Sustainable Irrigation in Rural South Africa:

Optimizing Design and Maintenance of the Alcock Ram Pump

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Background

- *Alcock Ram Pumps* (ARPs) are a robust and non-polluting technology for providing cost-free irrigation to community gardeners in KwaZulu-Natal (KZN), South Africa.
- ARPs use the energy of falling water from an intake weir and convert this energy to transport water to a delivery height much greater than the weir height
- Commercial ram pumps are expensive, manufactured out-of-country, and hared to repair/replace. Most home-made designs do not last.
- For developing regions like KZN, there are problems surrounding the maintenance and long-term servicing, even of robust sustainable systems.

Objectives

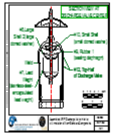
Develop new understanding of the ARP system, its fabrication, and servicing:

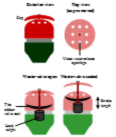
- Lab-based ARP performance testing to understand the system through pressure and flow readings on a new ARP test rig
- Exploration of new approaches for efficiently fabricating the few custom-made ARP parts.
- Systematic documentation of ARP design, fabrication, and maintenance for easier transfer of knowledge to in-country partners and communities.

Findings

- Tests on an ARP system test rig with varying supply height (3.0, 2.5, 2.0, 1.5, 1.0 and 0.5 m) verified most expectations (from field experience) about performance (flow, delivery height, efficiency).
- The ARP system is robust, and tolerant to minor design modifications: stroke length (30, 38, and 50 mm), size of water discharge holes, air vessel size. (Weight effects still under study.)
- Shorter stroke lengths give higher ARP efficiency at low weir height.
- The team identified potential cost savings for fabricating: domed stainless steel (SS) washers, discharge valve casing, rubber discs, and SS-encapsulated lead weight.
- The team created finalized operating, assembly, and disassembly manuals, with one translated into *Zulu*, as well as CAD drawings.

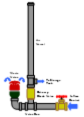
- ARPs show the best efficiency (70%) at intermediate weir heights (2.0 m), typical of those available in many rural areas of KZN.
- Different pumps of the same design showed great reproducibility in their performance.





Conclusions

- Improvements in fabrication methods can be used to make pumps and pump parts faster and cheaper.
- Local in-country service centers should be able to implement ARP technology efficiently with the produced technical documentation.
- The team is now very confident with the current "standard" ARP design and poised for further testing of variables: lead weight mass, rubber thickness.
- The testing results will facilitate in-field designs with higher efficiency.



Phase II Purpose

- To build on our Phase I results by demonstrating and assessing a new and innovative approach for providing in-country fabrication, service support, and field maintenance for ARP-based irrigation technology;
- To generalize and share our findings so that ram pumps may become a viable technology option for small-scale irrigation in other parts of the world;
- To foster a rich, interdisciplinary educational exchange – between students, professional partners, and the communities we serve – about the value of "service follow-through" in the implementation of innovative technologies for developing communities

Phase II Work

- Convene a team of JHU engineering students, business schools students, and local partners to draft a business plan for ram pump fabrication centers and service centers in KZN.
- Support – with the help of our Phase I outputs – the establishment by local partners of two ramp pump Service Centers and a Fabrication Center.
- Carefully track the centres' operations over a one year period and conduct pre- and post-implementation surveys to assess their performance and community impact.
- Document and disseminate our experience for academics and entrepreneurs interested in ram-pump technology and sustainability of technical interventions in developing communities.

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