Clarification of the actual condition of water use classified by purpose at home in Tokyo by water amount measurement

N. Hosoi*, T. Horii**, K. Sato***

**Bureau of Waterworks, Tokyo Metropolitan Government, 2-8-1 Nishi-Shinjuku, Shinjuku-Ku, Tokyo, Japan,
hosoi-naoki@waterworks.metro.tokyo.jp
**horii-takayuki@waterworks.metro.tokyo.jp
***sato-kiyokazu@waterworks.metro.tokyo.jp

INTRODUCTION

Necessity and Challenges of Analyzing Water Demand in Waterworks

- Analysis of water demand is extremely important because it can obtain basic information essential for planning water business management that will be reliable and sustainable into the future and developing facilities of the proper size.
- Water demand fluctuates due to various factors including population, lifestyle, weather, and socio-economic conditions, so it is not easy to accurately analyze future trends.

→ In order to accurately analyze water demand, it is necessary to clarify the actual condition of water use.

Current status of Tokyo Waterworks

- Use of water in households accounts for most water use (Figure 1).

→ To stably operate the water business, it is important to precisely investigate and analyze water use at home, and accurately estimate future water demand.

- The Tokyo Waterworks has installed water meters on water pipes of all households to calculate rates. It records and stores data on water consumption on a bimonthly basis.

→ However, we need a grasp of how much water was used for what purpose at home.

- We measured daily water use in households in Tokyo by purpose (toilet, laundry, etc.) to find quantitative traits of use.
- To consider the traits of fluctuations in water use, we analyzed water use and users and their conditions collected in a questionnaire survey.

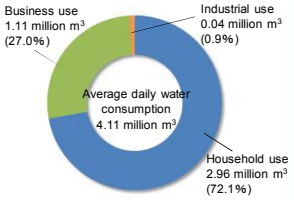


Figure 1. Average daily water consumption in Tokyo Waterworks (FY2016, Tokyo Waterworks)

Survey Method

Table 1. Survey Overview

Period	FY 2012 to FY 2015
Target Area	Water supply area of the Tokyo Waterworks
Target Households	101 households
Methods	・A total of 1,032 flow sensors and data loggers were installed on water pipes connected to toilets, laundry machines, etc. (Figure 2, 3) ・Surveyors visited each household twice per year to collected recorded water use data. ・Questionnaires given 4 times per year to find household size, presence of seniors, etc.

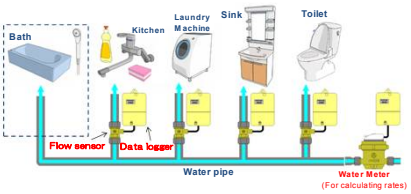


Figure 2. Measuring and recording water consumption

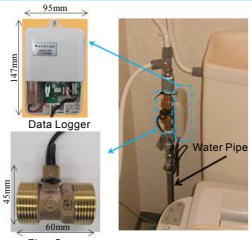


Figure 3. Flow Sensor and Data Logger

Survey Results and Analysis

Average daily water consumption per person and ratio of use by purpose

- The average daily water consumption per person during the survey period was 200.4 L, and the difference by fiscal year was 16.7 L at the maximum(Figure 4).
- Bath accounts for 39%, toilet accounts for 22%, kitchen accounts for 18%, and laundry accounts for 15% of the average daily water consumption by purpose, and these variations were within ± 1% of the average(Figure 4).
- The reason why the proportion of the water consumption in baths was the highest is because Japanese have custom of bathing in hot water in a bathtub.

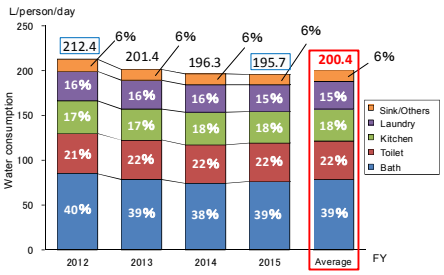
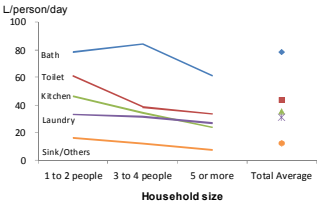


Figure 4. Average daily water consumption per person

Average daily water consumption by size of household

- The average daily water consumption per person for purposes other than bath becomes higher as the number of household members becomes smaller.
- Water consumption in toilets and kitchens was high in households which have one or two members, with the daily water consumption per person 17.5 L (140%) and 10.8 L (131%) higher than the household average respectively(Figure 5).
- In addition, the average daily water consumption per person in households which have five or more members was the smallest for all purposes. In particular, the daily water consumption per person in baths was 17.0 L (78 %) smaller than the average of all households(Figure 5).



L/person/day

	1 to 2 people	3 to 4 people	5 or more	Total average
Bath	78.0	84.0	61.2	78.2
Toilet	60.9	38.6	33.6	43.4
Kitchen	46.2	34.4	23.7	35.4
Laundry	33.1	31.4	26.9	31.0
Sink/Others	16.4	12.2	7.6	12.4
Total	234.6	200.6	153.0	200.4

Figure 5. Average daily water consumption by size of household (survey period average)

Average daily water consumption in households with or without seniors*

- The average daily water consumption per person in households with seniors was 51.9 L (129%) higher than that of in households without seniors (Figure 6).
- The average daily water consumption per person in households with seniors was particularly higher in kitchens and toilets than that of in households without seniors, being 19.7 L (172 %) and 17.6 L (149%) higher respectively(Figure 6).

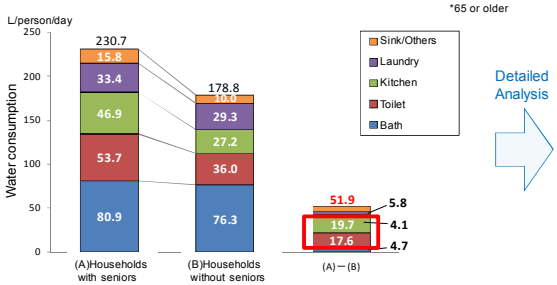


Figure 6. Average daily water consumption per person in households with or without seniors (survey period average)

Detailed Analysis

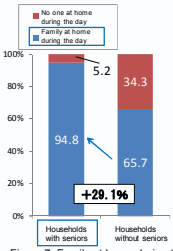


Figure 7. Family at home during the day in households with or without seniors (survey period average)

Many households with seniors have family at home during the day.

This may be the reason that households with seniors have higher water use during the day.

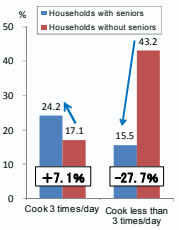


Figure 8. Percentages of households that cook at home 3 times every day and households that cook less often (Average 2013 – 2015)

Households with seniors cook more frequently.

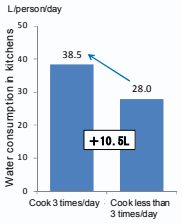


Figure 9. Average daily water consumption per person in kitchens of households that cook 3 times every day and households that cook less often (Average 2013 – 2015)

Households that cook often use more water in kitchens.

Cooking frequently is one reason for high water consumption in kitchens in households with seniors.

CONCLUSIONS

The Tokyo Waterworks analyzed the actual state of water use at home by using water consumption by purpose measured with flow sensors and data loggers installed in the water pipes and information on users collected through the questionnaire surveys.

- The biggest use of average daily water consumption per person was for baths.
- The average daily water consumption per person in baths was 39% of total water consumption, which is about 1.8 times that of toilets, and more than double that of kitchens or laundries respectively.
- The average daily water consumption per person by purpose differed depending on the number of household members. Depending on the purpose of use, there was a difference of more than 10 L compared with the entire household average.
- The average daily water consumption per person in households with seniors aged over 65 years was more than 50 L higher than that of in households without seniors. In particular, the difference of the water consumption in kitchens and toilets was more than 10 L.
- One factor of high average daily water consumption per person in households with seniors may be water use when they are at home during the day, and that they cook more frequently.

Changes in the population composition of society as a whole, including the number of residents in each home and higher population ratio of seniors, can be a factor of major fluctuations in water demand in waterworks.