

A SUSTAINABLE SOLUTION TO THE MOZAMBIQUE WATER CRISIS

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THE PROBLEM

LAST SUMMER, A STUDY ABROAD GROUP FROM THE UNIVERSITY OF ARKANSAS TRAVELED TO NAMPULA, MOZAMBIQUE TO ASSIST IN LOCAL AGRICULTURAL AND DRINKING WATER PROJECTS. THE STUDENTS WERE ABLE TO SEE FIRSTHAND THE DEVASTATION THAT THE LACK OF CLEAN DRINKING WATER IN A DEVELOPING WORLD CAUSES. UNSANITARY WATER CONTRIBUTES TO MULTIPLE DISEASES AND DEATHS EVERY YEAR, ESPECIALLY IN CHILDREN. OUR SENIOR DESIGN TEAM FELT PASSIONATE ABOUT FINDING A SOLUTION TO THE WATER PROBLEM THIS VILLAGE FACES. FIGURE 1 BELOW SHOWS OUR CLIENTE'S CURRENT WATER SOURCE. OVER 300 PEOPLE USE THIS HAND DUG WELL AS THEIR SOURCE OF WATER.



FIGURE 1

THE PROJECT

DECIDING THE DIRECTION TO GO FOR OUR PROJECT REQUIRED A LOT OF TRIAL AND ERROR. WE KNEW THAT OUR SYSTEM HAD TO BE INEXPENSIVE, EFFECTIVE, SUSTAINABLE, AND EASY TO USE. WE CONSIDERED UV FILTRATION, SAND FILTRATION, CARBON FILTERS, AND CERAMIC FILTERS. AFTER COMPARING ALTERNATIVES, WE DECIDED TO FOCUS ON CERAMIC FILTERS. USING CERAMICS FOR POTTERY IS VERY COMMON IN NAMPULA, SO WE KNEW THEY WOULD HAVE ACCESS TO HELPFUL RESOURCES AND EXPERIENCE.

THE DESIGN

OUR DESIGN CONSISTED OF A 5 GALLON TOP "DIRTY WATER" BUCKET WHICH SAT ON TOP OF ANOTHER 5 GALLON BOTTOM "COLLECTOR" BUCKET. TWO MATCHING HOLES WERE CUT IN THE BOTTOM OF THE TOP BUCKET AND THE LID OF THE BOTTOM BUCKET. FOR OUR FIRST TRIALS, WE MADE THE FILTERS WITH COMMON RED CLAY AND GROUND CASSAVA ROOT BECAUSE CASSAVA IS A READILY AVAILABLE MATERIAL IN THE AREA. THE FILTER SITS IN THE TOP BUCKET AND ALLOWS WATER TO FILTER THROUGH ITS PORES AND THEN THROUGH THE HOLES. THIS DESIGN CAN BE SEEN IN FIGURE 2 TO THE RIGHT. THE CERAMIC FILTERS WERE FORMED WITH 1.5 KG OF WET CLAY MIXED WITH 50 GRAMS OF CASSAVA ROOT AND FORMED INTO THE BOTTOM OF THE TOP BUCKET. THE HOLE IN THE BUCKET FORMS A NOTCH IN THE FILTER WHICH HELPS TO HOLD IT IN PLACE AND REDUCE THE SEEPAGE OF DIRTY WATER AROUND THE FILTER. THE DESIGN OF THE PLATE CAN BE SEEN IN FIGURES 3 AND 4.

THE FILTERS WERE THEN FIRED IN A KILN, WHICH BURNS UP THE COMBUSTIBLE MATERIAL AND LEAVES TINY PORES IN THE CLAY THAT BLOCK BACTERIA AND PROTOZOA FROM MOVING THROUGH WITH THE WATER. WE ATTEMPTED TWO DIFFERENT KILNS, A PIT KILN (FIGURES 5 AND 6) AND A BARREL KILN (FIGURE 7). OUR CLIENT REQUESTED A BARREL KILN BECAUSE IT CAN BE MOVED AROUND, BUT PIT KILNS CAN BE DUG ANYWHERE.



FIGURE 2 (LEFT), FIGURE 3 (TOP RIGHT), FIGURE 4 (BOTTOM RIGHT)

ADVANTAGES OF CERAMIC FILTERS

- REDUCTION OF BACTERIA
- REDUCTION OF PROTOZOA
- REDUCTION OF DIARRHEAL DISEASE IN USERS
- EASY TO MAKE AND USE
- SIMPLE DESIGN
- LONG LIFE
- EASILY REPRODUCABLE
- LOW COST



FIGURES 5 AND 6



FIGURE 7

THE OUTCOME

AFTER MUCH TRIAL AND ERROR, WE FOUND THAT CASSAVA FLOUR WAS UNSUITABLE TO USE IN CERAMIC FILTERS DUE TO A REACTION CALLED "STARCH GELETANIZATION" WHICH MEANS THAT WHEN HEAT WAS APPLIED IN THE FIRING STAGE, THE MOLECULES IN THE CASSAVA ABSORBED ALL OF THE MOISTURE AND SWELLED, CAUSING THE FILTERS TO BREAK. SAWDUST OR GROUND RICE HUSKS CAN BE USED EFFECTIVELY IN THESE FILTERS INSTEAD. THIS PRESENTED A PROBLEM FOR OUR PARTICULAR PROJECT, AS SAWDUST AND GROUND RICE HUSKS AREN'T AS READILY AVAILABLE IN NAMPULA. OUR DESIGN COULD BE VERY EFFECTIVE IN MANY LOCATIONS, BUT WE DECIDED THAT THIS WASN'T THE MOST PLAUSIBLE DESIGN TO SEND OVER AND IMPLEMENT IN NAMPULA.

WE TESTED THE EFFECTIVENESS OF CERAMIC FILTERS MADE WITH SAWDUST. THEY PROVED TO HAVE SIGNIFICANT EFFECTS ON THE QUALITY OF WATER.

ATP IN WATER		
BEFORE FILTER	AFTER FILTER	PERCENT IMPROVMENT
6836	908	87%
6915	1275	82%

SUSTAINABILITY

ONE OF THE MOST IMPORTANT ASPECTS OF OUR PROJECT WAS SUSTAINABILITY. OUR DESIGN PROVED TO BE ADEQUATE IN THIS AREA. IT REQUIRES ONLY 2 BUCKETS AND A 55 GALLON METAL DRUM FOR THE BARREL KILN. THE REST OF THE MATERIALS ARE CLAY, GROUND RICE HUSKS OR SAWDUST, WOOD, AND COAL. THE DESIGN DOESN'T REQUIRE ENERGY OR WASTEFUL MATERIALS. BECAUSE OF THEIR ENVIRONMENTAL ADVANTAGES, EASE OF USE, AND EFFECTIVENESS, CERAMIC FILTERS ARE A BENEFICIAL OPTION FOR A DRINKING WATER FILTRATION SYSTEM.