New research offers solutions to improve drinking water access in developing countries

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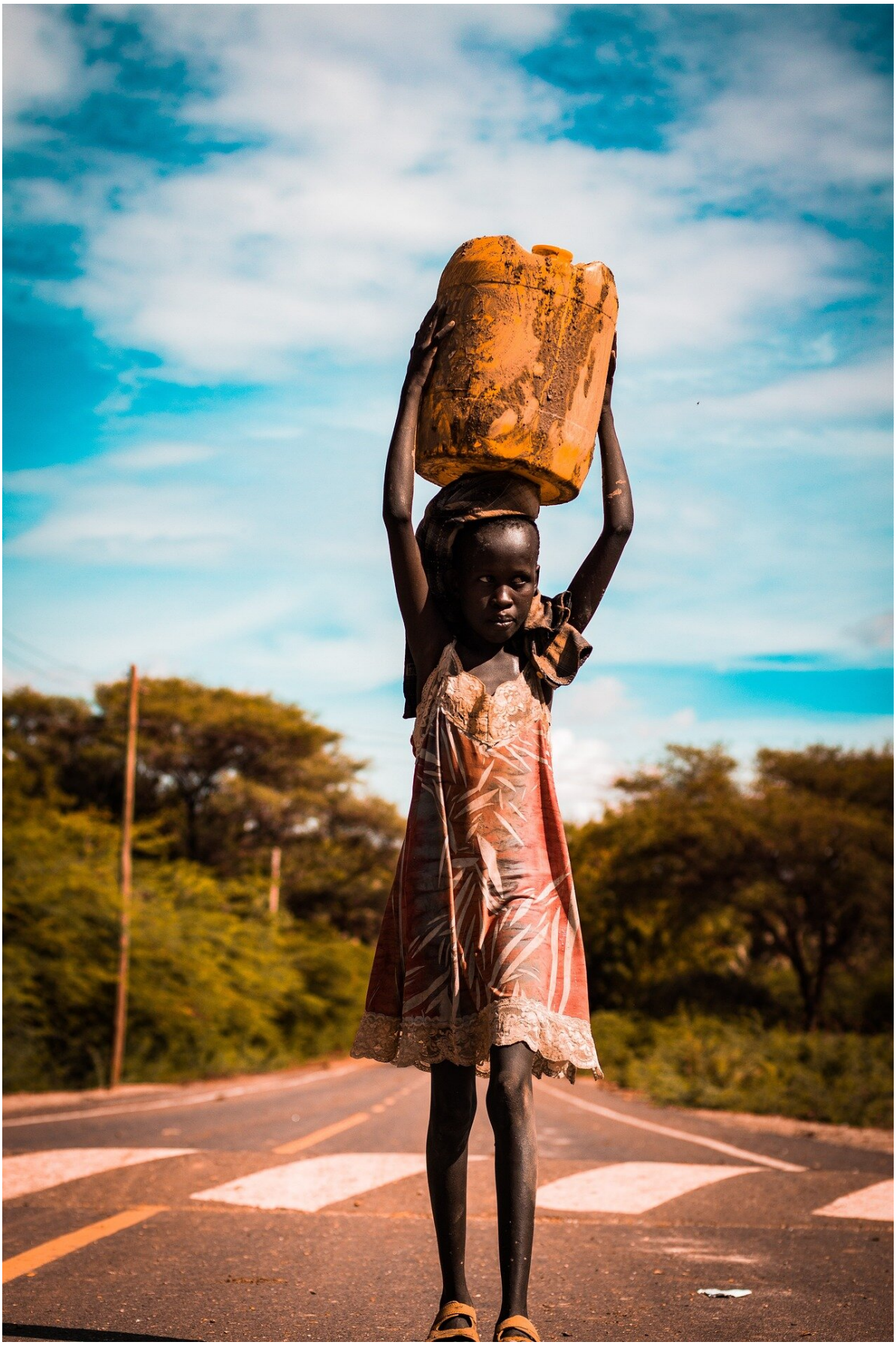

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New research from Alfonso Pedraza-Martinez, the Greg and Patty Fox Collegiate Professor of IT, Analytics and Operations in the University of Notre Dame's Mendoza College of Business, examines the critical problem of drinking water access in rural areas of developing countries and recommends optimal locations to build new water projects.

The work, titled "Improving Drinking Water Access and Equity in Rural Sub-Saharan Africa," forthcoming in the journal *Production and Operations Management*, studies access to drinking water in Tigray, Ethiopia, where millions of people walk hours each day to access communal water. The study, co-authored by Chengcheng Zhai, Kurt Bretthauer and Jorge Mejia from Indiana University, pulls from field research conducted in Tigray and collaborations with local and international NGOs.

"The burden of getting water falls mostly on women and children," said Pedraza-Martinez, who specializes in humanitarian operations and disaster management. "It is not rare to see a woman accompanied by her children carrying a heavy jerrycan full of water back home in the scorching hot weather."

Due to a lack of local government solutions, NGOs build water projects that extract underground water to reduce the population's distance and time to access it. In collaboration with U.S. NGO Charity: Water and Ethiopian NGO Relief Society of Tigray, the team worked to understand the roles of the different stakeholders.

"Building water projects is expensive and funding is scarce," Pedraza-Martinez said. "NGOs must select locations for new water projects while navigating tight budget constraints and very limited access to data on demand locations.

"We discovered that communities actively participate in the management of existing water projects, so we propose that two neighbor communities collaborate, pooling their demand, to increase the potential supply for both communities."

The team created a unique dataset with current demand and distance to an existing water project in Tigray. Using analytics, they built an optimization or ideal solution (centralized model) that incorporates community collaboration, and compared its solutions with the current practice that serves each community separately.

The community collaboration model proved to be a better solution—in terms of distance to water and equity in the access to water—than the other models they considered. The "minimax" model adjusted the objective to minimizing the maximum distance to water and the equitable allocation model adjusted the current per capita budget allocations to assign more budget to beneficiaries who are further from water.

"When Ethiopian communities (kebeles) collaborate to access water as a single, larger community, it removes geopolitical boundaries for water purposes," Pedraza-Martinez said. "It gives people who live on the outskirts of one kebele the option of walking a shorter distance toward another to use a hand pump or other water source, rather than walking a longer distance to find one in their own kebele. If there is cooperation, this solution is very effective to reduce distance and increase equity."

Motivated by Ethiopia's current civil war, the team also created a model

to study ways to improve drinking water access amid supply shocks.

The team is sharing its findings with Charity: Water, which is using the new model to inform the selection of locations for new water projects in Malawi and the Central African Republic, along with other countries. They also plan to publish a pedagogical case study to share their research findings with MBA programs around the world.

More information: Chengcheng Zhai et al, Improving drinking water access and equity in rural Sub-Saharan Africa, *Production and Operations Management* (2023). DOI: 10.1111/poms.14016

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