Lessons learned from a ram pump installation at a smallholder production site in KZN.

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Introduction

A partnership between Potatoes SA and the KZN Department of Agriculture and Environmental Affairs (now: KZN Department of Agriculture and Rural Development) was established in 2009 to mentor small-scale KZN black growers towards becoming successful potato farmers. It entailed Potatoes SA sponsoring all potato seed tubers, fertilizer and related inputs to candidate growers for the first year of 0.2 ha of potato production with prospects of a declining proportion sponsorship in later years. Extension officers mentored them under supervision of a Potatoes SA official (Louis Pretorius) and a departmental potato researcher (Morgan Naidoo). I (Michael Relihan) was running departmental potato trials then and was included in the advisory committee as minute secretary.

An important criterion of candidate sites was access to a reliable source of irrigation water and an installed irrigation system able to apply enough irrigation. It was soon recognized that this criterion greatly limited the number of qualifying sites, that were often remote and without Eskom supply. I proposed that renewable 'free' energy (solar, wind and water energy) powered irrigation systems be considered an alternative to electrical- or petrol-powered systems, and a ram pump system was proposed as widely applicable. Consultation with departmental engineers at the time failed to elicit their support, so I, a Plant Pathologist, took up the challenge to install a ram pump at a development site. I had experience making equipment but had not made or installed a ram pump. I was permitted to do this between research responsibilities and it was assigned a research project code.

A site at Vulamehlo, near the Umkomaas / Mkomazi river, was approved as a potato development site for the summer of 2009-2010. The KaMampungushe stream ran next to it with a low fall (about 1m per 100m), but I chose this site thinking the fall was adequate by using a stand pipe between a weir and the ram pump. A ram pump was made and installed there by November 2009, but it did not operate properly to irrigate the 2009-2010 potato crop. A concrete weir was built to replace the initial sand-bag weir in 2010, then an irrigation piping network was installed in 2010 to 2011. Pumping operation suitable for irrigation was only achieved after overcoming other challenges by the end of 2011, and it was used until severe flood damage at the end of 2012 brought an end to the project.

Design, construction, and installation of the ram pump

I made an impulse valve similar to that of the Papua New Guinea ram pump design from a 3-inch stainless steel nipple cut in half and other stainless steel parts. It had springs flanking its bush, and large weights were initially fitted. I internalized the non-return valve within the pressure chamber (as in many ram pump designs) to avoid exposing the brass delivery non-return valve to great leverage forces due to any drive pipe movement. The pressure chamber was made of galvanized iron and mounted horizontally. A small snifter valve was made in the fitting connecting the impulse valve and pressure chamber, to which the non-return valve fitted inside the pressure chamber (Fig. 1).

Fig. 1: Assembled ram pump. Initially the impulse valve (bottom left) was fitted with disk-weights which were removed later as it operated better without them. Operation after installation shown bottom right.

Initially a simple sand bag weir was made for the water collection point, to which the siphon pipe and a simple pre-filter were tied. A 50 mm siphon pipe (Fig. 2) was installed along the river bed (mounted by concrete mounting blocks bolted to rocks) exiting up the left bank where it connected to a concrete stand pipe. The drive pipe between the concrete stand pipe and the ram pump was made from straight 1.5 inch nominal bore galvanized pipe. Two locals built a small brick pump house in which the ram pump was mounted (Fig. 3), nearly 200m downstream from the water collection point.

The performance of the ram pump was initially inadequate as it often stopped pumping and its output pressure was too low. The impulse valve worked better after removing the large weights, installing suitable springs and adjusting the locking nut position. Increased pumping pressure came from lengthening the drive pipe and moving the stand pipe upstream. Initially there was also poor flow through the siphon pipe due mostly to air-lock, but also sediment accumulation, caused by vertical undulation of the pipe, and much better flow was achieved after re-routing it in the river with minimal vertical undulation. Another siphon pipe was installed much later to improve flow rate (Fig. 4). The siphon pipes were joined at their lower ends to a 75mm pipe for connection to the stand pipe.