

Moving up the self-supply technology ladder: mechanised pumping

Case studies of multiple use of water in Ethiopia (MUSRAIN case 3)

As part of the MUSRAIN project in Ethiopia, various approaches to water harvesting, multiple use of water and ecological sanitation have been studied. Here the potential of mechanised pumps on self-supply family wells is discussed.

Mechanised pumping in Ethiopia at a glance

Main features: Households initiate their own family well, or upgrade an existing one, fitting a mechanised pump. These can be electric, petrol or diesel-fuelled, submersed or on the surface. Water is used for irrigation, domestic uses and livestock watering.

Implementation: Usually farmers copy the idea from neighbours. They arrange and fund the water facilities by themselves, sometimes with credit. Pumps may also be rented in some areas.

Options for multiple use of water: Convenience and high discharges make the pumps very suitable for irrigation. With some additional interventions, water quality can be ensured to make such wells safe for drinking and increase health benefits.

Challenges for uptake: The Ministry of Agriculture promotes mechanised pumps under the 'one family, one well' approach sometimes as a step-up from rope pumps. Additional support is required to create demand for irrigated products, facilitate credit services and assist with water quality protection.

Introduction

Self-supply refers to households taking the lead in their own development, making investments in the construction, upgrading and maintenance of their own water sources, lifting devices and storage facilities.¹ The approach is especially suited to both shallow groundwater development and rainwater harvesting at household level. One key idea in promoting self-supply is the technology ladder. The idea is to first promote low-cost initial investments in basic access e.g. digging a traditional well, followed by gradually making improvements in affordable steps to improve performance. System components that might be upgraded over time include well depth, lining, head works, lifting devices and distribution networks. Improvements make performance better (and often convenience too), enabling more water to be pumped with less effort or improving water quality.

Households can move up the technology ladder by equipping their family wells with mechanised pumps, electric or diesel. This improvement is often driven by irrigation

requirements of high value cash crops such as *qat* in Eastern Hararghe (Oromia Region), and horticulture like vegetables and seedlings of pepper and coffee in Gurage Zone (e.g. Meskan district) in SNNPR.

Implementation

Families are motivated to (further) develop their water supplies by the anticipated benefits derived from multiple uses of water. In many cases this is cash income from higher yields through irrigation, though other productive activities may include cattle watering or water selling around urban and peri-urban areas.

Households usually copy the technology and practices from their neighbours, without external support. Sometimes a group of farmers, informally or as cooperative, share a pump to reduce the investment costs. Some farmers rent out their pump to others.

In some cases, government programs provide support on an ad-hoc basis to develop family wells to install mechanised pumps. This may

change rapidly under the new household irrigation strategy of the government, currently being implemented by the Ministry of Agriculture, the Agricultural Transformation Agency and the regions. This new approach 'one family, one well' widely promotes lifting devices. This includes simple technologies such as rope pumps, but also provides widespread access to mechanised pumps through bulk orders, an assisted micro-finance programme and supply chain development to support maintenance.

Technology

Based on the pump position, two categories of pumps are distinguished as a water lifting mechanism for family wells, depending on the water levels in the well: surface pumps, usually powered by diesel or petrol, where the water level is less than 5m and electric submersible pumps for lower depths. Sometimes surface pumps are used in deeper wells by hanging them in the well or positioning them in a second shaft dug next to the main well, to compensate the suction head of the pump with the delivery head.



Figure 1. Unlined well.



Figure 2. Well lined with concrete rings.



Figure 3. Well lined with car tires.

Family wells come in all shapes and sizes, with variety in lining, lifting devices and add-ons^a. Unlike those wells that are used for domestic purposes alone, mechanised family wells that are used for irrigation may have plastic-lined ponds for temporary water storage, where water is pumped from the well and stored till it is used for watering of the farm land, either through gravity irrigation or pumping.



Figure 4. Plastic-lined pond for temporary storage of pumped water in Haramaya district, Eastern Hararghe.

^a See MUSTRAIN case study 2 on family wells.

Additional infrastructure may include a variety of technologies such as overhead water storage for pressurized supply, shower rooms or drip irrigation kits.

Multiple use of water in Eastern Hararghe

Mechanised family wells in Haramaya and Kombolcha districts have almost all been constructed and equipped with pumps to enable higher water use for productive purposes in addition to domestic uses. Water availability in the wells appears to be adequate, as a well's night storage alone is more than the domestic water needs of a household: more than 1500 litres on average in the two districts. This is easily mobilized with a pumping capacity of 0.5- 0.8 l/s in half of the pumps used in Haramaya and Kombolcha.



Figure 5. Hand dug well with plastic hose, diesel pump, 'barrel water tower' and shower rooms in Kombolcha district, Eastern Hararghe.



Figure 6. Hand dug well with engine pump, overhead masonry reservoir and shower rooms in Kombolcha district, Eastern Hararghe.



The use of mechanical pumps at family level is fairly new. It is said that the elder Ahimed Mume (photo) pioneered the first of such pumps on his family well nearly 10 years ago in the Haramaya district.

Annual groundwater recharge, from rain, in the area is known to be around 20-42 mm.² However, it is not clear what would be a sustainable rate of groundwater exploitation as the total annual withdrawal from all wells in the area remains unknown. As an indicator, as much as 96% of the surveyed wells in the Haramaya and Kombolcha districts of Oromia had not gone dry between 2005^b and 2010.³

Water quality

As most mechanised wells are used for productive purposes, they do not necessarily have the right protection against water contamination. Some of the wells are unlined, and many miss appropriate well head works. However, the perception of most owners and users is that the mechanised family wells have better water quality than other wells. This is confirmed by microbiological analysis of water samples that show 82% of the mechanised wells have less than 10 faecal coliform units (FCU) per 100ml and 52% no coliforms at all. Conversely, only 56% of traditional wells had <10 FCU/100 ml en 26% none at all.³ Possible explanations for this could be the lower contact between hands and water (once the pump has been installed, the pipe stays in the water whereas a bucket on a rope can get contaminated every time it is pulled up) and the higher rate with which the water in the well is refreshed.

^b All dates are noted using the international (Gregorian) calendar.

Costs and benefits

Construction costs of mechanised family wells varies depending on the way the wells are drilled or dug, their size and most of all on their lining. The costs of well digging depend on several factors, such as depth (2- 25 m in Haramaya and Kombolcha), soil type, labour (skilled artisan or unskilled daily labourer), and method of digging or drilling. Artisans are traditionally experienced well diggers providing local well digging and construction services. The price of digging varies from € 0.76-5.43/m^c in the Central Highlands⁴ to some € 7.20 /m^d in Eastern Hararge (based on survey of 100 households)³. Some wells are lined only at the top, while others are fully lined. The lining material varies from stone masonry through wood and car tires to concrete rings. Thus, the price of internal lining varies from none to some € 33/m. The head work construction varies in type, material and thus costs, from none to € 125. The pumps themselves cost around € 140 on average and are expected to last 15 years. The total investment for a mechanised family well thus varies between € 167 and € 1150, with an average of € 555.¹

The costs of operating a pump depend on the irrigated area, type of crops and other factors that determine frequency and duration of pumping. For electric pumps, cost estimates range from € 10 to 15/month⁵ during the dry season. Minor maintenance such as cleaning and servicing is common but hard to quantify in terms of cash as most owners (86%) carry out their own small repairs. Capital maintenance expenditure usually depends on

^c Conversion rates according to xe.com, March 2010 (€ 1 ≈ ETB 18.4).

^d Conversion rates according to xe.com, March 2013 (€ 1 ≈ ETB 23.9), used throughout the case study unless specified otherwise.

outside expertise. Regular jobs in this category include the rewinding of the electric wire, ranging from € 50 to 84, based on the locally available market and service. This includes the material cost (replacement) that constitutes more than half of the expenditure.

Mechanised pumping on family wells results largely from user initiative. It is not clear what role the private sector plays in promoting technology or providing technical support or credit, although the market is the main mechanism to disseminate such technologies. At national level the government has created a conducive environment for promotion and implementation of family wells, household irrigation technologies and Multiple Use water Services.

The roles and responsibilities of the self-supply facility owners vary, depending on their financial and physical capacity as well as on their knowledge. The well owners decide what type of facility they want and for what purpose they want to use it. Almost all (98%) of the construction of new self-supply facilities is undertaken by the owners through investing their labour, material and cash. Similarly, two thirds (66%) of the improvement works or upgrading of family wells are conducted by the well owners.

Cost-benefit analysis

Users of mechanised wells usually generate incomes from the facility, more than with rope pumps. Calculations⁶ have shown that the net additional income, hence accounting for investment and running costs of the pump, could increase from € 15^e in the first year to € 50 in the third year. For rope pumps this would be € 3 and € 7, respectively.

^e Conversion rates according to xe.com, May 2011 (€ 1 ≈ ETB 24.5).

Ahimed Sani Abas lives in the Ganda Weday Usman community, Sibilu ward, Kombolcha district, Eastern Hararghe. He has a hand dug well of about 9 m deep installed with an electric pump. The well was not internally lined but has masonry plastered head works with a plastic sheet to cover the well mouth. He had bought the pump three years earlier at € 87 (ETB 1300 (at the time of the interview, such pumps were € 163⁵ in Harar town). The farmer invested € 106 for a power line extension to his well, including cable and switch board (this would cost the same in 2011). He also constructed a plastic-lined pond for temporary storage of the pumped water. Total investment costs including construction was € 624.

The family uses the well for irrigation, domestic purposes, including drinking, and cattle watering. In addition the farmer sells water at 2 euro cents for a 20 l jerry can, totalling on average € 1.63/day. The irrigated area is 0.5 ha with *qat* and vegetables (beat root, cabbage, garlic and potatoes). The sale of *qat* brings some € 2452 annually.



Figure 7. Irrigated *qat* field in Kombolcha district, Eastern Hararghe.

Challenges for up-scaling

The main driving force for the mechanised pump-installed family wells is income generation. Wherever there is a potential market for any well-based production, people

are likely to take the initiative for Self-supply. Currently this takes place for irrigated cash crops, particularly *qat*, or for direct water sales. Mechanised pumps help well owners to supply them with more water and meet their demand. Lack of awareness of potential markets or insufficient shallow groundwater can be limiting factors.

Another challenge is the independent, sometimes fragmented, action of institutions supporting multiple use water services. Various water uses have their own sectors such as agriculture, irrigation, water, livestock and health. Multi-sector planning is vitally important to maximize benefits from self-supply.

Such coordination would also facilitate access to credit services. This is not common for domestic water supply, but in the agricultural sectors loans can be obtained for improved water supply facilities.

Conclusion

Mechanised pumps on family wells are a promising way of upgrading Self-supply family wells, thus moving up the technology ladder. The pumps make more water available at higher discharges in a more convenient way than other lifting mechanisms. Farmers are eager to self-initiate and invest wherever they see business opportunities, such as the sale of cash crops or water. Scaling up mechanised pumping at family wells is facilitated by creating demand for irrigated products, increasing awareness through piloting and facilitating credit services for farmers.

An opportunity for improvement of multiple use water services from mechanised family wells would be better protection of the well – and groundwater- against contamination.

Most wells are used for domestic purposes and many households prefer the mechanised wells for drinking. Additional interventions such as lining, clean lifting devices (probably not feasible for submersible pumps) and

especially good well head protection such as mouth cover, parapet, apron, and drainage could make more family wells safe for drinking and thus increase the health benefits.

The MUSTRAIN project

The goal of the MUSTRAIN project is “to address the critical water problems in water scarce rural areas of Ethiopia by collaboration, implementation of innovative and alternative solutions and exchange of knowledge and mutual learning”. Scalable approaches to water harvesting (RWH) and shallow groundwater development (Self-supply) for multiple use services (MUS) has been the focus.

MUSTRAIN brings together the strengths and builds partnerships of a consortium of Dutch-based organisations (IRC International Water and Sanitation Centre, RAIN Foundation, Quest and Water Health) and Ethiopian partners and experts with complementary interests in the sustainable development of approaches to MUS. MUSTRAIN is led by IRC and funded by the Partners for Water (PvW) programme.

MUSTRAIN aims to promote uptake of Multiple Use Services in different contexts within Ethiopia, by documenting replicable water access/MUS models. In eight case studies cost-benefit relations are analysed, as well as opportunities and challenges for implementation.

The MUSTRAIN case studies are:

1. MUS from sand rivers
2. MUS and Self Supply
3. Mechanised pumping and MUS
4. Ecological sanitation for MUS
5. Greywater reuse for MUS
6. MUS and livestock
7. MUS and the Community Managed Project (CMP) approach
8. MUS and manual drilling

The current case study (3) is based on the main author’s experience in self-supply water

services in Ethiopia and data collected for UNICEF and RiPPLE. This included interviews with farmers in May 2011.

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The IRC International Water and Sanitation Centre is a knowledge-focused NGO working with a worldwide network of partner organisations to achieve universal access to equitable and sustainable water, sanitation and hygiene (WASH) services. IRC's roots are in advocacy, knowledge management and capacity building. IRC was set up in 1968 by the Dutch government on request of the World Health Organization as a WHO Collaborating Centre. Currently, IRC is established as an autonomous, independent, not-for-profit NGO with its Headquarters in The Netherlands, and local representation in the countries where IRC implements programmes. IRC has profiled itself over the years with innovation and action research to achieve equitable and sustainable WASH services.

In collaboration with:



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