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**ACCESS TO SANITATION AND SAFE WATER:
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**Domestic water consumption:
A field study in Harbin, China**

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The research city Harbin, one of the cities suffering from water shortage, is located in north-eastern. In the absence of data on domestic water consumption, a field study was carried out in order to obtain information on domestic water using behaviour, water appliance characteristics and ownership; the domestic water use pattern was then determined on the basis of the study results. This study indicated that there was domestic water-saving potential in the research city and promotion of water efficient appliances would have a positive impact on water-saving for both the home and the municipal water supply system.

Introduction

Household water use is usually the most important part of municipal water use, because it accounts for over half of the total municipal water use in many countries. In the UK, about half of the abstracted water was found to be used for the domestic sector (Environment Agency, 2007). In Spain, 70% of urban water consumption is for households, 24% for small industries and services, and 6% for public services (Lanllana and Krinner, 2001). With increased population, urbanization and raised living standards, water demand for urban domestic use will be in a strong growing pattern in the coming decades (Zhang, 1999).

The increased demand for water has put pressure on water supply systems, which in turn has led to environmental problems such as overexploitation of water resources, and breaks in the balance of the ecosystem. The increase in the demand for water has created more wastewater which places a burden on wastewater plants. Improvements in household water efficiency could reduce the pressure upon both water supply and waste water treatment. Water efficiency does not mean controlling the water supply but is all about sustainable water use. In China, research into residential water consumption in cities has been restricted to the capital or large cities. There is a lack of studies relating to other cities especially small and medium sized ones. Consequently, a field study was carried out in a medium sized city, Harbin urban area, in July, 2007.

Harbin is located in the northeast of China with about four million urban residents. Songhua River passes through the city and provides the major water source for the residents in Harbin. The river has experienced deterioration in water quality and the water quality due to the pollution from several upstream cities. Recent years Harbin is forecasted to have a shortage in water supply capacity of at least 450,000 m³/day by 2010, increasing to at least 950,000m³ /day by 2020 (Black and Veatch, 2006). A new water source is being developed under the Harbin Water Supply Project to address the urgent needs of Harbin. However, improving household water use efficiency is crucial for current needs and in a sustainable way for future generations. Therefore understanding household water use pattern and behaviours are essential factors to increase household water efficiency.

The purpose of this research was to understand household water using behaviours, household water appliance characteristics and water use patterns and to explore household water-saving potential and improve the efficiency of domestic water use. The field study is summarized in the paper and reported in detail by Lu (2007).

Methodology

End-use analysis

End-use Analysis(EUA) is one of a number of techniques to understand the demand for water, to enable projections of water demand to be made and effective demand management programs to be designed. It involves the disaggregation of water demand by customer sector and ultimately by end use within each sector

(Turner and Campbell, 2004). A typical residential sector could be disaggregated into specific end uses such as toilets, showers, baths and washing machines for the indoor component, and garden irrigation and car washing for the outdoor component (White, Milne, 2004). This study only considered the domestic indoor water use because outdoor water activity is very limited for Chinese households. The components of end-use model for Harbin include bathroom (shower and basin tap), toilet, kitchen tap and washing machine.

Questionnaire

Collected data are from the first author’s family, friends and households in one neighborhood. Face to face questionnaires consisted of 21 questions which were divided by different water use purposes. In total 40 convenient households were questioned. The select sampling from the population was used to make inferences about the overall households in Harbin. The average household size was 3.2 members per family. The sample was from middle -income households, whose average income is 3473 Yuan¹ per month per person. The majority of the sampling was from multi- storey apartments² and high-rise apartments³, 67% and 30% of respondents respectively. 70% of respondents moved into their current property around the year 2000.

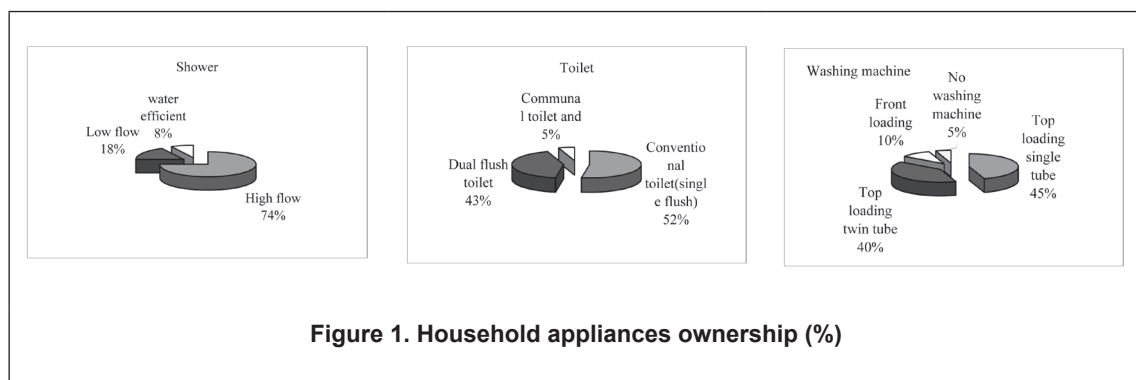
Flow rate experiment

Average daily water consumption reported from water bills was 136 l/p/c/d/The maximum flow rate data were only measured in four of the household surveys, because they were the only ones who agree to the experiment. The experimental procedure was based on Green Venture: how to conduct a flow rate test (Green Venture, 2007). The four Households’ characteristic is similar with sampling in the questionnaire.

Results and discussion

The most widespread appliances include top loading washing machines, single flush toilets and high flow showers (Figure 1). Dishwashers and baths were not common appliances in Harbin. Therefore, householders mainly washed dishes by hand. Water-efficient appliances are not common in the home and appliance market apart from dual flush toilets.

Figure 2 shows that basin taps and toilet and used more frequently every day i.e. 9.3 times per person and 6.4 times per person respectively. Average daily frequencies for shower and washing machine were only 0.57 per person and 0.07 times per day per person (about twice per month) respectively. Households washed clothes by hand frequently during the survey time, but did not wash many clothes each time. They hand washed clothes that were worn daily e.g. T-shirts or socks. So the washing machine was only used to wash large loads of clothes or large sheets and curtains or used to spin out water after hand washing. Figure 1 shows that 40% of households used twin tub washing machines. The twin tub machines have a washing tub and a spin drying tub separately. They are not automatic washing machines and require more operator time. Most of households mentioned that the washing machine used more water than hand washing and was inconvenient. Therefore, despite the ownership of washing machines being high, they are not used very frequently in the home.

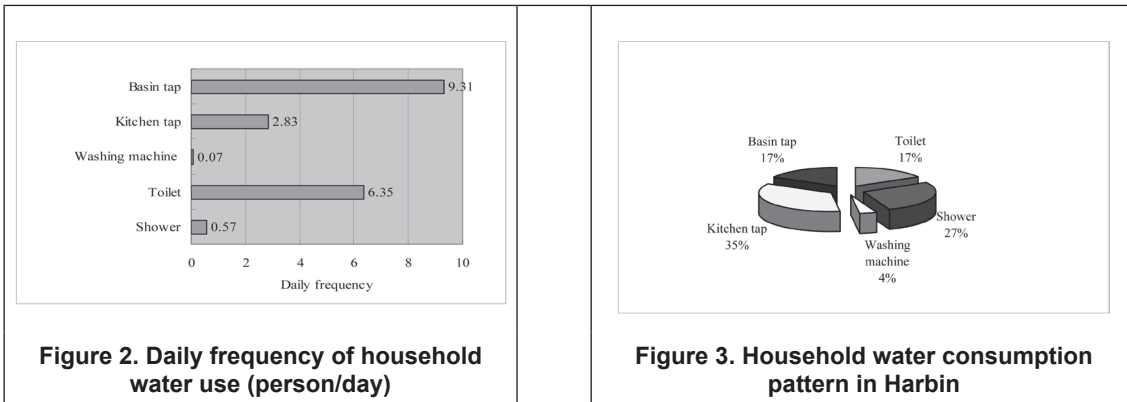


Several factors, such as personal habits, socio-economic, cultural and climatic conditions, affect household consumption patterns. (Vieira and Almeida et al, 2007). Household water consumption could be reduced after installing water-saving appliances.

Usually top loading machines use more water than front loaders. If washing machines are more water efficient and convenient then machine use will rise. Half the amount of water could be saved by water-saving

washing machines. In 1977 a third of washing machines in the UK were top loaders or twin-tubs and average water used per cycle was about 140 litres. This type of washing machine has almost disappeared now. A water efficient machine only used around 50 litres/cycle in 1998 (Waterwise, 2007).

Toilets only use 17% of the total water in Harbin because of high dual flush toilet ownership (Figure 1). In the UK and Finland, toilets use about 30% of the total water used in a household (Lanllana and Krinner, 2001). The high daily tap use frequency and flow rate lead to the big proportion for tap water use (Figure 2). More than half of the daily water used in the households was from taps, 35% of total daily water was used by the kitchen tap and 17 % by the basin tap (Figure 3). There is scope to reduce this for example by installing air devices taps. Lanllana and Krinner (2001) showed that if the amount of water used in the kitchen basin could be reduced by half, then household water patterns would be completely different.



Conclusions

It is difficult to collect data on water use by surveys on frequency of use and measurement of flow rate. This survey also had limitations from the sampling method and small sample size. Nevertheless, the study findings have lessons for Harbin and elsewhere.

- Most of the water used in households was through kitchen taps (35%) and by showering (27%). The lowest percentage of residential use is by washing machine (4%). Daily per capita water consumption is around 136 L in Harbin.
- The most popular water efficient appliance is the dual flush toilet. Other domestic water saving appliances are available on the market but are not very widespread in the home, perhaps because there is still a lack of information on them or their relatively high price.
- The promotion of water-saving appliances would have a positive impact on reducing household water consumption. However, the difficulty is often to encourage the water efficient appliance use and increase market penetration of appliances in the domestic sector.
- Households are willing to reduce water use but they lack water-saving knowledge and information.

Findings show that household water consumption could be further reduced after installing water-saving appliances. There is great potential for household water conservation and improving water-saving appliances in Harbin. Currently there is lack of detail study of domestic water use in Harbin. These research findings would provide a more current understanding of domestic water use patterns and provide baseline information for developing water use efficiency programs. A good understanding of household water use pattern could help the local Water Company to effectively plan and management of water use for the present and future needs. The information also could be used to understand current water demand and to improve forecasting of future demand.

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Endnote/s

- ¹ 15 yuan =1pound (Exchange rate for 2007).
- ² multi-storey: less than 7 floors flat.
- ³ high-rise: with more than 10 floors and an elevator.
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Keywords

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