The Impact of a New Piped Water System on the Well-being of Urban Residents: A Case Study in the City of Mandalay, Myanmar

浅岡, 浩章

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氏　　名　　浅岡　浩章

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The Impact of a New Piped Water System on the Well-being of Urban Residents: A Case Study in the City of Mandalay, Myanmar

（新規管路給水事業が都市住民の厚生に与える影響
：ミャンマー国マンダレー市の事例研究）

Access to safe water is a basic needs for all people, which is considered as one of the important elements of well-being of human beings. In 2015, the international communities set the SDGs' goal 6 to ensure access to water and sanitation for all. However, six years after, the number of urban residents without safe drinking water has even nearly doubled because of the population concentration in the cities. The rapid growth of urban population has increased the demand for water and the risk of water scarcity in many low- and middle-income countries.

Under such circumstances, constructing a piped water supply system has been regarded as a solution to sustainably provide safe drinking water for urban residents. Yet, the installation of a piped water system requires a large financial investment. The authorities or water supply entities need to make the investment decision with careful planning and assessment on the returns to the investment. Despite the importance of academic research, empirical evidence on what would be brought by the installation of a new piped water system for urban residents have been scarce. Hence, the main objective of this research is to provide a new piece of evidence on the impact of a new piped water system on the well-being of urban residents.

This research focuses on a piped water project (hereafter the Project) in urban area of Mandalay city, Myanmar. In the city of Mandalay, local authority (Mandalay City Development Committee: hereafter MCDC) had planned to expand the coverage area of the piped water system in Pyi Gyi Tagon township, located in the southern part of the city, to satisfy the increasing demand for safe water. While the households' connection rate of the piped water system in the northern townships of the city was about 80 percent, the connection rate in Pyi Gyi Tagon township was only 10 percent as of 2018. Thus, this research in Pyi Gyi Tagon township focuses on some city blocks that were not yet reached by piped water supply before 2018 and where MCDC had planned to supply water service from a new piped water system by August 2018. It was expected

that the new piped water supply would allow the users to obtain safe water disinfected by chlorine on the premises, which would improve the safety and convenience of water use among the households.

To evaluate the impact of the piped water system, this research employs a quasi-experimental approach with unique and detailed household panel survey data. The fundamental idea of the impact evaluation is to compare treatment blocks in the new water service area with control blocks in its neighboring area without a piped water service as of 2018. Prior to the baseline survey, an exhaustive block survey confirmed that both treatment blocks and control blocks had similar demographic and socio-economic characteristics. The baseline survey was conducted in May and June of 2018 (before the Project), and the end-line survey was conducted in June and July of 2019 (after the Project) in both the treatment blocks and control blocks.

This research begins with the analysis of water use situation before the installation of the piped water system with the baseline survey data. In the surveyed blocks of the research, majority of the households used water from the private wells in their premises for general purposes and purchased bottled water from vendors for cooking and drinking purposes. Households choose their water sources depending on the various aspects such as water quality, available water quantity, the cost to obtain water, and their socio-economic condition. Higher asset measure, which represents better household economic condition, is correlated with higher ownership of the private wells. Households with higher asset measure also report a higher ratio of purchasing bottled water and larger volume of bottled water consumption.

The baseline survey also inquired about the households' willingness-to-pay for the new piped water service. Before the Project, approximately 60 percent of households responded that they are willing to connect to the piped water system. The respondents who said that they were willing to connect were willing to pay 10.1 thousand kyat (7.48 USD) on the connection fee and 427 kyat (0.31 USD) per unit (1 m^3) of piped water on

the average. Households with owned house have higher willingness to connect. They have the intention to have a piped water connection since it is their own property.

Overall, however, willingness-to-pay on the connection fee is much lower than the necessary connection cost charged by MCDC. If many households do not connect, it is difficult to explore how the installation of the piped water system would affect the well-being of the residential households. In actuality, the connection cost was subsidized for the households in order to accelerate the private connection. As the result, the connection rate was 91.2 percent, and 88.1 percent of the households in the treatment blocks used the newly constructed pipe water system as of the end-line survey.

The research setting with full-subsidy for private connection allows me to examine how the installation of the newly-installed piped water system has changed the water use pattern of urban residents under the condition that they had other alternatives of water sources such as a private well or bottled water and how it affected their well-being. If households use and drink piped water, it is expected that their well-being would improve because of better access to safe water supply or better health condition. Furthermore, the reduced time in obtaining water and improved health conditions, if any, may enable them to enhance their economic and social activities such as working and schooling.

To conduct rigorous analysis of the impact of the installation of the new piped water system, this research employs the Double Difference (hereafter DD) method, which combines before/after and with/without comparison. Firstly, this research examines the impact on water use pattern. After the installation of the piped water supply, the households in the treatment blocks used 19.2 m^3 of the piped water per month. The Project has reduced the use of private wells by 11.8 percentage points and its water use volume by 6.7 m^3 per month, as compared with the households in the control blocks. In addition, the Project has reduced the purchasing ratio of bottled water by seven

percentage points and bottled water volume by 34 liters. It substituted the use of private wells with the use of piped water system, as the main water source. As the result, the Project has increased the total water use volume of the households by 11.2 m^3, as compared with the households in the control blocks.

Secondly, this research explores the health impact on the household members. Intention-to-treat (ITT) effect and average treatment effect on the treated (ATT) on those who used piped water and on those who drink piped water are estimated. The use of piped water reduced the cases of vomiting and diarrhea incidence within the last two weeks prior to the household interview by 0.008 and 0.011 cases, respectively (ATT on those who used piped water in the whole sample). The estimation results of ATT on those who used piped water reported more pronounced effect on the reduction of vomiting and diarrhea incidence in the working age sample, while there were mixed effects among household members who are of schooling age or under 5 years old. The estimation results of ATT on those who drink the piped water did not report any reduction on health incidence in the whole sample. Only 21.8 percent of the households used the piped water for drinking. There seems to exist some other pathways other than drinking through which the health benefits materialize. Since about 65 percent of households used the piped water for cooking purposes, there is a possibility that households who used contaminated private well water for cooking may have higher risk of vomiting and diarrhea. There are also other channels to have the contaminated water from other activities such as washing hands.

Thirdly, this research investigates the impact on the working and schooling status. The analyses are conducted using gender-divided samples in addition to age groups such as working-age sample, adolescent sample, and young children sample. However, the Project did not cause any change in the working and schooling status. This research also examines the impact on the pumping labor and time spent from using private well. The Project reduced the pumping labors of the household members, especially female

adolescents. It reduced the household's pumping time of the private wells by 26 minutes per day. The gender disaggregated analysis reveals that the Project reduced the engagement of pumping labor by 19.4 percentage points among working-aged men and 15.1 percentage points among working-aged women. The large impact is among female adolescents with a reduction of 28.3 percentage points on their engagement of pumping labor. Despite the time reduction in pumping, the saved time may not be enough to encourage family members to seek new income-generating activities outside home or school.

Lastly, this research attempts to estimate the economic value of the piped water project by using a coping cost approach. To obtain safe water for living, households pay direct costs such as purchasing bottled water and volumetric fee for piped water and incur indirect costs such as waiting time for pumping water from private wells. Before the Project, households incurred a direct cost of 5,940 thousand kyat (4.4 USD) per month to obtain water from pre-existing water sources. This accounts for the bottled water expense and electricity cost of pumping. On the average, households spent 5,721 kyat (4.2 USD) to purchase bottled waters. The average monthly electricity cost for pumping from private wells is estimated at 219 kyat (0.2 USD). After the Project, households increased the direct costs of obtaining water by 2,821 kyat (1.4 USD) and paid 8,761 thousand kyat (5.8 UDS) in total. After the Project, households spent an average of 3,890 kyat (2.6 USD) per month for the maintenance cost and volumetric water charge for using the piped water, whereas the bottled water expense and the electricity cost for pumping were reduced by 1,069 thousand kyat (0.8 USD) per month.

For the indirect cost, using their pre-existing water sources, the time cost for pumping was 12.9 thousand kyat (9.6 USD) as of baseline survey. The time cost is estimated to be equal to 50 percent of the national minimum wage rate. Using the new piped water system, these labor costs decreased by 5,250 kyat (3.5 USD). Hence, even if the direct costs of obtaining water increased after the Project, the reduction of the

indirect costs outweighed the increase in direct costs.

Moreover, households gained health benefits from the reduction of health incidence such as diarrhea. In case a household member has a health incidence such as diarrhea, the household member will not be able to work and will lose the opportunity to gain the wages. By using 50 percent of the national minimum wage rate and 2.8 days per incidence for suffering from each diarrhea incidence, the health benefit from having the better health condition is estimated to be 456 kyat (0.3 USD) per month.

In summary, the installation of the new piped water system increased the total water use volume (due to the use of piped water), as compared to the water use volume of the control blocks. Further, it reduced the usage, water volume, and expense for private well water and bottled water in the treatment blocks. While the direct costs for using water increased due to the newly-charged piped water fee, the economic value of the reduction of both direct and indirect costs of obtaining water from pre-existing water sources exceeds the additional direct costs for using the piped water, although this main conclusion rests on the assumption that the opportunity cost of the reduction in pumping labor is equivalent to 50 percent of the national minimum wage rate.

This research proved that by installing the new piped water system, the Project brought these benefits on the well-being of the urban residents, as the authority and the water supply entity expected. Yet, this research simultaneously reveals some challenges for improving the effectiveness and efficiency of materializing these benefits by the Project. First, the foreseen benefits on the well-being were realized because majority of the households connected to the piped water system with the full subsidy of the connection cost from the Project. Without the full subsidy, the benefits would not have been realized since there was a large gap between the connection fee and willingness to pay on the connection cost. Therefore, it is crucial to explore more efficient financial schemes rather than providing 100 percent subsidy to accelerate the private connection so that the expected benefits can materialize with lower public finance resources.

Second, it should be noted that the impact of the newly-constructed piped water system on the well-being of the urban residents was confirmed even under the situation that the drinking ratio of the piped water was low. If they used piped water more for drinking purpose, larger benefits in terms of the reduction of bottled water expense and improvement of health conditions would have been realized. However, the strange chemical odor and taste of the piped water might have discouraged the residents to drink it. Identifying the obstacles (in addition to chemical odor and strange taste of the piped water) for drinking and implementing some additional interventions to enhance the use of piped water for drinking purpose would improve the effectiveness of the Project.

Lastly, although the Project decreased the time burden for obtaining water, the reduction of pumping time from private wells may not be large enough to alter working or schooling status. Alternatively, there may exist only limited opportunities and constrains especially for female members to work outside home and attending school in the City. If this is the case, the water-related infrastructure investment alone cannot make any significant impact on both working and schooling status. Meanwhile, along with the Project, implementing policy measures aiming to improve employment opportunities outside home, particularly for females, and to enhance schooling outcomes would raise the economic value of the Project.

指導教員　島村　靖治　教授