Improving sanitation access with subsidies, loans, and community-led programs

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Programs involving community behavior-change campaigns and subsidies to boost toilet construction can improve people's access to and use of improved sanitation facilities. However, evidence on the downstream health impacts of common sanitation programs in low- and middle-income countries has been mixed.



Community toilet in India.

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Summary

As of 2022, 419 million people defecated in the open (in fields, forests, bodies of water, or other spaces), and 545 million people defecated in facilities that did not adequately separate waste from human contact (e.g., pit toilets without a slab, bucket latrines).[36], [1], Defecation in the open or in unsanitary facilities poses serious risks to public health, both by spreading disease through direct human contact with feces and by contaminating water. These unsanitary conditions contribute to the global burden of diseases and can limit children's physical and cognitive growth[39], . The United Nations Sustainable Development Goals (SDG #6) calls for ending open defecation by 2030. Many governments have attempted to reduce open defecation by encouraging the building and use of flush or pit toilets that separate feces from contact with people and drinking water.[10]

However, several barriers affect the construction and use of improved facilities. Households may find the cost of building an improved sanitation facility prohibitively high or lack access to the relevant materials or know-how to build them, while difficulty maintaining toilets can make them unappealing to use. They may also be unaware of the health risks of unsanitary defecation, or

social norms could limit their demand for improved sanitation facilities.

To understand the effectiveness of efforts over the past twenty years to overcome these barriers, J-PAL reviewed 27 randomized evaluations from fourteen countries that measured the impact of awareness programs, subsidies, and loans for sanitation purposes. Common programs provided communities with nudges and informational workshops to highlight the benefits of toilet usage along with financial subsidies to help households build toilets. There were three overarching findings. First, most sanitation interventions improved access to toilets. While many programs also boosted toilet usage, the relationship between increased access and usage was not one-to-one. Second, programs that provided subsidies or other support to build toilets were most successful at boosting household toilet ownership and usage. However, they rarely improved health outcomes like diarrhea, parasitic infection, or child growth, even when they increased toilet access and usage. Programs often fell far short of universal toilet coverage or usage, which may be necessary to realize health benefits from improved sanitation.

Nevertheless, sanitation information, subsidy, and loan programs can help reduce open defecation by increasing the use of improved toilets while governments continue pursuing more comprehensive piped sanitation systems, which have greater potential to minimize the spread of disease.

*Read on and listen to the **VoxDev podcast**, featuring Karen Macours (J-PAL Health sector Co-Chair) to learn more.*

Supporting evidence

Information campaigns can increase both people's access to and ownership of toilets. Information campaigns often involve a technique called Community-Led Total Sanitation (CLTS). CLTS programs aim to help community members understand the negative consequences of open defecation and enact solutions to reduce open defecation rates.[11], Facilitators often describe how fecal contamination can spread from waste to food and drinking water and walk community members through their village to identify areas of poor sanitation. Community members can often then set up community planning sessions to discuss ways to decrease open defecation.[11], The exact structure of CLTS activities can differ in intensity and scale (one review of CLTS programs in Ghana and Ethiopia found they cost between $14 and $82 per household[15]).

CLTS-only programs were largely successful in boosting household access to and ownership of toilets but to different degrees. Five [32], [11], [21], [8], [1], of six studies that evaluated CLTS-only programs[32], [11], [21], [8], [1], [19], found that they increased toilet coverage.[3], A CLTS-only program with frequent facilitator follow-ups in Mali almost doubled household access to private toilets (65 percent versus 35 percent in the comparison group)[32], , while households in Indonesian villages where a CLTS program was scaled up saw smaller gains and increased toilet construction by 2.4 percentage points[11], . By contrast, in Bangladesh, a CLTS-only intervention showed no impact on toilet access[19], . Program intensity, the existing sanitation situation, and other contextual factors likely drove these different levels of impact.[4], [1], For example, an evaluation in Nigeria found that CLTS increased toilet ownership by 10 percentage points in low-income areas but had no impact on ownership in high-income areas.[1]

Programs that reduced the cost of building toilets had more consistent impacts on access to and ownership of toilets, though subsidies often had to be large to be effective. Twelve evaluations reviewed here[5], [19], [29], [12], [13], [28], [20], [25], [26], [22], [30], [16], examined the effect of fully or partially offsetting the cost of building or maintaining a toilet, for example, through subsidies or providing materials, alongside toilet promotion campaigns. All twelve programs increased toilet coverage. In Bangladesh, for example, households living in villages with CLTS that also ran a lottery for 75-percent-off subsidy vouchers increased their toilet access by 7.3 percentage points, while CLTS programming alone had no effect.[4], [19], In the Indian state of Odisha, toilet coverage among households receiving a combined subsidy and toilet promotion program increased by 51

percentage points relative to the comparison group (63 percent compared to 12 percent), while coverage of functional latrines increased by less (28 percentage point increase, or 38 percent compared to 10 percent).[5], [13], While construction subsidy programs helped households to build toilets, making sure they continued functioning over time often proved challenging, suggesting that strategies to help households maintain toilets are also critical.[27], [35]

Subsidies for toilet *maintenance* can help households address the challenge of keeping toilets functioning. This may involve manually emptying waste pits, which directly exposes individuals to fecal matter and raises the possibility of contamination and disease. In Senegal, urban households received a subsidy worth 32 percent of the cost of emptying waste pits with a vacuum truck (a $16 subsidy for a $50 service), as opposed to manually desludging the pit with a shovel. Households receiving the subsidy increased mechanical desludging by 2.6 percentage points (34.1 percent mechanical desludging in the program group compared to 31.5 percent in the comparison group).[24]

Beyond direct subsidies, other financial interventions like offering microloans can also increase toilet ownership. In the Indian state of Maharashtra, households who were offered a low interest rate loan that was marketed as being for sanitation were 9 percentage points more likely to own a toilet two-and-a-half years later (50 percent compared to 41 percent in the comparison group).[5], In Cambodia, households offered small loans to purchase toilets at an unsubsidized cost of $40 increased toilet purchase rates by 33.8 percentage points. However, less than 40 percent of households who purchased toilets installed them. These low installation rates might have been caused by households' preference for more advanced (and expensive) toilet room designs with a roof and walls, causing them to postpone their toilet installation.[7], People's low willingness to pay market prices for toilet supplies, vendors' limited marketing activities, and intra-household gender dynamics can also affect the impact of offering loans for sanitation purposes.[31], [5]

Social interactions like social pressure, reciprocity, and learning from peers, as well as people realizing there are health benefits when other people use improved sanitation, can influence how people respond to sanitation programs. In Bangladesh, households who received vouchers covering half the cost of a toilet and its installation were 7.2 percentage points more likely to actually buy a toilet when half of their neighbors also received the vouchers, compared to when only 25 percent of their neighbors received them.[19], On the other hand, households in Cambodia who had more neighbors purchase a toilet were less likely to install a toilet of their own.[7], In this context, many households shared toilets or reported co-owning a toilet with their neighbors. As a result, a neighbor's decision to install a toilet may have decreased the incentives for a household to install their own.[7]

Interventions that increased toilet access consistently increased toilet usage and reduced open defecation, though the strength of the relationships varied by context. In the Indian state of Madhya Pradesh, households who received subsidies for toilet construction through a version of India's Total Sanitation Campaign were 17.7 percentage points (40.3 percent, relative to 22.6 percent in the comparison group) more likely to own an improved toilet.[28], Further, adult open defecation rates decreased by about 9 percentage points (about 75 percent open defecation among adults receiving the program, relative to about 84 percent in the comparison group).[28], On the other hand, a CLTS intervention in Tanzania increased household use of improved toilets by 15.1 percentage points, a rate higher than that by which household toilet ownership increased (8.2 percentage points).[8]

The extent to which households participating in CLTS programs increase toilet usage may depend on the intensity of the program and the presence of follow-up activities. Some CLTS programs only included an initial visit from a facilitator, after which community members were expected to take over leadership of the program. Programs from Mali and Pakistan that increased toilet usage in specific populations featured facilitators who frequently followed up with community members, and researchers hypothesized that this continued engagement was a factor in these programs' overall effectiveness.[10], In Pakistan, for example, households in communities with low-quality public infrastructure who received follow-up reminders were 26

percentage points less likely to openly defecate (versus 64 percent in the comparison group) and 26 percentage points more likely to use a functional toilet in their home (versus 44 percent in the comparison group) than those who did not receive follow-up reminders.[4] However, more intense CLTS programs require more follow-up visits by facilitators, which drives up their costs.

Sanitation programs—whether involving CLTS or subsidies—had mixed impacts on people's health outcomes, even when they meaningfully increased toilet access and usage. Eight[3], [33], [32], [13], [28], [26], [8], [22], of eleven studies examining the impact of sanitation programs on diarrhea rates[3], [33], [32], [13], [28], [26], [8], [22], [25], [20], [17], found no impact on diarrhea rates.[6], Further, all three of the studies that found reduced open defecation rates and also studied impacts on diarrhea rates found no reduction in diarrhea.[28], [8], [22], In Kenya, for example, 78 percent of participants in a program that upgraded household toilets and promoted toilet use had access to improved sanitation facilities after the program (compared to 20 percent with access to improved toilets in the comparison group), but this increase had no impact on diarrhea rates.[26]

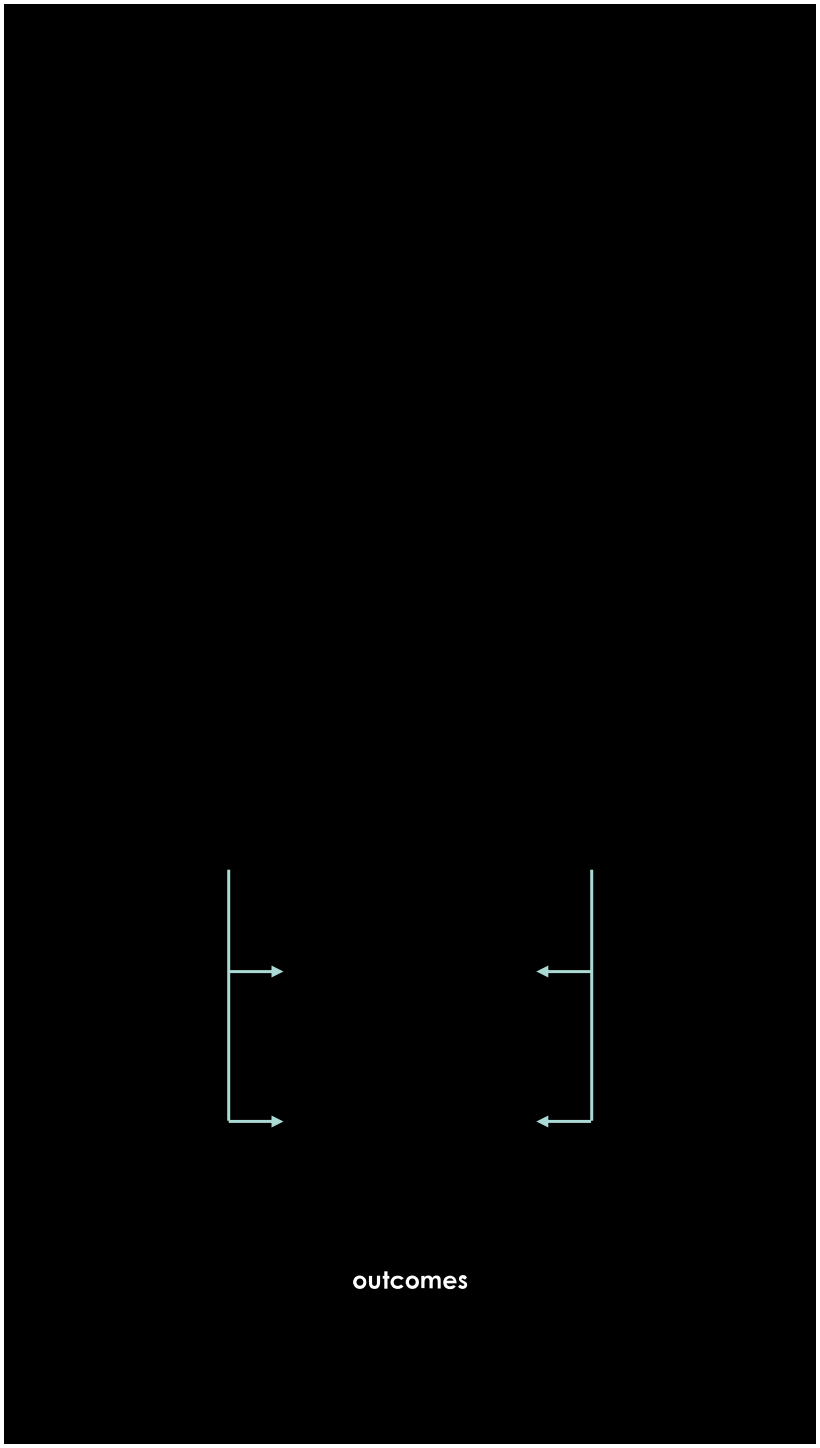
Similarly, sanitation-only interventions increased child height-for-age in two[32], [20], out of the ten studies where it was measured.[32], [20], [33], [11], [13], [28], [25], [26], [22], [8], Stunted growth can be caused by many factors, including nutritional deficits, so improved sanitation might not decrease stunting unless other barriers are also lifted.[25], For example, in Bangladesh and Kenya, providing nutritional supplements and counseling alone or alongside water, sanitation, and hygiene programming meaningfully increased children's height, while providing sanitation programming alone did not.[25], [26], In contrast, an intensive CLTS program in Mali reduced stunting rates by 6 percentage points.[32]

Although sanitation programs have inconsistent—and often limited—impacts on health outcomes, interventions that increase overall household toilet usage to sufficiently high levels may still yield bigger health impacts. Because diarrhea-causing pathogens can still spread if open defecation rates remain relatively high, sanitation programs may not affect health outcomes if communities do not reach this toilet usage threshold.[7], [23]

Until piped sanitation systems are feasible in a given context, policymakers can build on existing evidence showing that reducing financial barriers to toilet construction and intensively improving information can be effective at increasing toilet usage, while continuing to work with researchers to identify and test effective ways to sustainably increase coverage and usage of improved sanitation facilities and improve related health outcomes. In addition, as sanitation programs may also positively impact other outcomes like mental health, quality of life, and children's cognitive development[34], [39], more research is needed to test impacts on a wider set of outcomes to understand the full potential returns to sanitary interventions.

Listen to the VoxDev podcast to learn more.

Figure 1. Theory of Change: Sanitation



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1. WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene 2023 report. Improved facilities include flush/pour flush toilets connected to piped sewer systems, septic tanks, or pit latrines; pit latrines with slabs (including ventilated pit latrines); and composting toilets. Unimproved facilities are defined as pit latrines without a slab or platform, hanging latrines, or bucket latrines that do not separate waste from human contact.

2. Jennyfer Wolf et al., 2023, "Burden of Disease Attributable to Unsafe Drinking Water, Sanitation, and Hygiene in Domestic Settings: A Global Analysis for Selected Adverse Health Outcomes," *The Lancet* 401, no. 10393: 2060–2071, https://doi.org/10.1016/s0140-6736(23)00458-0.

3. One study reviewed here mixed CLTS with a training program for local masons to build and market toilets in Tanzania and improved toilet coverage. See Bertha Briceño et al., 2017, "Are There Synergies from Combining Hygiene and Sanitation Promotion Campaigns: Evidence from a Large-Scale Cluster-Randomized Trial in Rural Tanzania," *PLOS One* 12, no. 11: e0186228, https://doi.org/10.1371/journal.pone.0186228.

4. In addition to examining the effect of CLTS and subsidies, this study also examined whether making it easier to build a toilet without offering explicit financial support affected toilet ownership. Villagers who were linked with toilet suppliers and given more information about toilet quality and availability did not increase their hygienic toilet ownership. See Raymond Guiteras et al., 2015, "Encouraging Sanitation Investment in the Developing World: A Cluster-Randomized Trial," *Science* 348, no. 6237: 903–906, https://doi.org/10.1126/science.aaa0491.

5. Functionality was defined as having a roof, not being used for storage, with a complete pit, etc.

6. The mixed evidence on sanitation programs' effect on health outcomes may partly result from challenges with measuring the direct impact of sanitation programs on outcomes like diarrhea rates. Diarrhea rates are often self- or caregiver-reported, and recall error, misperceptions, or other reporting biases may induce substantial measurement error, possibly leading to biased estimates. More research featuring objective measures (e.g., laboratory validated) of fecal contamination is therefore necessary. See Joe Brown and Oliver Cumming, 2020, "Stool-Based Pathogen Detection Offers Advantages as an Outcome Measure for Water, Sanitation, and Hygiene Trials," *American Journal of Tropical Medicine and Hygiene* 102, no. 2: 260–261, https://doi.org/10.4269/ajtmh.19-0639.

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1. Abramovsky, Laura, Britta Augsburg, Melanie Lührmann, Francisco Oteiza, and Juan Pablo Rud. 2023. "Community Matters: Heterogeneous Impacts of a Sanitation Intervention." *World Development* 165 (May): 106197. Research paper.

2. Andrés, Luis, Bertha Briceño, Claire Chase, and Juan A. Echenique. 2017. "Sanitation and Externalities: Evidence from Early Childhood Health in Rural India." *Journal of Water, Sanitation and Hygiene for Development* 7, no. 2: 272–289. Research paper.

3. Armand, Alex, Britta Augsburg, Antonella Bancalari, and Maitreesh Ghatak. "Public Service Delivery, Exclusion and Externalities: Theory and Experimental Evidence from India." Working Paper, March 2025. Research paper.

4. Augsburg, Britta, Antonella Bancalari, Zara Durrani, Madhav Vaidyanathan, and Zach White. 2022. "When Nature Calls Back: Sustaining Behavioral Change in Rural Pakistan." *Journal of Development Economics* 158 (September): 102933. Research paper.

5. Augsburg, Britta, Bet Caeyers, Sara Giunti, Bansi Malde, and Susanna Smets. 2023. "Labeled Loans and Human Capital Investments." *Journal of Development Economics* 162 (May): 103053. Research paper.

6. Bakhtiar, M. Mehrab, Raymond P. Guiteras, James Levinsohn, and Ahmed Mushfiq Mobarak. 2023. "Social and Financial Incentives for Overcoming a Collective Action Problem." *Journal of Development Economics* 162 (May): 103072. Research paper.

7. Ben Yishay, Ariel, Andrew Fraker, Raymond Guiteras, Giordano Palloni, Neil Buddy Shah, Stuart Shirrell, and Paul Wang. 2017. "Microcredit and Willingness to Pay for Environmental Quality: Evidence from a Randomized-Controlled Trial of Finance for Sanitation in Rural Cambodia." *Journal of Environmental Economics and Management* 86 (November): 121–140. Research paper.

8. Briceño, Bertha, Aidan Coville, Paul Gertler, and Sebastian Martinez. 2017. “Are There Synergies from Combining Hygiene and Sanitation Promotion Campaigns: Evidence from a Large-Scale Cluster-Randomized Trial in Rural Tanzania.” *PLOS One* 12, no. 11: e0186228. Research paper.

9. Brown, Joe, and Oliver Cumming. 2020. “Stool-Based Pathogen Detection Offers Advantages as an Outcome Measure for Water, Sanitation, and Hygiene Trials.” *American Journal of Tropical Medicine and Hygiene* 102, no. 2: 260–261. Research paper.

10. Cameron, Lisa, Paul Gertler, Manisha Shah, Maria Laura Alzua, Sebastian Martinez, and Sumeet Patil. 2022. “The Dirty Business of Eliminating Open Defecation: The Effect of Village Sanitation on Child Height from Field Experiments in Four Countries.” *Journal of Development Economics* 159 (November): 102990. Research paper.

11. Cameron, Lisa, Susan Olivia, and Manisha Shah. 2019. “Scaling Up Sanitation: Evidence from an RCT in Indonesia.” *Journal of Development Economics* 138 (May): 1–16. Research paper**,** | J-PAL Evaluation Summary.

12. Cameron, Lisa, Paulo Santos, Milan Thomas, and Jeff Albert. 2021. “Sanitation, Financial Incentives and Health Spillovers: A Cluster Randomised Trial.” *Journal of Health Economics* 77 (May): 102456. Research paper.

13. Clasen, Thomas, Sophie Boisson, Parimita Routray, Belen Torondel, Melissa Bell, Oliver Cumming, Jeroen Ensink, et al. 2014. “Effectiveness of a Rural Sanitation Programme on Diarrhoea, Soil-Transmitted Helminth Infection, and Child Malnutrition in Odisha, India: A Cluster-Randomised Trial.” *The Lancet Global Health* 2, no. 11: e645–e653. Research paper.

14. Crocker, Jonny, Elvis Abodoo, Daniel Asamani, William Domapielle, Benedict Gyapong, and Jamie Bartram. 2016. “Impact Evaluation of Training Natural Leaders During a Community-Led Total Sanitation Intervention: A Cluster-Randomized Field Trial in Ghana.” *Environmental Science & Technology* 50, no. 16: 8867–8875. Research paper.

15. Crocker, Jonny, Darren Saywell, Katherine F. Shields, Pete Kolsky, and Jamie Bartram. 2017. “The True Costs of Participatory Sanitation: Evidence from Community-Led Total Sanitation Studies in Ghana and Ethiopia.” *Science of the Total Environment* 601–602 (December): 1075–1083. Research paper.

16. Deb, Saubhik, George Joseph, Luis Alberto Andrés, and Jonathan Grabinsky Zabludovsky. 2024. “Is the Glass Half Full or Half Empty? Examining the Impact of Swatch Bharat Interventions on Sanitation and Hygiene in Rural Punjab, India.” *Journal of Development Economics* 170 (September): 103295. Research paper.

17. Deutschmann, Joshua W., Molly Lipscomb, Laura Schechter, and Jessica Zhu. 2024. “Spillovers Without Social Interactions in Urban Sanitation.” *American Economic Journal: Applied Economics* 16, no. 3: 482–515. Research paper.

18. Gimaiyo, Gerishom, Jeffery McManus, Matt Yarri, Shiva Singh, Andrew Trevett, Grainne Moloney, Ann Robins, and Lilian Lehmann. 2019. “Can Child-Focused Sanitation and Nutrition Programming Improve Health Practices and Outcomes? Evidence from a Randomised Controlled Trial in Kitui County, Kenya.” *BMJ Global Health* 4, no. 1: e000973. Research paper.

19. Guiteras, Raymond, James Levinsohn, and Ahmed Mushfiq Mobarak. 2015. “Encouraging Sanitation Investment in the Developing World: A Cluster-Randomized Trial.” *Science* 348, no. 6237: 903–906. Research paper**,** | J-PAL Evaluation Summary.

20. Hammer, Jeffrey, and Dean Spears. 2016. “Village Sanitation and Child Health: Effects and External Validity in a Randomized Field Experiment in Rural India.” *Journal of Health Economics* 48 (July): 135–148. Research paper.

21. Harter, Miriam, Jennifer Inauen, and Hans-Joachim Mosler. 2020. “How Does Community-Led Total Sanitation (CLTS) Promote Latrine Construction, and Can It Be Improved? A Cluster-Randomized Controlled Trial in Ghana.” *Social Science & Medicine* 245 (January): 112705. Research paper.

22. Humphrey, Jean H., Mduduzi N. N. Mbuya, Robert Ntozini, Lawrence H. Moulton, Rebecca J. Stoltzfus, Naume V. Tavengwa, Kuda Mutasa, et al. 2019. “Independent and Combined Effects of Improved Water, Sanitation, and Hygiene, and Improved Complementary Feeding, on Child Stunting and Anaemia in Rural Zimbabwe: A Cluster-Randomised Trial.” *The Lancet Global Health* 7, no. 1: e132–e147. Research paper.

23. Kresch, Evan Plous, Molly Lipscomb, and Laura Schechter. 2020. “Externalities and Spillovers from Sanitation and Waste Management in Urban and Rural Neighborhoods.” *Applied Economic Perspectives and Policy* 42, no. 3: 395–420. Research paper.

24. Lipscomb, Molly, and Laura Schechter. 2018. “Subsidies Versus Mental Accounting Nudges: Harnessing Mobile Payment Systems to Improve Sanitation.” *Journal of Development Economics* 135: 235–254. Research paper.

25. Luby, Stephen P., Mahbubur Rahman, Benjamin F. Arnold, Leanne Unicomb, Sania Ashraf, Peter J. Winch, Christine P. Stewart, et al. 2018. “Effects of Water Quality, Sanitation, Handwashing, and Nutritional Interventions on Diarrhoea and Child Growth in Rural Bangladesh: A Cluster Randomised Controlled Trial.” *The Lancet Global Health* 6, no. 3: e302–e315. Research paper.

26. Null, Clair, Christine P. Stewart, Amy J. Pickering, Holly N. Dentz, Benjamin F. Arnold, Charles D. Arnold, Jade Benjamin-Chung, et al. 2018. “Effects of Water Quality, Sanitation, Handwashing, and Nutritional Interventions on Diarrhoea and Child Growth in Rural Kenya: A Cluster-Randomised Controlled Trial.” *The Lancet Global Health* 6, no. 3: e316–e329. Research paper.

27. Orgill-Meyer, Jennifer, Subhrendu K. Pattanayak, Namrata Chindarkar, Katherine L Dickinson, Upendra Panda, Shailesh Rai, Barendra Sahoo, Ashok Singha, and Marc Jeuland. 2019. “Long-Term Impact of a Community-Led Sanitation Campaign in India, 2005–2016.” *Bulletin of the World Health Organization* 97, no. 8: 523A–533A. Research paper.

28. Patil, Sumeet R., Benjamin F. Arnold, Alicia L. Salvatore, Bertha Briceño, Sandipan Ganguly, John M. Colford, and Paul J. Gertler. 2014. “The Effect of India’s Total Sanitation Campaign on Defecation Behaviors and Child Health in Rural Madhya Pradesh: A Cluster Randomized Controlled Trial.” *PLOS Medicine* 11, no. 8: e1001709. Research paper**,** | J-PAL Evaluation Summary.

29. Pattanayak, Subhrendu K., Jui-Chen Yang, Katherine L. Dickinson, Christine Poulos, Sumeet R. Patil, Ranjan K. Mallick, Jonathan L. Blitstein, and Purujit Praharaj. 2009. “Shame or Subsidy Revisited: Social Mobilization for Sanitation in Orissa, India.” *Bulletin of the World Health Organization* 87, no. 8: 580–587. Research paper.

30. Peletz, Rachel, Alicea Cock-Esteb, Dorothea Ysenburg, Salim Haji, Ranjiv Khush, and Pascaline Dupas. 2017. “Supply and Demand for Improved Sanitation: Results from Randomized Pricing Experiments in Rural Tanzania.” *Environmental Science & Technology* 51, no. 12: 7138–7147. Research paper.

31. Peletz, Rachel, Joyce Kisiangani, Patrick Ronoh, Alicea Cock-Esteb, Claire Chase, Ranjiv Khush, and Jill Luoto. 2019. “Assessing the Demand for Plastic Latrine Slabs in Rural Kenya.” *American Journal of Tropical Medicine and Hygiene* 101, no. 3: 555–565. Research paper.

32. Pickering, Amy J., Habiba Djebbari, Carolina Lopez, Massa Coulibaly, and Maria Laura Alzua. 2015. “Effect of a Community-Led Sanitation Intervention on Child Diarrhoea and Child Growth in Rural Mali: A Cluster-Randomised Controlled Trial.” *The Lancet Global Health* 3, 11: e701–e711. Research paper.

33. Sinharoy, Sheela S., Wolf-Peter Schmidt, Ronald Wendt, Leodomir Mfura, Erin Crossett, Karen A. Grépin, William Jack, Bernard Ngabo Rwabufigiri, James Habyarimana, and Thomas Clasen. 2017. “Effect of Community Health Clubs on Child Diarrhoea in Western Rwanda: Cluster-Randomised Controlled Trial.” *The Lancet Global Health* 5, no. 7: e699–e709. Research paper.

34. Tofail, Fahmida, Lia C. H. Fernald, Kishor K. Das, Mahbubur Rahman, Tahmeed Ahmed, Kaniz K Jannat, Leanne Unicomb, et al. 2018. “Effect of Water Quality, Sanitation, Hand Washing, and Nutritional Interventions on Child Development in Rural Bangladesh (WASH Benefits Bangladesh): A Cluster-Randomised Controlled Trial.” *The Lancet Child & Adolescent Health* 2, no. 4: 255–268. Research paper.

35. Trimmer, John T., Joyce Kisiangani, Rachel Peletz, Kara Stuart, Prince Antwi-Agyei, Jeff Albert, Ranjiv Khush, and Caroline Delaire. 2022. “The Impact of Pro-Poor Sanitation Subsidies in Open Defecation-Free Communities: A Randomized, Controlled Trial in Rural Ghana.” *Environmental Health Perspectives* 130, no. 6. Research paper.

36. WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene. 2023. *Progress on Household Drinking Water, Sanitation and Hygiene 2000–2022: Special Focus on Gender*. Geneva: WHO and UNICEF. Research paper.

37. Wolf, Jennyfer, Paul R. Hunter, Matthew C. Freeman, Oliver Cumming, Thomas Clasen, Jamie Bartram, Julian P. T. Higgins, Richard Johnston, Kate Medlicott, Sophie Boisson, and Annette Prüss-Ustün. 2018. “Impact of Drinking Water, Sanitation and Handwashing with Soap on Childhood Diarrhoeal Disease: Updated Meta-Analysis and Meta-Regression.” *Tropical Medicine & International Health* 23, no. 5: 508–525. Research paper.

38. Wolf, Jennyfer, Sydney Hubbard, Michael Brauer, Argaw Ambelu, Benjamin F. Arnold, Robert Bain, Valerie Bauza, et al. 2022. “Effectiveness of Interventions to Improve Drinking Water, Sanitation, and Handwashing with Soap on Risk of Diarrhoeal Disease in Children in Low-Income and Middle-Income Settings: A Systematic Review and Meta-Analysis.” *The Lancet* 400, no. 10345: 48–59. Research paper.

39. Wolf, Jennyfer, Richard B. Johnston, Argaw Ambelu et al. 2023. “Burden of Disease Attributable to Unsafe Drinking Water, Sanitation, and Hygiene in Domestic Settings: A Global Analysis for Selected Adverse Health Outcomes.” *The Lancet* 401, no. 10393: 2060–2071. Research paper.

40. Augsburg, Britta, Bansi Malde, Harriet Olorenshaw, and Zaki Wahhaj. 2023b. “To Invest or Not to Invest in Sanitation: The Role of Intra-Household Gender Differences in Perceptions and Bargaining Power.” *Journal of Development Economics*162 (May): 103074. Research paper.