How households respond to better water infrastructure: *Evidence from the Kyrgyz Republic*

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Fresh water is an increasingly scarce resource, and widespread participation in properly priced municipal water provision can help prevent excessive water usage. While the Kyrgyz Republic has improved its municipal water infrastructure over the last 20 years, popular resistance to price increases has hindered the introduction of cost-reflective tariffs. This EBRD Impact Brief explores how households responded to improved water infrastructure in the Kyrgyz Republic, in terms of connecting to the municipal water network and how much more they would be willing to pay for improved services.

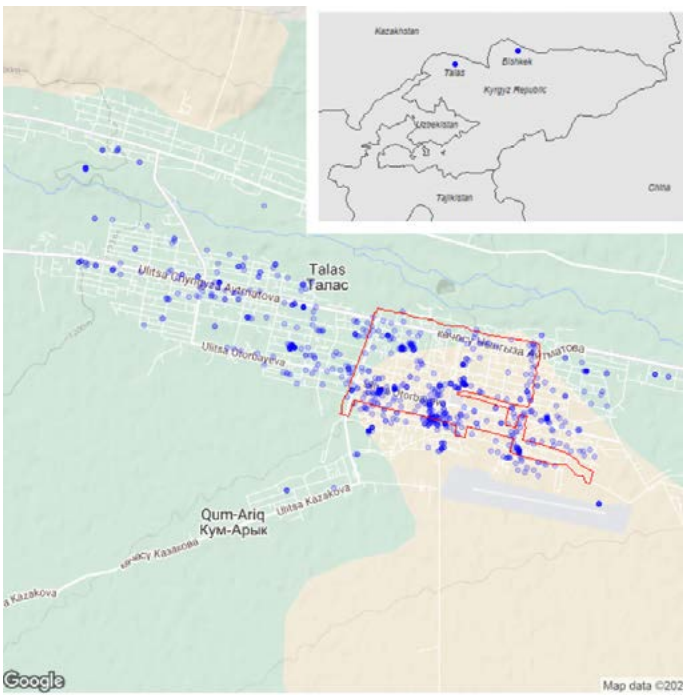
Since 2009, the EBRD has committed over €60 million to finance improvements in water and wastewater infrastructure in the Kyrgyz Republic. But have the improvements changed households' demand for water services? We conducted a study to assess this, looking at the uptake of household connections to the municipal water network and willingness to pay for improved water services.

The study site was Talas, a small city in the north of the Kyrgyz Republic (see Chart 1) that was part of an EBRD programme for water infrastructure improvements starting in 2015. Until 2015, 61 per cent of households in Talas still used private wells as their main source of water (the other main types of water sources were house taps and yard taps).[1] Connection to the water network was voluntary and provided to interested households for a fee. The impact of the project, particularly with respect to cost recovery, would be limited if too few households were to adopt taps, refuse to pay higher tariffs or disconnect from the water network altogether.

There may also be unintended consequences of improved water infrastructure in terms of time use. For example, less time may be spent on water-related chores, freeing up time for paid labour or leisure. Alternatively, easier access to water may lead to more time spent on water consumption activities, such as bathing.

Only 38 per cent of Talas's residents were customers of the utility company in 2015. The utility's water network covered roughly half of the city area. While relying on wells means that households do not pay for water services, residents need to leave their building to access water, which takes time. Wells also entail added expense for maintenance.

Chart 1: Map of Talas and panel survey sample



Note: The map indicates the (approximate) locations of households in the study sample (blue dots). It also indicates the area that received improvements, outlined in red. All households inside the red lines are within two city blocks of a repaired pipe, as per data from the water utility company in Talas. White lines indicate streets.

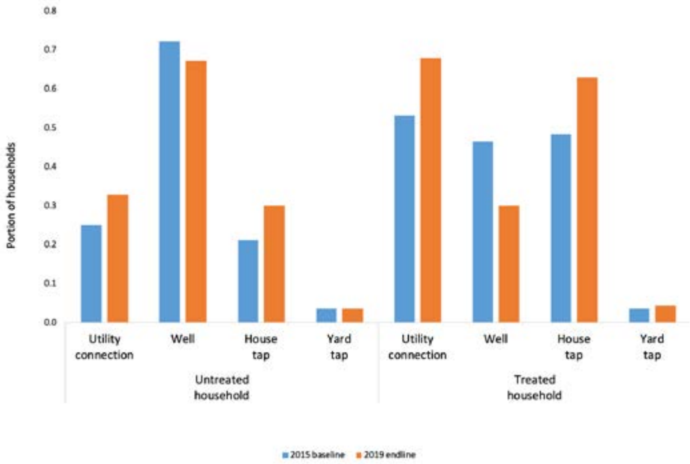
[1] Approximately 1 per cent of residents sourced their water from public street taps provided by the utility company.

[2] Per capita gross national income in 2015 was US$ 1,170. We convert to local currency using the mid-year exchange rate of 60 Kyrgyz som per US dollar (as per the National Bank of Kyrgyzstan, which provides historical daily exchange rates). In 2015, the exchange rate went from 58.89 on 1 January to 75.89 on 31 December.

However, since installing taps is relatively costly, it was unknown if the network improvements would impact people's reliance on wells.

The EBRD project in Talas involved replacing leaky water supply pipes and pumps, updating service equipment (such as network flow meters), and rehabilitating and expanding the sewerage network. Households could then pay to have yard taps or house taps installed so that they could directly benefit from these improvements. The median cost to convert a well into a house tap was 13,000 Kyrgyz som, about 18.5 per cent of per capita gross national income in 2015.[2] The corresponding cost to convert a yard tap to a house tap was about half of that.

Chart 2: Prevalence of different water network connections, before and after infrastructure improvements



Note: The sample is a panel of 349 households across two survey waves (2015 and 2019). The survey respondent was the person responsible for water chores. The average respondent was female with a secondary school education, 45-48 years of age and married or with a long-term partner. The average household size was 3.5 people.

To obtain data, we ran a household panel survey, with waves in 2015 and 2019 (see Chart 1). The survey dates book-end the first stage of the EBRD project, which included the rehabilitation of water and wastewater networks. Sixty per cent of works were completed by 2017, and over 90 per cent completed by the middle of 2019. Therefore, by the time of the second survey, nearly all residents in the treated area would have had time to observe works, adopt taps and experience effects from service improvements.[3] A second stage of the project (not covered by this study, and completed in 2022) was to provide households with water meters. This means that households' expectations about future meter introduction may have informed the likelihood of their taking up household taps.

The survey sample consists of randomly selected households, stratified by baseline connection type. The survey respondent in each household was the person primarily responsible for water chores. We control for stratification in all analyses to make results generalisable to the people responsible for water chores.[4] The survey included questions on residents' main sources of water, types of utility connections, time use and socio-demographic traits (such as income and employment status). We also conducted a stated preference choice experiment to measure willingness to pay for improved water quality, water pressure, shorter service cuts, and less frequent cuts in the water supply.

Chart 2 shows the portion of households with water network connections versus wells, before and after infrastructure improvements. Alongside this, it shows changes in the prevalence of house taps versus yard taps. Blue and orange bars indicate baseline and endline averages, respectively. Households in both the treated and untreated areas show an increase in network connections and a decrease in wells. Both areas also see an uptick in house taps, but limited changes in yard taps. Nonetheless, changes in the treated group are larger, suggesting a positive impact from being in the treated area. The next section describes the treatment effect estimates.

[3] The empirical estimates capture the "intention to treat" effect. This measure acknowledges that not all households in the treated area will have experienced the treatment.
[4] Water chores include preparing food; washing clothes and cleaning the house; and fetching water from outside.

Improved water infrastructure promotes the adoption of house taps

Since the water infrastructure improvements were not randomised, we use a weighted difference-in-differences approach to estimate causal impacts. Ordinary difference-in-differences relies on the assumption that treatment and control areas would have followed the same trend over time, had the project not taken place. Showing parallel trends in the pre-project period helps to verify whether this might be a reasonable assumption. Due to data limitations, we cannot examine pre-treatment trends in Talas. The study therefore applies doubly robust difference-in-differences, which uses inverse probability weights to give a higher weight to observations in the untreated area that are most similar to households in the treatment area (and therefore more comparable dynamically).[5] We also use panel fixed effects to improve estimate consistency with respect to time invariant traits.

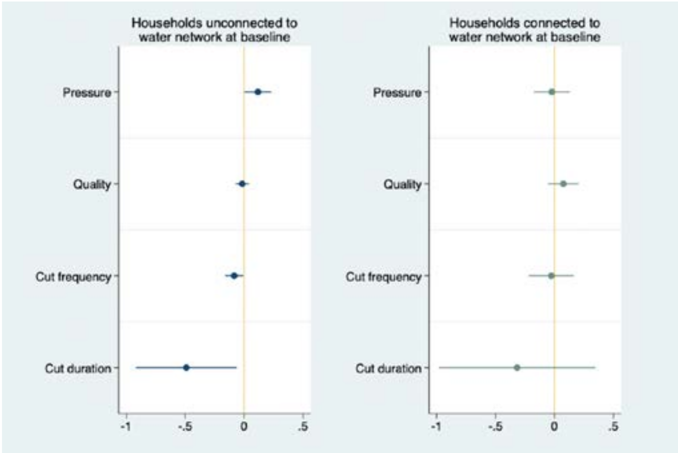
Among households that did not have a connection at baseline, the EBRD project led to 28 per cent more households to establish water connections with the utility company (in the treated area, compared with the untreated area) – 71 per cent of this effect reflects households adopting taps. The rest of the effect comes from households adopting new (and less costly) yard taps. Getting connected to the municipal water network means shifting away from private wells. The infrastructure improvements caused a 31 per cent decrease in the reliance on wells among households not connected to the municipal network at baseline. Nonetheless, overall house tap ownership remains below 60 per cent of all households (Chart 2).

More willingness to pay for increased water pressure

We use a choice experiment survey to assess willingness to pay. Choice experiment surveys present respondents with a series of alternatives to their status quo, and respondents are asked to choose the option they prefer the most. Respondents make a series of such choices, each time facing a different set of alternatives. In our survey, each alternative is defined by five attributes: type of connection to the water network, water pressure, water cleanliness, frequency of service disruptions, duration of disruptions and water bill. When respondents choose their preferred options, they implicitly make trade-offs between the service level for each attribute and price. We randomise each attribute's service level for each choice the respondent faces. Analysing the choice experiment data thereby provides causal estimates of how (hypothetical) changes in attribute service level affect willingness to pay.

Chart 3 shows how the project affected people's willingness to pay, for households that were and were not connected to the municipal network at baseline (left and right panels, respectively). The EBRD project caused an increase in willingness to pay for improved water pressure, but only among households that did not have a water network connection before the project. Among these same households, willingness to pay for less frequent and shorter service disruptions goes down. There is no impact on willingness to pay in households that were already connected to the water network at baseline.

Chart 3: Changes in willingness to pay for incremental improvements in water service attributes (quality, pressure, reduced duration and reduced frequency of cuts).



Note: Marginal willingness to pay is calculated using data from a stated preference, discrete choice experiment. For the experiment, respondents make a series of choices where they choose between water service bundles, each of which has different service levels for each attribute. These data give the additional Kyrgyz som that the respondent is hypothetically willing to pay on each water bill for the marginal improvement in each service attribute. Spikes indicate 95 per cent confidence intervals.

Households not connected at baseline spend 25 more minutes per day bathing

Using data from a time-use questionnaire, the study finds that people who get newly connected to the water network spend significantly more time bathing (in contrast, there is no change in time use among households already connected at baseline). We do not observe impacts on time use for any other water-related activity. This implies that benefits from adopting taps are in terms of convenience, rather than time. Increased convenience likely pushes up water consumption,

[5] Weights are equal to the inverse probability of each household being located inside the treatment area. This is estimated using a logistic regression model. Results on willingness to pay and time use are sensitive to model specification. The background paper for this Brief explains the inverse probability weights in detail.

especially in terms of bathing. The future introduction of household meters and correct pricing may therefore be essential to avoid excessive consumption.

Lessons learned

This study reveals that, even with an expectation of having a water meter in the future, households respond to improved water infrastructure by increasing their uptake of municipal water services. This supports cost recovery and allows for centralised management of scarce water resources, which is important for environmental sustainability.

However, our research also finds that tap adoption is associated with an increase in bathing time, which may boost water consumption. Metering could fail to motivate water conservation if this demand is inelastic. Therefore, complementary campaigns may be needed, alongside meters. For example, encouraging water-efficient kitchen and bathroom hardware (such as low-flow showerheads and water-saving toilets) or using carefully designed social comparison nudges on water bills may be effective.[6] Further research is needed to assess how metered billing affects water consumption and time spent on activities that use large volumes of water.

While improving infrastructure before installing meters has helped build the client base, this Impact Brief shows that households adjust their willingness to pay once they are connected to the network. A negative trend in willingness to pay could stall further progress. The utility company may therefore need to continue to invest in improving water pressure – the attribute for which households increase their willingness to pay. An important caveat is that willingness to pay (and time use) could continue to evolve, especially once meters are installed. Therefore, the impact on willingness to pay mostly indicates that measures taken to improve municipal services can change consumer sentiment. It may be necessary to continue tracking willingness to pay to fully understand how the project affects the value that households place on improved water services. Pulse surveys can help track population-level satisfaction and willingness to pay for different service attributes.

There is still considerable reliance on private wells. As long as well water is clean and time spent on water management is minimal, this may not be a problem in the short run. In the long run, however, it can undermine sustainable water management. Therefore, water utility companies may want to consider building their customer base further. Helping marginal households to obtain utility company connections may be particularly important. A survey from the feasibility study suggests that poor households are very interested in tap installation, but face cash constraints. Grants or zero-interest loans for tap installation may be appropriate for households that can afford the water bill but not the installation fee.

[6] For example, a household can be motivated to conserve water if they learn that households comparable to theirs have done so and are saving money.

Suggestions for further reading

E. Akcura, L. Bost and J. Michelle Brock (2023), "Household response to improvements in water infrastructure: Evidence from peri-urban Kyrgyz Republic", EBRD Working Paper Series, No. 277.

F. Devoto, E. Duflo, P. Dupas, W. Parienté and V. Pons (2012), "Happiness on tap: Piped water adoption in urban Morocco", *American Economic Journal: Economic Policy*, 4(4), pp. 68-99.

R.C. Meeks (2017), "Water works: the economic impact of water infrastructure", *Journal of Human Resources*, 52(4), pp. 1,119-1,153.

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PHOTOGRAPHY

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