



PUMP TECHNOLOGY CHANGES COMMUNITIES

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Reporting from Zambia & Malawi

In the heart of the Kasungu District in the Central Region of Malawi, a 45-year-old grandmother of six stoops to slice fresh okra into a large woven basket. The red brick behind her glows against the backdrop of lush green Acacias, banana trees and broad tobacco leaves. It is the end of the rainy season, and soon the crops will be harvested and dry air will suck the life out of the ground.

Even during Malawi's driest days, the bucket of clear, cool water sitting in the red dust by this woman's feet will be filled again and again. Children will continue to drink, and gardens will still grow.

For Vickness Nyirenda and her neighbors in Zolomondo village, a simple hand pump has changed everything.

The Gift of Clean Water

In November 2013, Zolomondo received a gift that transformed the entire community: a deep-well, progressive cavity (PC) hand pump known as the LifePump.

Provided by humanitarian engineering nonprofit Design Outreach in partnership with World Vision and private donors, the LifePump is engineered to reach depths of 325 feet—more than twice that of a typical hand pump. It supplies a consistent flow of clean water, which for this community, is life-saving.

Supplied by SEEPEX, a German-based pump manufacturer, the LifePump's PC pumping elements work to continuously and efficiently move water to the surface with every turn of the handle. Unlike piston pumps that lift the entire column of water with one push of the lever, this design allows virtually anyone—regardless of strength or size—to access safe water.

Nyirenda no longer has to wait for hours or hack away at the earth with a hoe to ensure her family has enough water to survive. She no longer has to fear for her life.





“Even if I come to the pump late or there are others gathered,” Nyirenda says in native Chewa, “my family and I are certain we will get water.”

This design gives her confidence that she can easily pump the water herself and that there will be enough.

Reaching New Depths

The LifePump’s outer components, including the concrete mounts, spout assembly, base, gearbox and handles, are connected to the PC pump and foot valve at the bottom of the well by riser pipe and drive rods.

“The weight of the rod and water in the column in a LifePump are supported by bearings,” says Mike Dillon, SEEPEX president. “In a conventional hand pump, the mechanism and the water have to be lifted with each stroke. That’s a lot of unnecessary work. Plus, with reciprocating equipment there are a lot of high moment loads, plus hinges and chains with sprockets that are all moving and wearing. Fewer parts and fewer moment loads means that it lasts longer.”

The LifePump consists of a single helix metallic rotor that turns inside a double-helix elastomeric stator. Each turn of the handle rotates the drive rod, which turns the PC pump element to create cavities that draw water to the surface.

“The sealing lines between the rotating and stationary parts have to be carefully designed to allow the pressure capability to lift the column of water, but at the same time not be excessive to require high torques that would make it difficult to turn the handles,” says Kamran Mirza, SEEPEX director of business development. “This challenge is overcome by the geometry of the helical design, selection of materials and processes during manufacturing that help reduce friction between the parts.”

A critical feature of the LifePump is its depth capacity. The current LifePump is designed to reach 325 feet, and another in research and development will reach 500 feet. In mountainous areas such as Malawi, this is crucial. “You can find water in just about any part of the world if you drill far enough,” says Dr. Greg Bixler, CEO and co-founder of Design Outreach. “But most pumps only go 150 feet. If there’s no water there, the pump won’t work. This is part of the untold story.”

Before the LifePump came to Chilekwa village in Malawi, this was their fate. A borehole was drilled to the standard 150 feet, but it wasn’t deep enough to hit water. Unsuccessful, the operators packed the drill truck and left, devastating and disappointing the villagers.

But when Design Outreach returned to the same borehole a few weeks later and drilled deeper for the LifePump that stretches to greater depths, hundreds of villagers saw clean water for the first time.

“The celebration lasted for a long time, with villagers singing and passing around clean water to everyone in the village,” Bixler says. “It was a very moving celebration, watching the joy and sharing, and it made it very evident what a difference clean water makes.”

The Power of Water

Water, as Nyirenda knows, is a powerful thing. Her village is living proof.

Less than two years ago, the lives of Nyirenda and her neighbors ticked away as they waited at a watering hole that produced just a trickle of water.



Clockwise from top left: Dr. Greg Bixler, CEO & co-founder of Design Outreach, offers training in Zambia; Children at Kafwikamo Community School show off clean water from the LifePump; A woman in Malawi gathers water from a polluted water source that serves 1,100 people.



The women would walk two kilometers deep into the African grassland in the afternoon, only to return the next morning with dirty water laden with disease.

The women, already exhausted from only three to four hours of sleep every night, would often bring hoes to increase their chances of finding water. “Since water is life,” Nyirenda says, “we had no option but to dig down to get it.”

While they waited as long as 12 hours for water to flow, wild animals from a nearby national park would sometimes wander beyond their territories to drink from this same water source. “Sometimes we’d be chased by hyenas,” Nyirenda says. “We were afraid that wild animals would kill us.”

The water they returned with was rarely sufficient for daily needs. Nyirenda and her family would often go without food, because rice and nshima—a corn-based staple in Malawi and Zambia—require water.

This is not an isolated story. More than 750 million people worldwide lack access to a safe and reliable water source, and women and children spend an estimated 140 million hours every day collecting water. Of the water that is gathered, much of it is so dirty that a child dies every minute of water-related disease.



LifePump

Preventive Maintenance

A vital part of the LifePump solution is preventive maintenance. Each village has a water committee that is trained by World Vision to report problems to the pump technician, or pump minder. The pump minder is trained to easily service or replace parts, such as seals on the gearbox.

Every three months, the village checks for leakage, which could indicate wear. On a yearly basis, the pump minder conducts inspections for leakage, discharge, loose nuts and bolts, and any other unusual behaviors or problems.

In addition, Design Outreach uses satellite data loggers provided by SonSet Solutions to monitor pump performance. So far, the max amount pumped per day was 1,980 gallons.

But in places like Zolomondo, Design Outreach and its partners are working to reverse these statistics. Every LifePump installed means more time and opportunity for people like Nyirenda.

Solutions to a Crisis

Design Outreach was born five years ago when Bixler and co-founder Abe Wright decided to use their engineering expertise to provide innovative solutions to help break the cycle of poverty.

While working with Water for Good in the Central African Republic, Bixler says he began learning about hand pumps and the challenges they pose for rural communities. Many of the world’s hand pumps often last six months or less before needing repairs, and some estimate that about a third are broken. Because most hand pumps reach depths of only 150 feet, drilled wells in some places hit water about 68 percent of the time.

Having seen firsthand the devastating effects of lack of access to clean water, the two engineers wanted to build a pump that would reach deeper and last longer.

Inspired by a PC pump designed in the 1970s that was still operating in some places 30 years later, the Design Outreach team engineered an improved PC hand pump and installed a prototype in 2011. “The prototype had some major issues we just couldn’t work around,” Bixler says. “It needed to be created custom for this application. We needed to make an optimal PC pump element, or the project was not going to work.”

Through a random series of events, Bixler was introduced to Dillon, who worked on the PC hand pump project in the 1970s and 80s.

“Something else funny was happening. We had a team of engineers looking for a supplier to make this part. One of the suppliers was SEEPEx,” Bixler says. “When we described the project to Mike, his jaw about hit the ground because he was so happy to see this project come back to life.”

Now, SEEPEx manufactures and provides the PC pumping element—the rotor and the stator—for the LifePump. “It’s not just a job for them,” Bixler says. “You can tell they really want to make it work.”

In addition, the SEEPEx team has funded a LifePump installation in Malawi and is working on their second campaign. Having been to parts of Africa himself, Dillon sees the need for a pump that won’t break down.

“It’s just absolutely heartbreaking to see the suffering people go through,” he says. “When you see something like that you think, ‘I really wish I could do something.’”

Engineered for Life

An hour flight west of Malawi’s capital city in a Jetstream 32 turboprop and a bumpy ride in a Land Rover lead to the heart of Zambia, where nearly 80 percent of people live in poverty. In the Mumbwa District, Kafwikamo Community School, developed in part by World Vision, seeks to improve the lives of about 400 children through education.

In December of 2014, a LifePump was installed on the school grounds, serving the students and the surrounding homes. The community’s previous pump was difficult to use and faced frequent breakdowns. Women needed to assist each other, and the water they did draw was polluted.

Aggrey Shanzala, Kafwikamo school manager, says the previous pump’s pipes would leak and parts would wear out within a few months.

“You would expect some to come back without water,” he says. “Now everybody drinks. Even the nearby community can draw water, and we’ve never experienced trouble. The kids are very grateful.”

The school has planted a garden of papaya, carrots, tomatoes and other vegetables, and they no longer fear that a pump breakdown would waste their investment in seed during the dry season. School attendance has also improved. “With breakdowns, we couldn’t prepare meals,” Shanzala says. “Now, more children come because they have food to eat.”

Kafwikamo School is just one example of the innovative technology that makes the LifePump work. The PC pump design minimizes stress and wear on parts, and durable, corrosion-resistant materials ensure resilience even during continued use. The lack of frequent maintenance makes the LifePump affordable for local communities to operate without constantly relying on outside funding.



Clockwise from top left: Children in Malawi drink from the LifePump; Nyirenda, her sister and grandson in front of a brick home built after the installation of the LifePump; Amelia Messamore, *Pumps & Systems* managing editor, (second from left) with the Design Outreach and World Vision teams in Malawi; Children in Zolomondo Village in Malawi



How to Help

Each LifePump is funded by the support of donors. Companies, organizations or individuals can bring clean water to a village in Africa by sponsoring a pump campaign. For more information about the LifePump or to sponsor a campaign, visit doutreach.org.



During a year and a half of use in Zolomondo, for instance, the LifePump has shown no signs of degradation or reduction in efficiency. While some pumps can take 30 minutes or more to first get water, the LifePump produces water almost immediately and averages a flow rate of about 2.5 gallons per minute. In Nyirenda's words, "The pump has no mistake."

The Center of Everything

Since the pump installation, Zolomondo has been transformed. Homes and schools built of brick—which require water to mold—have replaced mud walls and thatch roofs. Gardens flourish, and children who once missed days of school because of illness are healthier and happier.

"Now, families are intact as it is supposed to be," Nyirenda says, children bursting into song and dance near the pump behind her. "Development has resurfaced in villages. Children can go to school. Kids eat every morning."

The pump has allowed Nyirenda to build two brick homes with sturdy roofs and glass windows. One of these, complete with a solar panel to power a 12-inch TV, she rents to her sister for extra income—2,000 kwacha, or about \$5, per month. Her friend and neighbor has even started a brick-making business to support his growing family.

"Water is the basis for everything," Bixler says. "Not just for health, but for food security, washing clothes, bathing, building houses with bricks, starting businesses. It's amazing how everything is connected to water."

Zolomondo, the first village to receive a LifePump, is now one of eight villages across Africa that benefit from this life-changing technology. The LifePump is currently providing clean water to three villages in Malawi, three in Zambia and two in Kenya, with 22 more ready to be installed across the continent.

As part of the Hundred Pump Project, Design Outreach plans to install 100 LifePumps by the end of 2015. If this goal is reached, an estimated 40,000 people will celebrate the gift of clean water. ■

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MAJOR PARTNERS

that have helped make the LifePump a reality

World Vision | Water for Good | The Water Project | SEEPEX | Exact Machine Corp. | Strataflo | SonSet Solutions | Messiah College | Biomet | The Ohio State University | DePuy Synthes (a Johnson & Johnson company) | Battelle Memorial Institute | Force Design | Grace Brethren Churches

About **140 million** hours a day are spent collecting water.

WORLDWIDE WATER FACTS

1 OUT OF 9 PEOPLE

lacks access to improved sources of drinking water.

\$1 spent on water / sanitation

= **\$4** economic return

Increase In Water Withdrawals By 2015:

18% DEVELOPED COUNTRIES

50% DEVELOPING COUNTRIES

80% OF WASTEWATER

is not collected or treated.

Nearly **1** out of every **5** deaths before the age of 5 is due to a water-related disease.

1 out of 3 people lacks **IMPROVED SANITATION.**

At least **750 million** lack access to clean water.

APPROXIMATELY **3.5 million** die each year due to inadequate water supply, sanitation and hygiene.

Sources: UN-Water | WHO/UNICEF | Water.org
The New York Times



To learn how to help, visit
[pumpsandsystems.com/
giftofcleanwater](http://pumpsandsystems.com/giftofcleanwater).