# Understanding WASH Systems with System Dynamics Modeling

## Understanding Complexity

Water and sanitation services exist within a complex system. A web of interacting actors and factors influences how WASH services are delivered and sustained.

Given this complexity, it can be hard to figure out what factors are constraining a service, where interventions can best be leveraged, and the effects on specific outcomes over time. By modeling your dynamic system, you can uncover opportunities to drive positive change and improve WASH service levels over the long term.

### WATER AND SANITATION SERVICE DELIVERY IS A COMPLEX SYSTEM WITH ELEMENTS OF:

**FEEDBACK LOOPS**

Factors have circular relationships with positive or negative effects on each other

- Water tariffs affect household water demand which in turn affects tariff setting
- Improved functionality promotes pump use and increased component wear which leads to less functionality

**STOCKS AND FLOWS**

Inputs, outputs, and accumulation of what is being studied

- Household water storage
- Fecal sludge treatment plant capacity
- WASH committee bank accounts

**INTERACTIONS AND INFLUENCES**

Small changes in certain factors can have disproportionate effects on outcomes

The predicted lifespan of components and the time to repair them is affected by:

- Distance to site
- Prices
- Weather

**SEQUENCES AND TEMPORAL INFLUENCES**

Factors that slow down progress toward an objectve

- Availability of spare parts
- Treatment time
- Suppressed demand
- Travel times
- Vehicle access

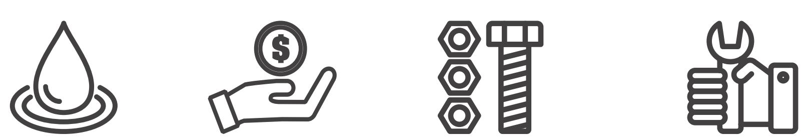
## Turning Findings into Actions

The goal of modeling is to support decisions that improve your system. An effective System Dynamics Model can help you answer questions such as:

- What will the demand for this service be in 10 years or longer?
- How much to invest in the service for long-term sustainability?
- What resources constrain performance and outcomes?
- What is the optimal frequency of inspections to reduce costs?

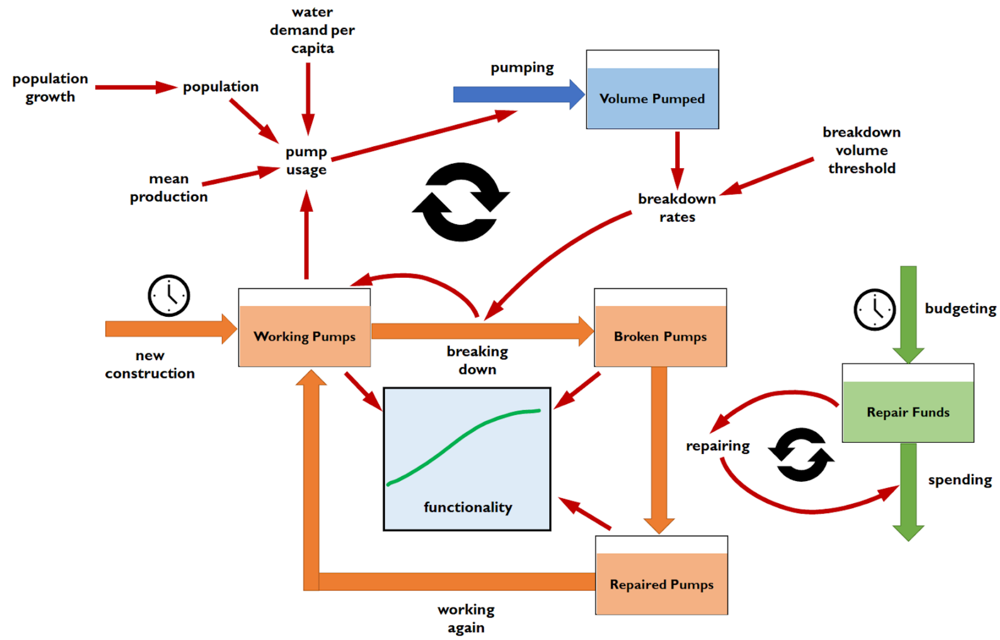
System Dynamics Modeling can be applied to:

- Test interventions and implementation strategies with cost-benefit and sensitivity analyses
- Generate multi-year simulations for:



water demand tariff-setting spare parts supply frequency of repairs

## *Example: Water Pump Maintenance*




In this example model, SWS simulates the functionality of groundwater pumps that go from a state of working, to broken, to repaired. Components of the model include:

- Stocks of working, broken, repaired pumps, repair funds, and volume of water pumped,
- Interactions and influences like population growth, new construction time delays, and breakdown volume threshold (the volume a typical pump will produce before a breakdown occurs), and
- Feedback loops. Loop 1 is the balancing relationship between pump usage, breakdown rates, and working pumps. Loop 2 is the balancing relationship between repair funds available and the number of repairs service providers conduct.

By running the model, SWS sees that if repairs happen faster than breakdowns, functionality increases!


## LEARN MORE

SWS is using System Dynamics Modeling to investigate the effects of resource allocation on borehole repairs in Ethiopia as well as the financial and functionality implications of scaling professional maintenance services for the rural water sector in Kenya. For updates on this research, including upcoming publications, check out Globalwaters.org/sws.