8 IMPORTANT DISCUSSIONS
in the Water Aid Community

well aware

well aware

About This White Paper

This report focuses on eight major areas of discussion within the water-aid community: the status of clean water in rural African communities, inadequate technical expertise, community involvement & proper training, water system performance by type, the problem with hand pumps, solar powered water systems, community WASH training, and lack of measurement & evaluation. In writing this detailed report, we hope to shed light on the failures and successes of attempts to improve access to clean water in rural African communities.

About Well Aware

More than two billion people lack access to reliable clean water, and with climate change now an unfortunate reality, half of the world's population will face water scarcity by the year 2025.[1] Climate change, conflict, and poor infrastructure impact communities' right to this basic necessity to live. While there are many efforts to address growing concerns in water-stressed regions, there is great opportunity for improvement in the water development sector. Current technology is not meeting the global standards of reliability and efficacy in a time when water scarcity is becoming increasingly present. Well Aware was born of necessity and inspired by insight in response to the needs of our industry. We provide technical and community expertise to supplement partners' missions, and our services range from brief consultations to entire project oversight. Our patent-pending software is significantly improving our clients' water system maintenance and impact reporting. Well Aware is available globally, but this paper specifically addresses Africa.

[1] *The World Health Organization. (2019). Drinking Water: Key Facts.*

Status of Clean Water

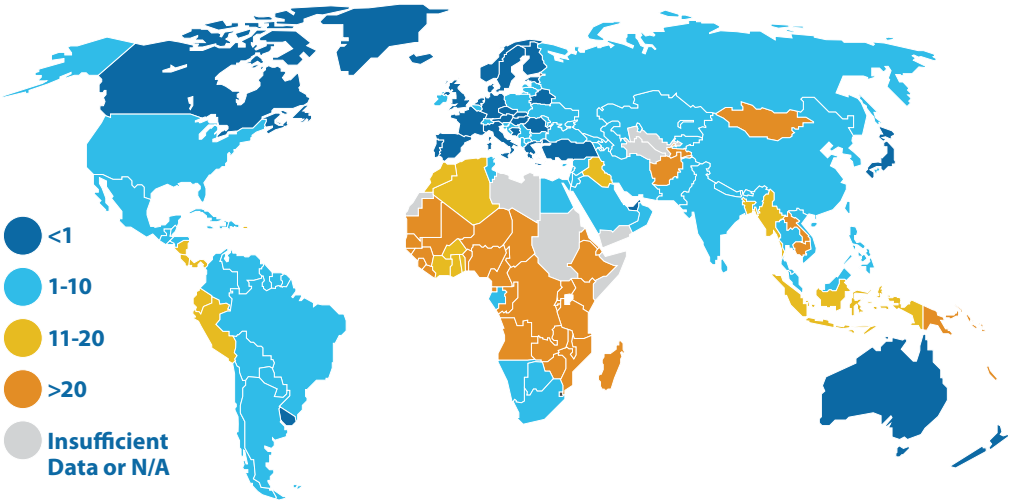
In the United States, losing access to readily available clean water is not a concern that often comes to mind. In certain regions of developing countries, people are not sure where their water will come from on a daily basis, and if the water will even be safe to drink. Not having access to clean water, or even contaminated water plays host to a variety of risks, including increased infant mortality, decreased classroom attendance, decreased community economy, increased conflict and domestic violence, and precludes any community development. The public and private sectors have made large-scale efforts to address this humanitarian crisis by attempting to install an assortment of clean water systems, but more than 60 percent of existing water wells currently do not work on the African continent.[2]

In a 2017 article, the authors, Anadon et. al., report that of the 663 million people around the world drinking from unprotected sources in 2015, almost half live in Sub-Saharan Africa. Illustrated on the world map provided below, a fifth of the world's population drink water from a source that is not protected from contamination. Drinking contaminated water drastically increases the risk of contracting many types of waterborne diseases such as Cholera, Guinea worm disease, Typhoid, and Dysentery.[3]

Women and girls spend a total of ***200 million hours*** every day collecting water.[4]

The impact of gaining access to safe and reliable water is especially meaningful for women and girls because it is their primary responsibility to walk long distances to collect water for their families. When clean water becomes available in their village, the time it takes women and girls to collect water drastically decreases, therefore allowing more time for girls to attend school on a regular basis, and for women to engage in commerce and community activities normally reserved for men.

Percentage of Population Using an Unimproved Drinking Water Source



[2] *Well Aware. (2018). Entire Well Aware Website. Retrieved from https://wellawareworld.org*
[3] *Slaymaker, T. & Bain, R. (2017, March 17). Access to drinking water around the world – in five infographics. The Guardian.*
[4] *UNICEF. (2016). UNIFEF: Collecting water is often a colossal waste of time for women and girls.*

Inadequate Technical Expertise

Technology plays a key role in the success or failure of water projects. Technical expertise (hydrogeology and engineering) is critically important to the success and sustainability of water projects, yet this component is often missing from project planning and oversight. There are many reasons for water project failure, but the primary cause is the lack of technical knowledge, the quality of knowledge, and the application of that knowledge during project planning, implementation, and oversight. Too often will an organization set out to drill a borehole without this vital component. Having professional technical support is essential to the overall success of the water project,, along with proper routine maintenance and community involvement, are the only way to ensure the longevity of the project.[5]

Of the top five water-centered charity organizations around the world, only two of them emphasize the need for dedicated technical staff. The organizations who do not plan for the long term technical upkeep of projects have a primary focus on the financial aspect of the "water issue," and while raising money is an important part of the overall process, it is not the answer. The key is not only to raise funds, but to effectively and efficiently implement the projects through technical planning and implementation.[6]

TECHNICAL EXPERTISE IMPROVES

Life of the water system

Yield from the well

Impact on community

Community buy-in

TECHNICAL EXPERTISE REDUCES

Ongoing maintenance costs

System failure rates

Resource waste

Community confusion

[5] *Tong, L. (2016). What, no impact assessments? Monitoring and evaluation around evolving WASH activities. WaterAid.*
[6] *The Water Project. (2018). Poverty in Africa Begins With Lack of Clean Water.*

Community Involvement and Proper Training

It is commonplace for NGOs to use the unsustainable model of quickly building a water project for a rural community without including the community members in the process. In order to meaningfully and effectively contribute to the ever-present and growing problem of water scarcity and overall availability, NGOs must include community members on the entire process, and ensure that measures are taken to manage and maintain the project.

Many communities are unaware of their ownership and responsibilities to the upkeep of their water projects. Comprehensive community assessments, community-specific trainings, and community resource contributions all decrease the risk of project failure. Additionally, our research has revealed that communities are more likely to take ownership and responsibility of deep boreholes yielding enough water for community development initiatives. This shows that communities were less likely to take such ownership and responsibility of hand-dug or hand-pumped water projects, indicating water availability beyond just consumption leads to community growth, increased health and prosperity for the community as a whole. This simply shows community ownership is connected to the respect and proper care of the system.

There is a major gap between water project implementation and ongoing maintenance. In order to reduce ongoing technical problems in water projects, community members must be involved and trained in regular maintenance. By providing technical training, communities therefore reduce their dependence on external organizations, and are empowered to diagnose and service important elements within the water project.

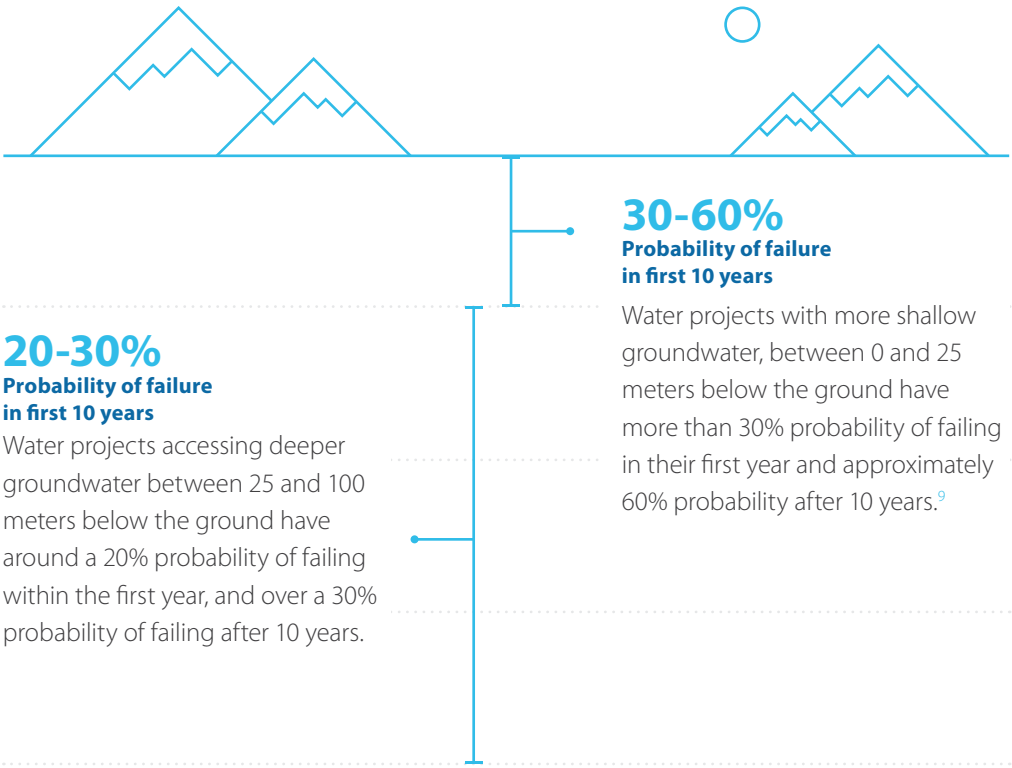
Well Aware has noticed this major gap in the structure of water projects and taken measures to reduce it by the creation of its diagnostic and maintenance app. 34% of Kenyans between the ages 18 and 34 own a smartphone, so the development of an app was the best possible way to share large amounts of reliable and technical information.[7] The app itself is easy to use and allows community members to take ownership of the project while saving time and money, all while extending the life of the water system.

[7] *Cell Phones in Africa. (2015). Pew Research Center.*

Water System Performance by Type

The African continent is home to many resource-rich countries with rapidly increasing gross domestic products (GDP); however, while these countries are going through this accelerated growth, increasing access to clean water is not keeping pace, in part because the definition of water project functionality is not widely agreed upon, making it difficult to assess the success or failure of a specific water system.[8] Various governmental and non-governmental agencies have tried their hands at tackling the issue, but often fall short of making a lasting and meaningful impact. Many types of water projects have been used to combat the water crisis in many Afican countries, but often fail over time without proper oversight.

Water projects that tap shallow groundwater *(hand dug wells and augered/drilled hand pump wells)* are more likely to fail than those that extract deeper groundwater.



30-60%
Probability of failure in first 10 years

Water projects with more shallow groundwater, between 0 and 25 meters below the ground have more than 30% probability of failing in their first year and approximately 60% probability after 10 years.[9]

20-30%
Probability of failure in first 10 years

Water projects accessing deeper groundwater between 25 and 100 meters below the ground have around a 20% probability of failing within the first year, and over a 30% probability of failing after 10 years.

[8] *Bayliss, K. (2013). Financing Water in Africa. SOAS Department of Economics Working Paper Series. P.28.*
[9] *Andres, L., Chellaraj, G., Gupta, B.D., Grabinsky, J., & Joseph, G. (2018). An Evaluation of the Contributing Factors of Water Scheme Failures in Nigeria. World Bank Group: Water Global Practice.*

The Problem with Hand Pumps

For decades, hand pumps have been the go-to device used for water projects around the world. It is important to note that it is difficult to discuss hand pump functionality because there is not a single agreed upon definition of what a functional hand pump is, and how it is universally measured. Consequently, it is imperative that researchers exploring this topic state how they define hand pump functionality in their study, so their results can be accurately interpreted.

The problem with water point and hand pump failure is not new. The exact number of people who rely solely on hand pumps as their main source of water procurement is unknown, but it is estimated to be close to 1 billion. According to a 2009 study by UNICEF, 60,000 hand pumps are installed in Sub-Saharan Africa every year,[10] and recent findings by the Rural Water Supply Network (RWSN) show that 30-40% do not work at any one time. Furthermore, RWSN summarizes that there is a 15% rate of hand pump failure in the first year after installation, and by the fourth year after installation, "25% of water points are non-functional," leading to an overall industry investment loss of $1.2 billion.[11]

The problem itself is not simple, therefore it will require a much more complex solution, rather than "a new type of pump or more capacity development." Long term sustainability, meaning "permanent beneficial change in WASH services and hygiene practices," should be an overall goal, among others, to ensure water point and hand pump functionality.[12]

The failure of hand pumps can be attributed to a variety of reasons.

1. First, the majority of them are manufactured in India, where quality control is not consistently enforced, and low-grade recycled metal is used, meaning parts break more easily.
2. The second and most common reason hand pumps stop working is because a borehole is not properly drilled - either in the wrong way or in the wrong place.
3. There is a shortage of skilled drillers and site laborers, which only exacerbates the already prevalent problem. When a hand pump fails and no one is available to fix it, the community loses access to a precious resource.[13]

Hand pumps are also often drawing from water that is contaminated. Hand pump wells can only extract water from shallow sources, which are easily polluted by absorption of contaminants from the surface, typically coliform from human and animal waste.

Additionally, hand pump water systems are only able to accommodate consumptions needs for up to a few hundred people per day. Further development potential, such as agriculture and distribution, can not be met with this yield. Subsequently, studies also reveal that communities lack respect for these systems and therefore, are less likely to maintain them.

The failure of hand pumps has contributed to a loss of investment of over $1.2 BILLION

[10] *Sansom, K., and Koestler, L. Afrifcan Handpump Market Mapping Study. 2009. Summary Report for UNICEF WASH Section and Supply Division.*
[11, 12] *Banks, B. & S. G. Furey (2016) What's Working, Where, and for How Long. A 2016 Water Point Update to the RWSN (2009) statistics, GWC/Skat, RWSN, St. Gallen, Switzerland*
[13] *Purvis, K. How do you solve a problem like a broken water pump? The Guardian.*

Solar Powered Water Systems

Solar powered systems perform better and are more cost effective over time.

A Solar Submersible Pump is a fairly basic electric pump which provides its energy from a Photovoltaic solar panel. It is a more impactful and sustainable alternative to hand pumps and can be used to pump water from bore holes, water reserves such as ponds, or other supplies of water.[14]

Solar-powered submersible pumps have the general benefit of becoming completely self-powered. They can be installed far from other energy sources, particularly in remote areas. There are no moving parts with the addition of the solar panels, which reduces maintenance costs and failure rates. As their use becomes more popular worldwide, reductions in the cost of manufacturing photovoltaic cells is dramatically decreasing, therefore increasing the efficiency of a program set to use more solar panels for the submersible pumps.[15]

Solar submersible pumps also have the capability to extract much greater quantities of water, further contributing to community development and community system ownership.[16]

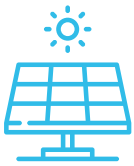
ADVANTAGES

Unattended operation

Low maintenance costs

Long lifetime (low average yearly costs)

Yield more water than hand pump systems



The International Renewable Energy Agency is projecting a **60% decrease in the production cost** of photovoltaic solar panels within the next decade.[17]

For the overall life of the system, the cost of using solar is roughly **8 cents per cubic meter versus 24-44 cents per cubic meter** with other systems and power options.[18]

[14] *Chandel, S., Naik, M. N., & Chandel, R. (2015). Review of solar photovoltaic water pumping system technology for irrigation and community drinking water supplies. Renewable and Sustainable Energy Reviews,49, 1084-1099.*
[15] *Food and Agriculture Organization of the United Nations. (2018). The benefits and risks of solar-powered irrigation – a global overview.*
[16] *Solar Water Pumps. ClimateTechWiki.*
[17] *Ralon, P., Taylor, M., Ilas, A., Diaz-Bone, H., Kairies, K. (2017). Electricity Storage and Renewables: Costs and Markets to 2030. International Renewable Energy Agency.*
[18] *Rural Water Supply Network. (Producer). (2018). Taking stock of solar pumping for domestic waters supply - Operation and maintenance [Video webinar].*

Community WASH Training (and lack thereof)

The majority of diseases contracted in poor rural communities are caused by lack of access to clean water. These diseases, such as cholera, Hepatitis A and E, trachoma, etc. are the direct consequence of poor sanitation practices, whose effects can be reduced by WASH training that accompanies a reliable clean water source. When there is a lack of clean running water, the spread of disease is common, most of which are primarily caused by fecal ingestion via fingers, flies, soil and food. In addition to safer health practices,WASH provides the community with an overall feeling of well-being, safety and comfort. Community WASH training, in addition to access to clean water, will easily and drastically reduce the risk of waterborne diseases by allowing community members to become familiarized with sanitation practices.[19]

A very serious problem often overlooked is the proximity of pit latrines, which are the most common human waste disposal systems, to drinking water systems. It is critical to drill for water away from the latrines and to drill as deep as necessary, to prevent any surface contamination. This is a one prime example of how WASH services are incredibly important to the overall health and sustainability of a Community.[20]

Worldwide in 2015,

500K

CHILDREN DIED

from diarrheal illnesses, most of which are caused by unsafe water, poor sanitation, and inadequate hygiene.[21]

With proper WASH training, diseases, overall, can be

REDUCED BY MORE THAN

64%[22]

[19] *Hutton, G. & Chase, C. (2016). The Knowledge Base for Achieving the Sustainable Development Goal Targets on Water Supply, Sanitation and Hygiene. International Journal of Environmental Research and Public Health, 13(6), 536.*

[20,21] *Planning and Training for a Water, Sanitation, and Hygiene (WASH) - related energy. (2016). Center for Disease Control and Prevention.*

[22] *The World Health Organization. (2019). Drinking Water: Key Facts.*

Lack of Measurement & Evaluation

In order to assess, replicate, and improve any large-scale development projects, there must be measures taken to assess the efficacy and impact of the project. It is imperative to determine that the goals of the project have been met by measuring consistent benchmarks through uniform methodology.

Impact Overview of Properly Functioning Water System Availability [23]

34%↑ Education Rates Increase Overall

58%↑ Education Rates Increase for Girls

64%↓ Disease Rates Decrease Overall

↓ Overall Decrease in Birth Rates & Infant/Childhood Mortality

Traditionally, evaluation has not been given the same weight, or has not been seen as critically significant as monitoring, and it is not uncommon for organizations to lack the skills and experience to develop robust evaluation frameworks and study designs.

Without proper measurement and evaluation, there is no level of accountability to assure others that positive change is really truly achieved for the most marginalized communities. It is, furthermore, a sizable waste of resources and extremely detrimental to the communities' success and how these communities perceive our intervention.[24]

Despite the prevalence of this understanding throughout the water aid sector,

FEWER THAN 1%

of international NGOs conduct any form of measurement and evaluation.

[23] *The World Health Organization. (2019). Drinking Water: Key Facts.*
[24] *Tetra Tech. (2015). WASH Sustainability Index Tool Assessment: Ethiopia. United States Foundation for International Development.*

Summary & Acknowledgements

As it is today, most dollars sent to water projects are not funding lasting solutions. But, it doesn't have to be this way. With proper technical expertise, appropriate water system type, community involvement, WASH training, and Measurement and Evaluation, projects can succeed and communities can thrive.

8 Important Discussions in the Water Aid Community was made possible by:

- Sarah Evans, J.D., Well Aware Founder & Board Chair
- Anna Provenzano, Well Aware Director of Operations
- UMUC Capstone
- Well Aware, Inc.
- Well Aware Technical Team of Hydrogeologists and Engineers

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