Practical Utility Platform (PUP)

Affordable Transportation, Agricultural Mechanization, Portable Power, and Utility Vehicle

Purdue University

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Purdue Utility Project

Potential Users:

- Smallholder farmers
- Community Based Organizations (CBO/NGOs)
- Cooperatives
- Individual entrepreneurs & small business owners
- Municipalities

Additional Applications:

- Crop Harvesting
- Urban waste collection
- Delivery & taxi services
- Portable electricity generation/welding
- Hydraulic press for clay bricks & biomass briquettes
- Refrigeration transport box
- Emptying pit latrines & sewage pumping in urban areas

What is it?

A low-cost mobile platform that is suitable for off-road conditions, able to carry a payload of 700-900 kg (1500–2000 lbs), pull implements, and power attachments using the on-board engine. The Purdue team focuses on designing a system that is locally owned, manufactured, and maintained in sub-Saharan Africa.

Empowering communities to meet challenges of

- Transportation
- Water
- Crop Production
- Food Security
- Poverty
- Energy

Typical Specifications

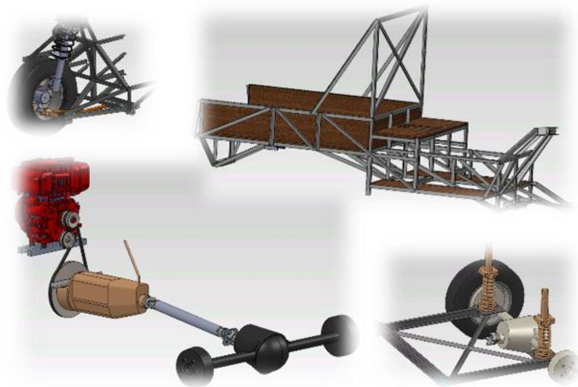
Empty Weight	<500 kg
Payload	700-900 kg
Transmission	Belt clutch, 5sp w/reverse (option: hi-low range for 10sp)
Engine	Any 4-8 kW small engine
Length/Width	3.8m/1.2m
Top speed	30-50km/hr (configurable)
Brakes	Hydraulic brakes on each wheel
Suspension	Coil springs on each wheel (torsion bar for high roll stiffness)
Frame	Lightweight truss, entirely from 30x30mm angle iron, all locally sourced
Required Tools/Skills	Constructed by cutting and welding angle iron, limited bolted joints, with no custom tooling required
Estimated Cost	Less than $1200 USD in materials, plus labor, and licensing if necessary

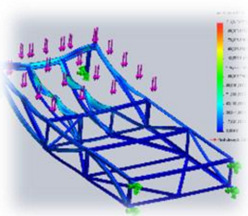
Design Process

Modeling & Analysis

From the mechanical to the economics, the entire system is modeled and simulated:

- End-user needs and preferences
- Local materials and resources
- Driveline & Frame
- Ergonomics & Safety
- Manufacturing, Labor, Tools
- Operating Costs, Business plan



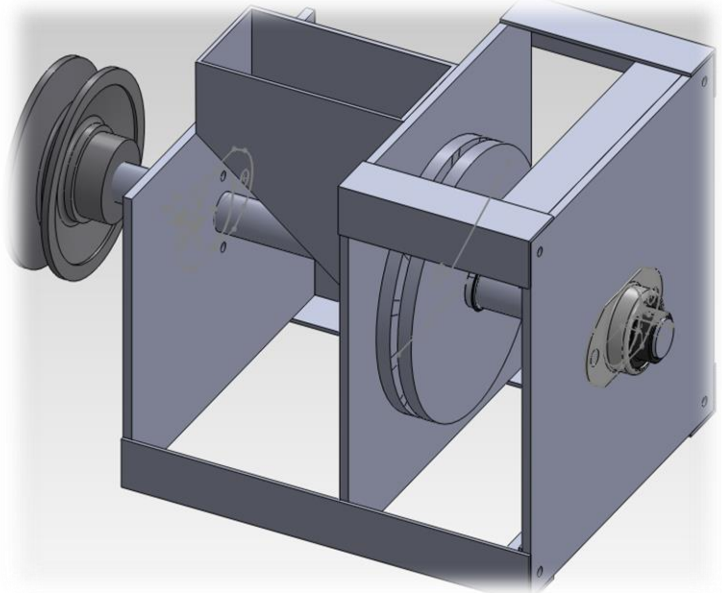


The Partnering Process

- Joint needs assessment
- Brainstorm possible solutions
- Refine solutions and find optimal design
- Analysis and modeling of entire system
- Build and test; use data to refine design
- Travel and collaborate with partners to build and test on-site for implementation and field studies
- Disseminate results

Maize Grinder

- Design criteria
  - Low cost
  - Built with locally available materials
  - In-country processing
  - Grind maize to the required particle size
    - Equivalent distributions as commercially available ground grains
  - Powered by small (<7 kw) power source
    - Easy attachment to PUP engine shaft or electric motors



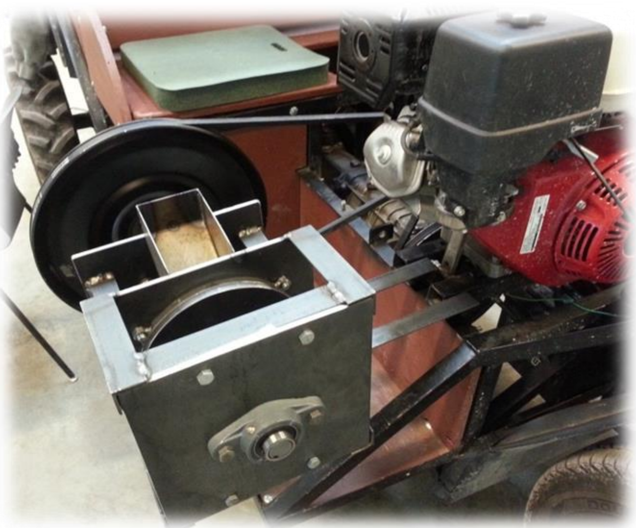
The plate mill is made of angle iron and steel plate. Power is transferred to the grinder via a belt driving the pulley at a 4.6 ratio.

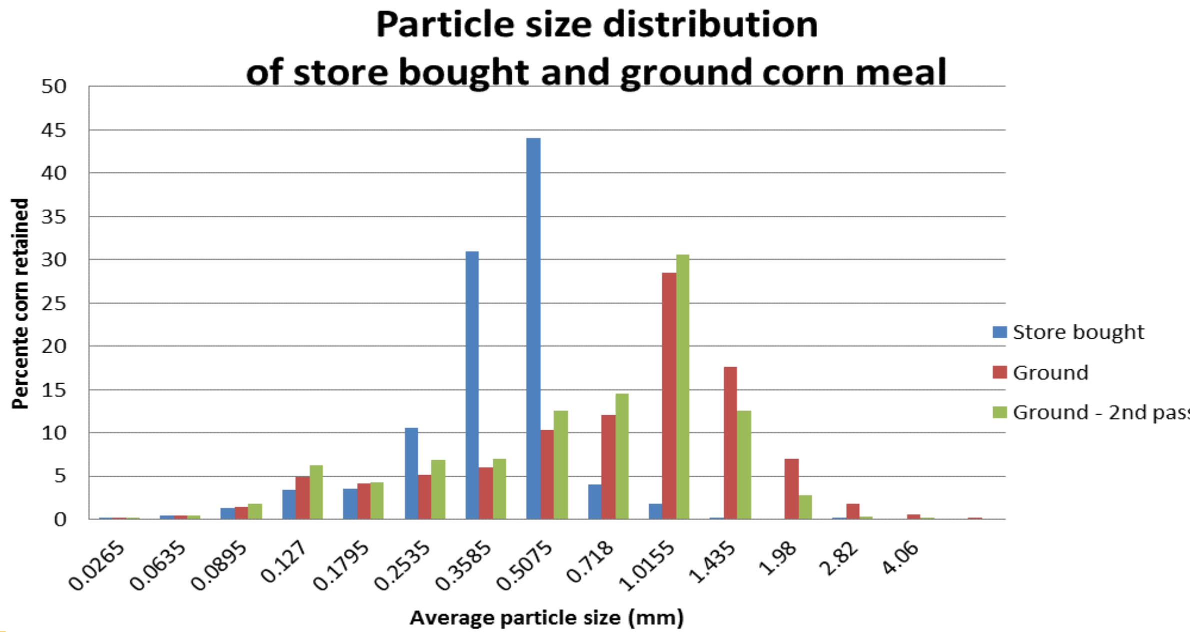
Plates are cut using a hand grinding wheel. The left plate rotates with the shaft, the right plate is attached to the frame .

The rotating shaft feeds the corn into the plates.

Maize Grinder

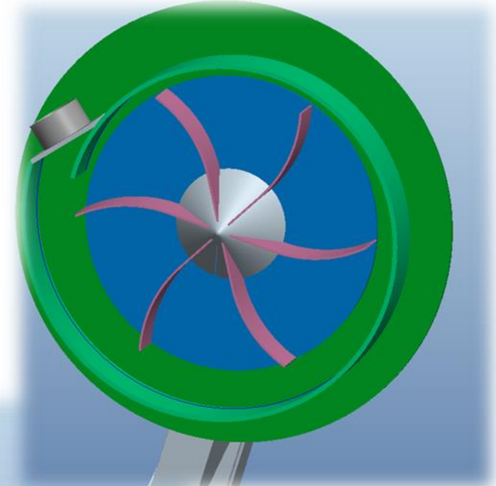
- At a grinder speed of 300 rpm throughput is approximately 0.2 kg/min.
- A second pass did not significantly reduce the particle sizes.
- Prototype cost $148

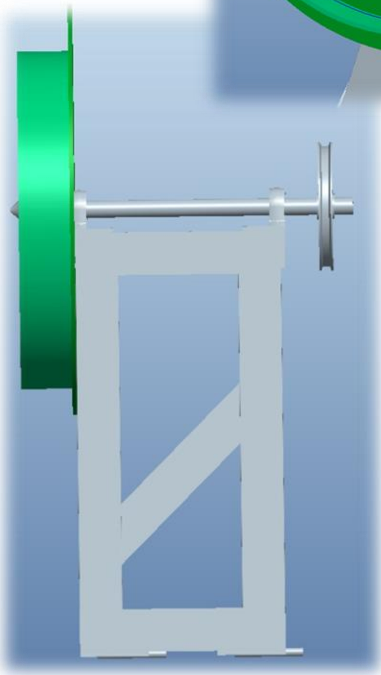




Water Pump

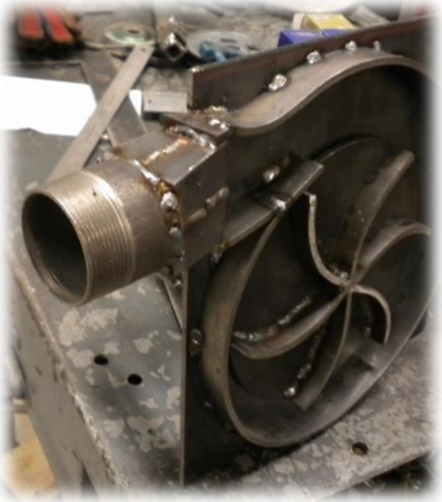
- Water pump designed to be built using locally available resources and using the PUP as a power source
- Centrifugal Pump design
  - High flow rates
  - High operational speeds allows direct coupling to engine
  - Challenges include complex geometry and a need to prime the pump





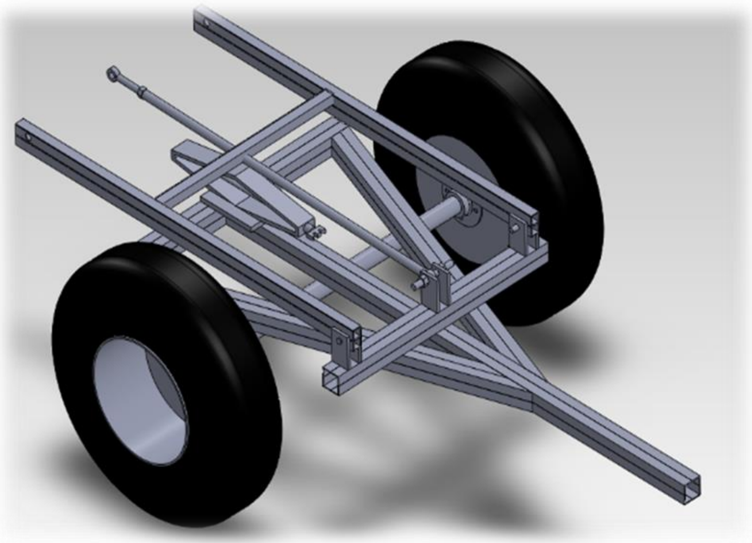
Water Pump

- The prototype pump did increase the kinetic energy of the fluid, but not enough to achieve the estimated pressure head of 10m
- The pump was unable to prime properly.
  - When trying to prime the pump, it was unable to pull water from the bucket.
  - One issue that may have caused this is the diameter of the pipe.
- Prototype cost $186 USD



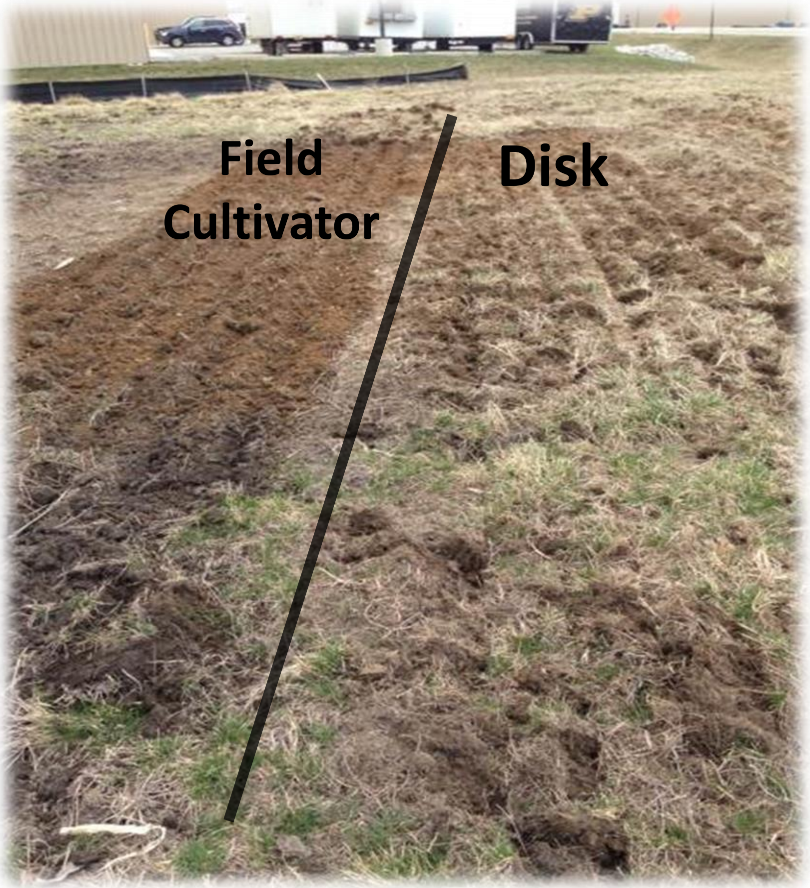
Tillage Caddy

- 3-point caddy designed and tested with two category 1 tillage implements
  - tested the PUP's capabilities to pull tillage implements
- Uses same local resources and construction methods as the PUP
- Prototype caddy cost $260 USD



Tillage Caddy

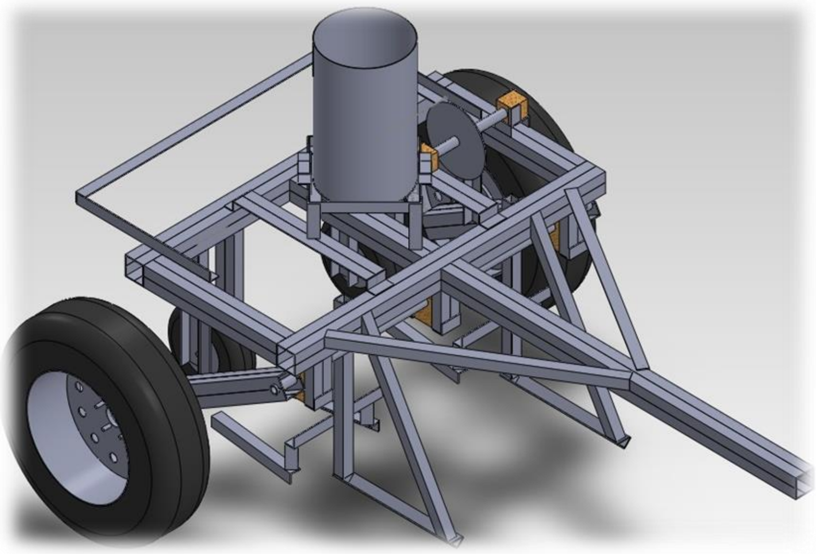
- Testing of cultivator and disk
  - Included testing in heavy sod residue to imitate no-till conservation agriculture
  - The cultivator was set to a depth of 6.5cm and did an excellent job of burying sod and mixing soil.
  - The disk cut through residue well, but did not incorporate the residue into the soil like the cultivator.



Planter

- Design
  - Constructed using locally available resources
  - Two-row seeder, expandable design
  - Interchangeable seeder plates for different seeds
- Key Parts/Components:
  - Soil Opening and Closing
  - Frame and Axle Assembly
  - Drive Mechanism
  - Seed Metering

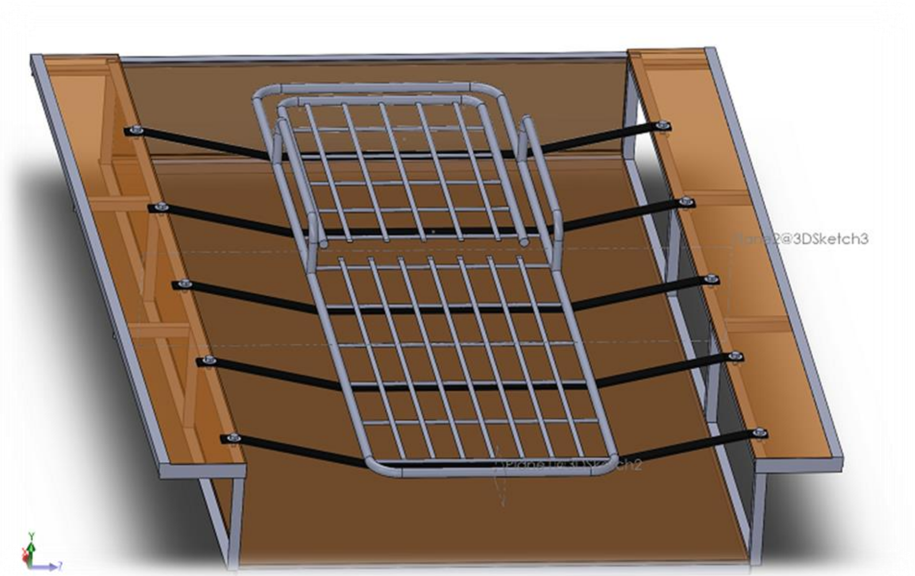
Planter



- Operation
  - Soil is opened by two pieces of flattened angle iron
  - Once seed is dropped, two pieces of angle iron push soil back
  - Press wheels compact the loose soil, improving seed to soil contact.
  - One press wheel drives a bicycle chain, which drives the horizontal driveshaft.
  - This driveshaft is connected to the seed hopper via handmade gears. This gear turns a shaft connected to the seed plate, delivering the seed.

Ambulance Modification

- Transport vehicle for injured or pregnant people
- Able to travel on poor roads not accessible by car
- Tire strap suspension system
  - tire straps strung across the bed support a stretch to provide an affordable shock absorbing system



Associated Projects

- Market strategy
- Micro-financing
- Micro-factory design and layout
- App & web based training material
  - Construction and operation
- Conservation agriculture implements
- Electric driveline & FWD transmission versions

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PUP

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Practical Utility Platform

Portable Utility Power

Partners United 4 Progress