PURDUE UNIVERSITY

CAPSTONE/SENIOR DESIGN EXPERIENCE 2018

Title: Dual Powered Irrigation System

Agricultural & Biological ENGINEERING

Carter Keirn (Agricultural Systems Management) Seth Farmer (Environmental and Natural Resources Engineering)

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

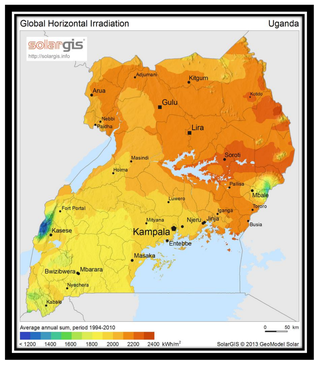
- Surface Water readily available
- Rugged terrain
- Pump 50m from the water source with elevation change
- Store up to 20 gallons of water
- Limit cost to $600-$700
- Weight not to exceed 100 kg for mobility

3. Alternative Solutions

Design Piece Considerations	Cost	Mobility/Storage	Material	Weight
Steel Generator Frame	X	✓	X	✓
Plastic Wind Turbine	X	X	X	✓
Cloth Turbine	✓	✓	✓	✓
Car Alternator Turbine	✓	✓	N/A	✓
Wooden Dowel Frame	✓	✓	✓	✓
Square Water Tank	✓	X	X	X
Jerry Cans	✓	✓	✓	✓

4. Engineering Tools and Management Principles

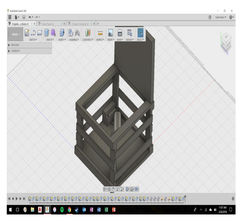
- Re-use of last year's pump (2.1 gpm, 12V, 60 Psi)
- Battery Size determined by pump amp draw



Solar Panel Size Determination
Solar Intensity x Panel Rating

Wind Power Feasibility
- 30 years of wind data
- Existing turbine used in estimation

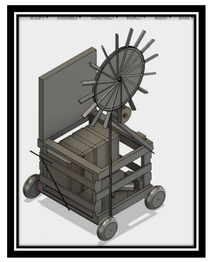
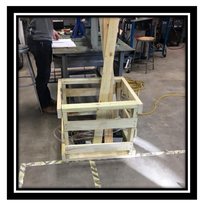
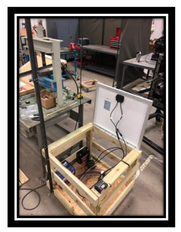
$$P_m(U_m) = \int_0^\infty p(u)W(u)\,du$$



Fusion360 used in 3D models

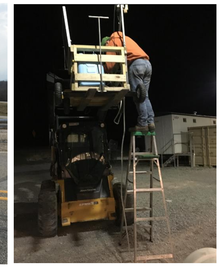
5. Final Design

- 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



Testing of mobility, wind, and flow

6. Economic Analysis

Part	Description	Cost
AGM Battery	12 Votlt 18 Amp	$ 52.65
Treated Lumber and Wood Screws	1X4; 2x4	$ 53.45
Car Altenator	Toyota 12V	$ 149.99
Solar Panel	50W 12V and Charge Control	$ 98.25
Tires	10 inch	$ 72.88
V-Belt	100 inches	$ 19.64
Water Storage	5 Gallon Jerry Cans	$ 56.60
Total		$ 503.46

- 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)

Part	Blades	Tires	Bike wheel	Alternator	Panel
Estimated Life	1 Month	1 Year	2 Years	10 Years	20 Years

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

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