1. Introduction
   • Problem: Small scale farmers in Uganda must travel distances to retrieve water for irrigation, often resorting to diesel pumps for irrigation.
   • Objective: Create an affordable dual powered irrigation system capable of moving across rugged terrain for use by small scale farmers in Uganda.

2. Background and Constraints
   • Surface Water readily available
   • Rugged terrain
   • Pump 50m from the water source with elevation change
   • Store up to 20 gallons of water
   • Limit cost to $600-$700
   • Weight not to exceed 100 kg for mobility

3. Alternative Solutions

4. Engineering Tools and Management Principles
   • Re-use of last year’s pump (2.1 gpm, 12V, 60 Psi)
   • Battery Size determined by pump amp draw

5. Final Design
   • 2.5 x 2.5 ft Wooden Frame, Angle Iron Post, 18 AH battery, 50W Solar Panel and charge controller, Toyota Alternator, Bike Wheel Pulley System, and Pivot Steering, Jerry cans
   • RESULTS
     • Averaged 3:32 to fill 5 gallon bucket up elevation of 7 feet
     • 1.4 gpm
     • 10 mph wind begins power generation 0.1 Volts
     • 20 mph gusts produces 0.65 Volts

6. Economic Analysis
   • Estimated Time of Assembly: 6-10 hours
   • Over $200 saved by downsizing tank and battery
   • Re-use of materials (pump, angle iron, blades, hose, bike wheel)

7. Impact & Sustainability
   • System 100% sustainable renewable energy
   • Right now can assist small scale farmers in Uganda
   • Future improvements on current design could cause wide implementation
   • Low cost of materials limit the sustainability of system, with parts needing to be replaced

8. Assessments and Recommendations
   • Improvement in Wind Turbine design and durability
   • Ability to set angle panel to receive most sunlight
   • Pump specifically for drawing water
   • Longer handle for better mobility uphill