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**EQUITABLE AND SUSTAINABLE WASH SERVICES:
FUTURE CHALLENGES IN A RAPIDLY CHANGING WORLD**

**Decentralized solar-powered drinking treatment
in Kisumu County, Kenya**

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Background

Safe, affordable drinking water is not readily available to many people in low- and middle-income countries, particularly in rural communities. As a result, nearly 500,000 children under the age 5 years died in 2019 due to diarrhea caused by unsafe water. Centralized drinking watertreatment systems remain out of reach due to costs, and while health benefits have been difficult to consistently demonstrate for point-of-use treatment methods.¹ We previously described the impacts of solar-powered ozonation on water quality in Western Kenya. In the first study we addressed the deployment of this technology asa a point-of-use method.² Based on the efficacy of that approach, as well as community perspectives, this technology was been scaled up for deployment as a solar-powered, decentralized process for treating heavily contaminate surface water.³ However, the ability of the systems to reduce fecal indicator bacteria levels, impact water insecurity among local residents, and the financial viability of the system needs to be assessed.

Methods

We collected several types of data regarding the performance and operation of two solar-powered decentralized drinking water systems in Western Kenya known as Sola Maji (“solar water” in Swahili). Turbidity and *E. coli* concentrations in source water and finished water were measured at the two sites, as were water production volumes and water sales. Household water insecurity before and after the treatment system became operational was evaluated among households near one of the sites using the internationally validated HWISE scale, at baseline, 4-month later (six weeks after the water treatment system become operational) and again 4 months later. The challenges and success of these systems are described.

Results

With one year of follow-up, the Sola Maji systems reduced turbidity and *E. coli* concentrations by at least 99% at both sites. Water production and sales at each site is approximately 2,000 liters/day. Between the baseline assessment in July, 2020 and the first follow-up assessment in November-December, 2020, household water insecurity decreased, even though rainfall decreased. This was also true for comparisons of household water insecurity between the November/December 2020 follow-up and the March, 20201: ambient temperature increased and precipitation decreased, yet housholed water insecurity scores decreased significantly. Stratifying analyses by use of the solar powered water treatment systems showed that decreases in water insecurity were limited to the household ailability of treated water at the kiosks (change in HWISE score: -3.9 (p<0.001) among kiosk users (n=49) vs. -0.28 (p>0.4) among non-users (n=39). Water sales alone were not sufficient to cover operating costs, however, entrepreneurship by community members centered at the water kiosks resulted in a varity of other revenue streams, which approached operating costs (approximately USD 220/month). Partnerships between communities, entrepreneurs, local government, an

non-governmental organization (NGO), and an academic partner all were critical to the establishment and continued operation of the treatment systems. In particular, the transition of the system operation and sales of water at the sites' kiosks was accomplished as a result of the establishment of a community based organization (CBO) and the mentoring and support of the CBO by the NGO partner.

Discussion

Based on measures of water quality and household water insecurity, solar powered decentralized water treatment stations such as Sola Maji should be promoted for use in rural areas of low- and middle-income countries. The fact that operating costs are nearly met by operating revenue suggests that by scaling up the production capacity and standardizing system design and operations should allow the systems to become financially viable as well. Whether such systems would be culturally acceptable and fiscally viable in other regions of the world has yet to be determined.

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