



BEYOND THE GAP

How Countries Can Afford the Infrastructure They Need while Protecting the Planet

Policy Note 2/6

Water, Sanitation, and Irrigation: Target, Technology, and Public Support Shape Costs

In low- and middle-income countries, infrastructure—defined here as water and sanitation, electricity, transport, irrigation, and flood protection—falls short of what is needed to address public health and individual welfare, environmental considerations, and climate change risks, let alone achieve economic prosperity or middle-class aspirations. How can this situation be reversed? This policy note is drawn from *Beyond the Gap: How Countries Can Afford the Infrastructure They Need while Protecting the Planet*, edited by Julie Rozenberg and Marianne Fay, Sustainable Infrastructure Series (Washington, DC: World Bank, 2019). The report not only contends that the focus should be on the service gap—not the investment gap as is typically the case—but also offers a careful and systematic approach to estimating the funding needs (capital and operations and maintenance) to close the service gap. The results presented here were developed specifically for this report, based on clearly specified access and climate goals and using numerous scenarios to explore both uncertainty and the consequences of policy choices.

Policy Note 2—one of six drawn from *Beyond the Gap*—explores the costs of needed infrastructure for water, sanitation, hygiene, and irrigation. Policy Note 1 provides an overview of the report, Policy Note 3 focuses on the power sector, Policy Note 4 focuses on the transport sector, Policy Note 5 focuses on coastal and river flood protection, and Policy Note 6 focuses on climate change.

Key messages

- **Universal coverage of safe water, sanitation, and hygiene (WASH) in low- and middle-income countries (LMICs) could be achieved at the relatively modest capital cost of 0.3 percent to 0.6 percent of gross domestic product (GDP) per year, depending on the ambition of the target (basic or safe service) and the technology adopted (low cost or high cost).**
- **However, operations and maintenance (O&M) more than doubles the funding needed, to between 1.1 percent and 1.4 percent of GDP. Our “preferred” strategy—involving a gradual rollout of safely managed water and sanitation using high-cost technology where appropriate given population density—would cost LMICs a total of 1.3 percent of GDP per year.**
- **Extending irrigation to the full extent of available water (after satisfying human and industrial consumption) would cost between 0.15 percent and 0.25 percent of GDP per year, depending on policy choices pertaining to subsidies. Our “preferred” strategy—involving subsidies for irrigation equipment, but not for water consumption—would cost around 0.13 percent of GDP per year for capital and maintenance. In all scenarios, complementary policies are needed to limit the negative impacts on ecosystems.**

Water is a central concern for populations in LMICs. Yet only 43 percent of the population of LMICs has access to “safely managed” water and 30 percent has access to sanitation—far from the universal coverage for safe water and sanitation set by Sustainable Development Goal (SDG) 6. Even access to *basic* water and

sanitation is not universal (81 percent for water, 61 percent for basic sanitation). Irrigation, another critical facet of the water infrastructure agenda, covers only 30 percent of global cropland—less than half of irrigation potential—despite the fact that irrigation can improve land productivity and climate resilience, thereby contributing to SDG 2 on food security.

What would it cost to achieve the water-related SDGs? *Beyond the Gap* undertakes a comprehensive quantification of future investment needs for LMICs in WASH and in irrigation by 2030. The two most important determinants of cost for WASH are the ambition of the goal for access and quality—underscoring the need for policy debates focusing on this issue—and for technology.

Water: Tailored strategies and attention to O&M can keep costs reasonable

SDG targets 6.1 and 6.2 set out the goal of universal access to *safely managed* water, sanitation, and hygiene services and an end to open defecation by 2030. This goal can be achieved using more or less expensive technologies (for example, relying on septic tanks rather than sewerage systems with treatment). We compare the cost of achieving the SDGs with the cost of achieving access to *basic* water and sanitation (two different levels of ambition), and we vary technologies, pathways toward the SDGs, and assumptions regarding population growth and urbanization as well as capital costs.

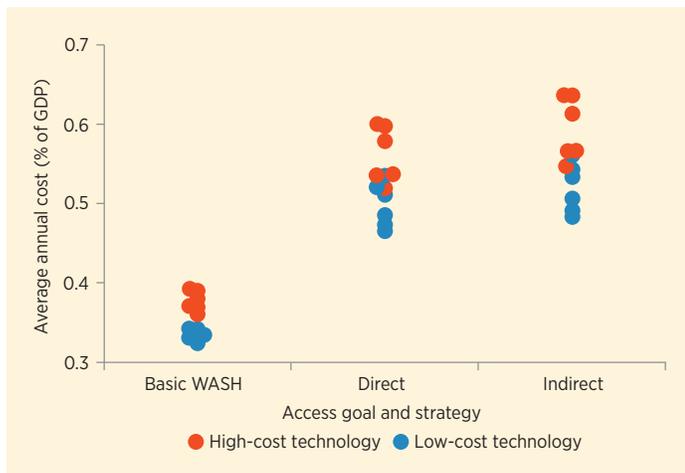
Lower-cost technologies can help to achieve the SDGs at a relatively modest 0.5 percent to 0.6 percent of GDP in capital costs

Our results show that, while the total capital cost to achieve universal access to *basic* water and sanitation ranges between US\$116 billion and US\$142 billion, the cost to achieve the SDG targets ranges between US\$171 billion and US\$229 billion (0.5 percent to 0.6 percent of GDP). This includes the costs of extending coverage to persons who are currently unserved, as well as around US\$100 billion to replace *existing* assets that have reached the end of their useful life. The principal driver of capital cost beyond the ambition of the goal is the choice of technology (figure 1).

Thus, countries may want to limit the use of high-cost technology to higher-density cities and deploy low-cost technologies where the conditions (population density, urbanization) allow, with conventional sewerage and wastewater treatment phased in

FIGURE 1 The goal and the choice of technology are the main drivers of investment costs

Average annual cost of capital investment in water and sanitation, by access goal, strategy, and choice of technology, 2015–30



Source: See figure 2.2 in the full report.

Note: Each dot corresponds to 1 of 36 scenarios based on variations across three goals (basic WASH, direct, indirect), two technologies (high cost, low cost), three possible rates of population growth and associated urbanization, and a high and a low estimate of capital cost. The graph (like others in this policy note) is a “beeswarm” plot, which plots data points relative to a fixed reference axis (the x-axis) in a way that no two data points overlap, showing not only the range of values but also their distribution. The “direct” pathway is one in which every new household served is provided with safely managed water and sanitation; the “indirect” pathway first rolls out universal access to basic services before upgrading to safely managed services. Estimates include capital costs both to expand access and to preserve it for those currently served. WASH = water, sanitation, and hygiene.

as population density increases. Such an approach (our “preferred scenario”) would rely on high-cost technology in cities and low-cost technology in rural areas, bringing the total amount to US\$198 billion, or an average of 0.55 percent of LMICs’ GDP.

O&M accounts for more than half of financing needs

But capital investments are only part of the story. For water and sanitation, average annual O&M costs exceed capital costs in all of the scenarios considered, accounting for 54–58 percent of the total annual expenditure needed to deliver the service. When O&M costs are included, meeting SDG targets 6.1 and 6.2 would cost between 1.1 percent and 1.4 percent of LMICs’ GDP (figure 2). Failure to perform routine maintenance would reduce the useful life of installed capital and increase overall capital replacement costs by at least 60 percent.

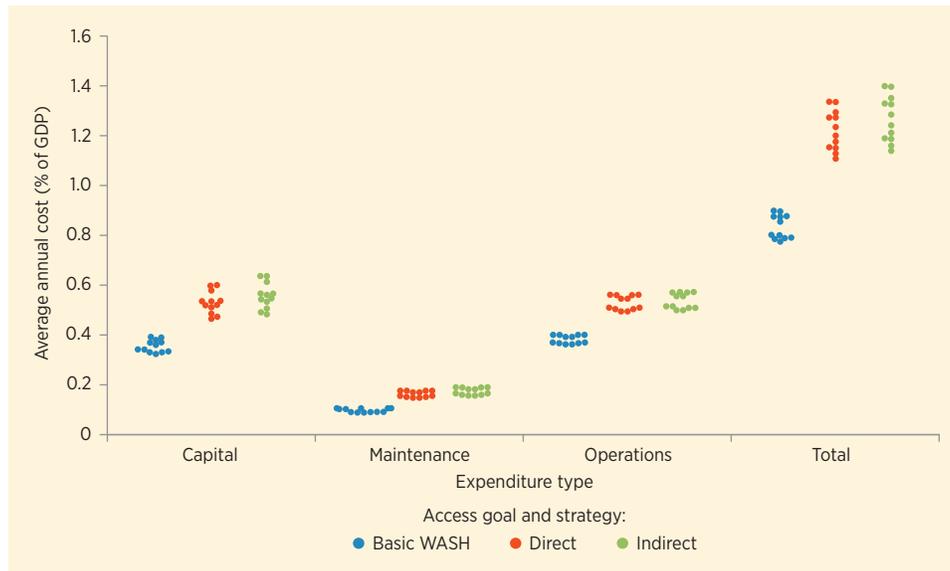
The fact that O&M constitutes the bulk of overall costs means that countries need to think about the affordability of expansion plans. It is not enough for donors to raise funds and for governments to make room for capital investments. Allowance for an equivalent amount, or more, must be made for O&M in order to ensure that safe water flows through the pipes.

Irrigation: Public support boosts food security but can pose issues for other SDGs

How much would expanding irrigation in LMICs cost? Where irrigation is appropriate, public support for irrigation is necessary, as the needed investments go well beyond the economic means of farmers. We thus model two strategies for public support for irrigation, which differ in the degree to which they subsidize irrigation capital and water use. We assess the cost of these two strategies across multiple scenarios, varying assumptions regarding trade openness for food markets, climate change, and changes in diets.

The primary driver of future investment costs for irrigation is the extent of public support. Under high public support policies—which subsidize both capital and operating costs, resulting in irrigated land extending to its full potential—irrigation investments would be between 0.15 percent and 0.25 percent of GDP per year, on average, between 2015 and 2030 in LMICs. This is substantially more than under moderate public support policies that cover only capital expenditures (figure 3). As with water and sanitation infrastructure, a large share of total spending would be to replace existing capital (0.05 percent of GDP per year between 2015 and 2030).

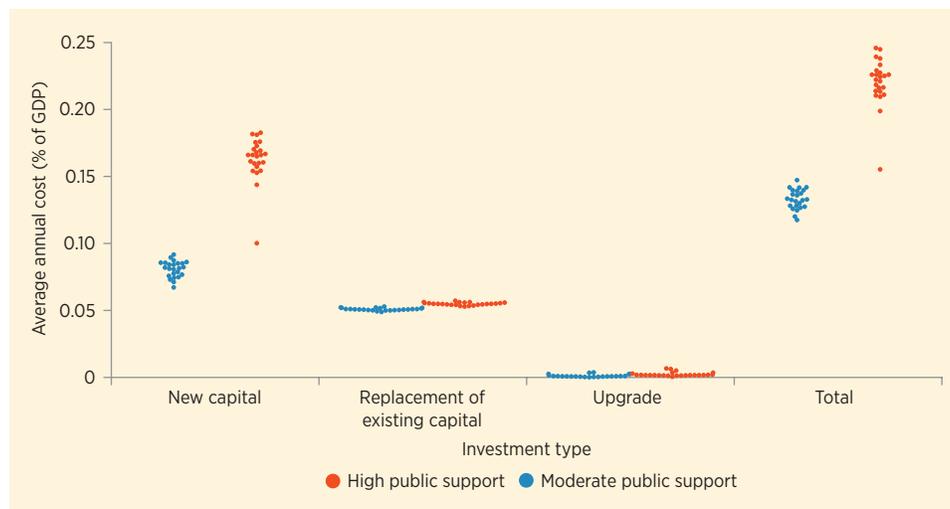
FIGURE 2 Operations and maintenance spending matters as much as capital spending for water and sanitation
Average annual cost of capital and operations and maintenance in water and sanitation, by access goal and strategy, 2015–30



Source: See figure 2.4 in the full report.

Note: Capital, operations, and maintenance costs are for both new and existing users. They represent the amount needed both to expand service and to continue serving existing users. The “direct” pathway is one in which every new household served is provided with safely managed water and sanitation; the “indirect” pathway first rolls out universal access to basic services before upgrading to safely managed services. WASH = water, sanitation, and hygiene.

FIGURE 3 Public support policies drive investment costs in irrigation
Average annual cost of investment in irrigation, by investment type and level of public support, 2015–30



Source: See figure 2.6 in the full report.

Note: High public support policies fully subsidize irrigation capital expenditures and water for farmers. Moderate public support policies cover only capital expenditures.

Costs vary significantly across regions—from between 0.08 percent and 0.16 percent of GDP annually for the Middle East and North Africa to between 0.32 percent and 0.72 percent

of GDP annually for Sub-Saharan Africa—as do impacts on food security: the impact on food security from increasing irrigation to its full potential varies from 10 kilocalories per capita per day

in Europe and Central Asia to 51 kilocalories per capita per day in South Asia.

In addition, investments in irrigation can have negative impacts on environmental flows and on forests—because of the rebound effect created by higher yields, which increase the expansion of cultivated land—and thus on greenhouse gas emissions and biodiversity. Further, in dry areas, irrigation can lead to maladaptation, whereby farmers drain finite underground water resources or specialize in “thirsty” crops ill-suited for the

local climate. Thus, complementary policies are needed to limit the negative impacts on ecosystems and provide farmers with climate-smart practices and technologies.

The most desirable strategy in our analysis is perhaps to provide moderate public support for irrigation, which subsidizes irrigation equipment but not water, so that farmers gain a sense of increased water scarcity when too much water is extracted. This strategy would cost LMICs around 0.13 percent of GDP per year.