villages to the outer world.

In January 2012, the two teams met and went together to the 8 villages in rural Gambia. They interviewed the villagers, promoted the briquette making technologies, and provided recommendations to improve the maintenance of water wells and roads.

1 Introduction

The Gambia is a small country at the tip of West Africa. It spreads along the Gambia River and cut through a large section of the Senegal. Centuries of slave trading and colonial control left the country underdeveloped economically. Since its independence on 1965, the country had witnessed several military coups and the union with and separation from Senegal. Today, the Gambia is still one of the poorest countries in the world.

Figure 1: (Left) Location of the Gambia. (Right) Location of the villages.

Starting from 2009, the student chapter of Engineering Without Borders (EWB) in Rowan University started to target a small area of the Gambia for their aid effort. It is a group of eight villages located at the Niamina East, about 300km east from the capital city, Banjul. The area is also considered as remote and under-developed even to the standard of the Gambia. The population of the villages is about 1000. Although many of them are related through marriage, they belong to two different tribes, Fula and Wolof. English is the official language of the country, but except for a few who had several years of education, most residents in these villages can only speak their own languages: Fula, Wolof, or Mandinka.

Late 2011, the Rowan EWB team established contact with a group of faculty and students from the University of the Gambia. There were 6 students in the Gambia team, 3 in Physics major and 3 in Education major. Although not in Engineering major, they were well educated and technically strong enough to discuss engineering solutions proposed by the Rowan EWB team.

At January 2012, the Rowan EWB team flew to the Banju, met with the Gambia team. Then the combined team conducted an assessment trip to the villages. During the trip, the team tried to help the villagers preserve forest by using peanut shell as cooking fuel, assess their need of fresh water, and evaluate the road conditions.

Through this trip, the teams achieved the planned goal to help the people in need by using their engineering background. Meanwhile, they also learned a lot:

1. Engineering truly can affect people's lives even in a remote region.
2. The best technology is not necessary the state-of-art technology, but the one suitable for the settings and meet the needs.
3. The engineering solution is subject to the working constraints, especially the local infrastructure.
4. Available budget is often the top priority to make or break a project, especially an engineering project.
5. To make a project successful in a foreign country, it is important to obtain help and support from local people.
6. Even a partially fulfilled project goal can be a success.

2 Cooking Fuel

A relatively peaceful life in the past decades brought rapid growth of the population (372 thousands in 1960 to 1.77 million in 2011[1]) in the Gambia. However, as in many parts of the developing world, most Gambia people cannot afford the gas or electricity. They have to rely on trees and firewood for their cooking needs (Figure 2A). The practice leads to a significant deforestation at about 6% per year, which makes the continued use of wood as a cooking fuel unattractive and unsustainable [2]. The villages we visited were built in the forest. However, the forest is retreated so far away that the residents have to travel half an hour to collect firewood today (Figure 2B).

One major cash crop of the Gambia is peanut. It counts up to 6.9% of the country's gross domestic product [3]. While peanut products are exported, the peanut shells are left in the country as an agricultural waste. The peanut shells are available in great quantity in many areas of the Gambia. During our visit, we visited a dumping site where tons of peanut shells were left there useless (Figure 2C).

(A) (B) (C)

Figure 2: (A) The firewood is the main cooking fuel for the Gambia people. (B) In the past 10 years, the forest has retreated from right next door to about half hour walking distance from the villages where we visited. (C) Tons of discarded peanut shells are piled along the road.

While working on a school project on sustainable energy, a student concerning the environment change envisioned an idea to partially solve the problem by turning the peanut shells into cooking fuel. The main concept is to crush and press the loose peanut shells to more compact and dense briquettes.

After numerous improvements, the Rowan team settled to a process of preparing the peanut shells and a device (i.e. two used tin cans) to press the shells to briquettes without any special binding material. They tested usability (Figure 3A), durability, calorific value, and other characters of the briquettes, which were all satisfactory.

A detailed instruction was then developed and passed to the Gambia team. The Gambia team followed the instructions and tested the technology (Figure 3B&C). With this inspiration, they also started to explore the possibility of using other agricultural wastes such as corncobs, dry grass, sawdust, and their other combinations.

During the trip, the team visited each village and interviewed the residents about the impact of deforestation on their life. Many villagers complained about the longer time to collect firewood today comparing to the past. Some of them were also thinking about the way to limit the use of the firewood. However, limited by the knowledge and skill, they could not find a way out of the dilemma.

(A) (B) (C)

Figure 3: (A) A typical three stone stove. (B) Students from the University of the Gambian learned to use two used tin cans to make peanut shell fuel briquette. (C) A peanut shell briquette was tested by the local people.

When the team demonstrated the technology of converting the peanut shells to fuel briquettes, almost all the villagers were excited. The tool needed was simple and easy to obtain. The process was straightforward. The burning was much better than loose grass or corncobs. Although still cannot substitute firewood completely, the briquette will reduce the need of firewood significantly. Besides slowing down the rate of deforestation, the practice will free up a great amount of time of women and children, who were in charge of collecting firewood, to do more productive work or to attend school.

While developing the technology, the students have various devices such as home-made wood press, car-jack modified press and step-on press. Then they experimented on lowering the pressing pressure until they found that contrary to industrial practice, the force is not the critical factor in manual briquette making. Proper preparation of the shells is the key. Although the final result was surprisingly simple, to reach this result is not. The students also learned that by changing the approach to a problem may help them find a more elegant and simpler solution.

3 Water Problem

Although only 300km east of coast and merely 3~10km away from the Gambia River, the water supply is a daunting challenge to the villages. Traditionally, the local people used open wells (Figure 4A) for their drinking and irrigation needs. However, the open wells were chronically polluted by leaves, dirt, and excreta from the domestic and wild animals. Meanwhile, the water of some shallow wells was getting bitter and salty in the recent years. Although not proved, we suspect the reason is the combined effect of raising sea level, disappearing mangrove swamp along the coast, shrinking forest inland, and the flat geography of the country.

(A) (B) (C)

Figure 4: Three different types of wells used by the villagers. (A) An open well. (B) A deep well with a hand pump. (C) A well with a solar powered pump.

More recently, some aid groups had helped to install deep wells with either hand pumps or solar powered pumps. For example, West African Village & Environment (WAVE) Project drilled four deep wells (up to 75m) with hand pumps (Figure 4B) for four villages. The goal was to help each village start a vegetable garden so they can save the precious cash of buying vegetables from the market. Meanwhile, the Gambia Horse and Donkey Trust also helped three villages and installed several solar powered pumps (Figure 4C).

The sealed deep wells provide clean and sweet water. However, they could only meet partial water needs of the villages. Moreover, some of the components installed were inexpensive and not suitable for the hot, humid and dusty environment of the region. For example, as seen in Figure 5A, the submersible water pumps were small and could only generate a flow of 10L per minute, which is far from adequate for even the drinking needs of the villagers. At the same time, the villagers did not know that they should keep the solar panel clean and clear from the sand dust (Figure 5B), which might hamper the energy efficiency.

(A) (B) (C) (D)

Figure 5: Key components of a solar pump. (A) Submersible electric pump. (B) Dusty solar panel. (C) DC-AC inverter used in the village. (D) An industrial type DC-AC inverter used in a more advanced farm.

Likewise, the inverters used were designed for light and non-continuous uses in a car (Figure 5C), not the heavy duty one as seen in a more advanced farm at the coastal area of the country (Figure 5D). The inverters broke down frequently and the cost to repair or replace them was a heavy burden to the villagers.

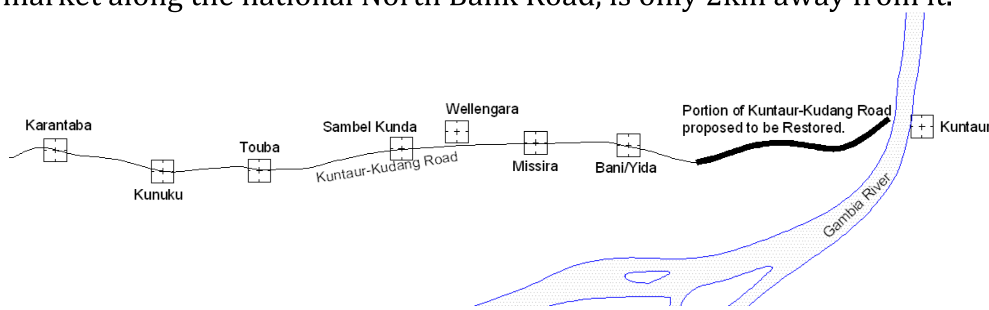
The under-build of the pump, overuse of the well, and the sub-optimal maintenance brought frustration and sometime misunderstanding. In our interview, the villagers sometime expressed their anger toward some aid groups and technicians who they thought had cheated both the donors and the villagers.

The student team conducted a thorough survey of the health of each well. Although they could not help the villagers immediately by drilling more wells, they provided a list of advices. First, they explained to the villagers the importance of maintenance and proposed a service plan to keep the machines running smoothly. Second, the team recommended several self-helping routes such as building protective covers for the open wells and dig ditches for irrigation purpose. Third, the team evaluated the needs of the villages and compiled a priority list for the potential donors.

It was often tricky for the outside people to give advice, especially when it asked them to make changes themselves. However, it was not a problem for their peer countrymen speaking the same language. The college students of the University of the Gambia were considered the future leaders of the country. The suggestions from them were more acceptable and helped the villagers evaluate their own effort more on the external aid. It was even more helpful when the faculty advisor of the Gambia team shared the experience of his very profitable orchard.

4 Road Assessment

The targeted villages are connected together by an 18km-long dirt road (Figure 6B). We called the road Kuntaur-Kudang road (Figure 6A), named after the two larger towns on the east and west ends of the road. The stretch from Bani/Yida, the east-most villages, to Karantaba, the west-most village, is about 5km. Walk 10km from Karantaba, people can go to Kudang, a small town along South Bank Road, a partially paved national road. From there, they can catch a bus to market, hospital, or even all the way to the capital. A more convenient option for the villagers at the east end is to go further east, then take a ferry (Figure 6C) to the small town Kuntaur crossing the Gambia River. There is a small hospital in the town. The weekly Lumo, or the open market along the national North Bank Road, is only 2km away from it.



(A)

(B) (C) (D)

Figure 6: The 8 villages are connected to the outside with a dirt road and a ferry. (A) Locations of the 8 villages. (B) The dirt road leads to the west. (C) The ferry to Kuntaur. (D) The restored dirt road to east.

In the rainy seasons, the dirt road was generally muddy and slippery. It became an endurance test to travel west. To east, the part marked black in Figure 6A was always deeply flooded (sometime as high as 1 meter) in the season. Large wild animals such as hippopotamus often left large potholes on the road and made it un-passible even with a donkey cart.

About two years ago, the Horse and Donkey trust raised some fund and helped restore the dirt road to reach the river (Figure 6D). However, to save cost, the road was not built to last. Rutting and cracking were rampant. We estimated that the road would degrade or destruct in another two to three years without further action.

Again, some level of misunderstanding between the villagers and the aid group was surfaced during our interview. The limited funding made it hard to pave the road or build it up to the engineering standard. Although the villagers never expressed their disappointment directly to the aid group, they expressed their frustration when they saw their fellow citizens from the capital area.

With sympathy to the villagers and understanding to the aid group, the team tried to help the villagers extend the life of the road themselves. The students with civil engineering background taught the villagers how to use grass, dirt and gravel to fill a pothole. They also recommended the engineering standard should the road would be rebuilt in the future when the aid group finishes another round of fund raising.

5 Summary

Figure 7: (A) People from different background were relaxing together with the hosting family. (B) Evaluating the conditions of a solar water pump.

The trip was a success to the students of both the Rowan University and the University of Gambia. For most of the US students, it was the first time for them to venture outside the country, not to say a remote site without paved road, electricity, running water, and other modern amenities. Some Gambia students also had never been to the countryside. They all learned to communicate and work with people from different culture, speaking different languages, and observing different religions. They also learned to use their basic skills to solve real problems. For example, when the villagers brought up the problem of a broken solar pump, everyone was required to brainstorm and troubleshoot since no one had prior experience on it (Figure 7). With some help from the professors, the faulty inverter was identified, and a replacement recommendation was proposed to the villagers.

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