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Determination of Water Consumption Pattern in Tehran Using Questionnaire and Survey

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ABSTRACT

During recent decades, supplying and distributing appropriate potable water in urban areas with considering consumption pattern has become one of the most important challenges in both developed and developing countries. Doing survey with questionnaires is a useful method to determine consumption patterns. This article illustrates results of a survey which was done through interviewing large number of water consumers in all twenty two districts of Tehran and for statistical analysis SPSS software was used. This paper represents the amount of usage in each micro-component and also gives information on kinds of water that were used. According to the survey, Tehran residences used hot or warm water in more than 80% of their indoor activities.

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INTRODUCTION

It is argued that sustainable water management solutions for new developments in domestic areas should be based on economic, environmental and more importantly social implications (Fenner, R.A., 2006; Makropoulos, C., 2006; Makropoulos, C., 2006). In recent years, in developed countries, different researches are carried out using new instruments and technologies to measure water consumption (Carragher, B.J., 2012; Cole, G. and A.S. Rodney, 2013). According to these researches, water consumption stops growing or begins to fall when it reaches a plateau (Bengtsson, M., 2005). However, in developing countries more researches should be done in order to solve serious water challenges. Water management should be based on a participatory approach, involving all parts including users, planners, and also policy-makers (Huggins, C., 2000). Without a doubt, in urban areas, supply and distributing appropriate water is one of the most important government's duties. So, in order to achieve sustainable solutions, decision makers should identify the actual water demands of their societies.

Problem Statement:

Nowadays, supplying appropriate potable water becomes one of the main concerns of humans' societies in both developing and also developed countries. So, to achieve this goal, in first step, it should be determined that how much water with what level of quality is needed for each consumer. In other words, governments are able to manage water resources more appropriately if they know the exact amount of water demands. There are several methods for measuring water consumption for residential uses such as time series, direct method and using questionnaire and survey. Furthermore, countries especially in water crisis regions have severe problems in supplying fresh water to meet water demands. In such countries, considering above problems and the necessity of using short time solutions, it would be much better to use simpler, cheaper and also more applicable research methods such as survey.

Objectives:

Using new instruments and technologies could be one of the best solutions to improve water supply and distribution systems. Furthermore, in urban areas we need to know people's tendency to each solution. In this research, different aspects of Tehran consumers' water uses such as kinds of water, water temperature and consumers' manners toward using water were investigated. In addition, the influence rate of some appliances including washing machines and dishwashers and new kinds of water such as bottle water were investigated. At

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first, methodology and survey procedure are represented, and then characteristics of the study region such as population, area and total water in use are mentioned. In next part, results and in the end conclusion are represented.

Methodology and Survey Procedure:

As it is mentioned before, in this research interview method was used. To evaluate residential water use and water consumption pattern, interview was carried out for about 300 interviewees (1300 family members) in whole regions of Tehran. To achieve real results interviewees are chosen from different cultures and social levels. In this research the questionnaire consists of two parts. In the first part, some general information about consumers' habitat such as types of house and types of ownership was asked. In the next section some information about consumers such as number of family members, their gender and the level of parent's education was considered. At the main part of this survey, various questions were chosen and asked. The procedure of designing questionnaire was in a way that at first, consumers' knowledge about determined water consumption pattern and also comparing it with the amount of water consumption was being asked. Then the amount and type of water consumption of different task was asked. After collecting all data, it was transferred to SPSS software and the statistical analysis was carried out using this software. Gathered data was verified and unrealistic data was omitted. Reliability and validity of selected questionnaires are assessed by the Coronbach's Alpha. The Cronbach's Alpha is calculated by equation (1) (Bayazidi, E., 2009).

$$\alpha = (n/(n-1))*(1-((\Sigma S_i^2)/S_t^2)) \quad (1)$$

Where α is Cronbach's Alpha, n is number of questions, S_i^2 is Variance of question number i, and S_t^2 is Variance of total test.

Tehran is a city with an area of 700 square kilometers with an average height of 1191 meters above the sea. Water supply and distribution system of Tehran covers more than 8 million consumers and about 1 million cubic meters potable water is supplied and distributed every day. According to researches because of crowded population 59 per cent of total distributed water is assigned to domestic use. In order to recognize characteristics of interviewees some general questions were asked. Most of the interviewed families had 2 to 5 members and More than 80 per cent of houses were apartments. According to researches, water consumption decrease per person in accordance with increasing household size. Richter and Stamminger found out that the reduction in water consumption per person compared to a single-person household is small for a two-person household (10%), but it is increase significantly to (54%) for five-person households (Richter C.P. and R. Stamminger, 2012). In another study, results of research were indicated similar outcome in this issue (The Mayor's Draft water Strategy, 2009).

RESULT AND DISCUSSION

Generally, in order to determine the water consumption pattern different kinds of activities should be considered in house. Moreover, kinds of the consumed water with considering the source and also temperature of the water should be determined. Some of the results of the study are represented and discussed in the following.

In first part, the kinds of water that was used for drinking and cooking activities were specified. These activities need water supply with high quality so piping water and bottle-water are considered as two main sources. Results illustrate that over 80 per cent of Tehran residences used piping water and less than 3 per cent used bottle-water for both drinking and cooking (Figure1). According to Figure 2, more than 40% of interviewees used piping water for their outdoor activities. It should be considered 40% of total consumers did not have outdoor water use.

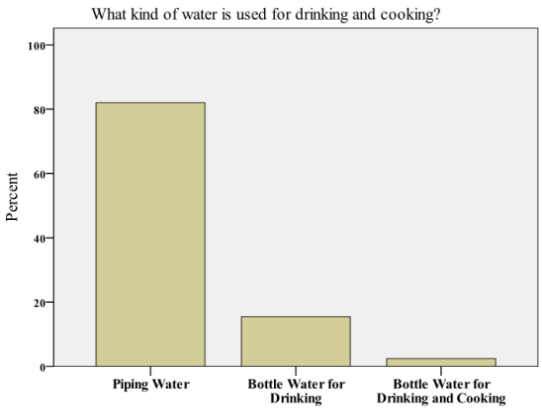

Fig. 1: Water which is used for drinking and cooking

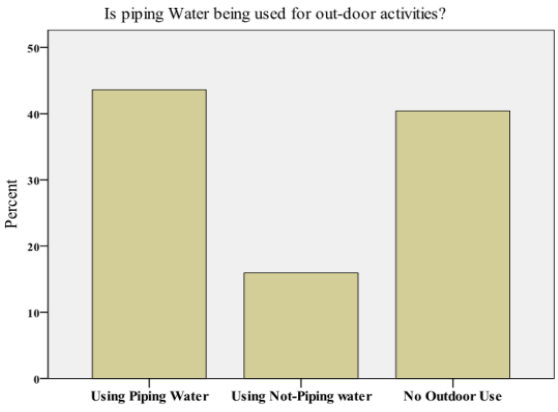

Fig. 2: Piping water for outdoor activities.

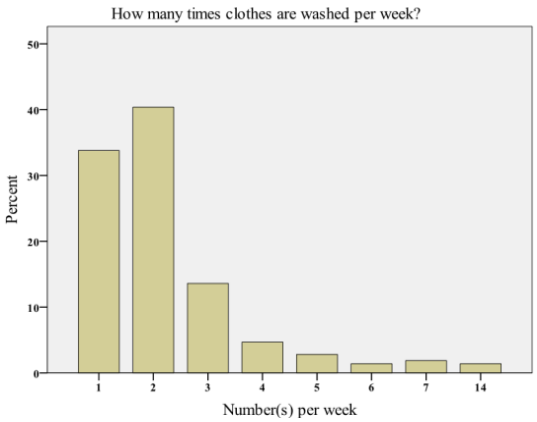

Fig. 3: Methods of washing clothes.

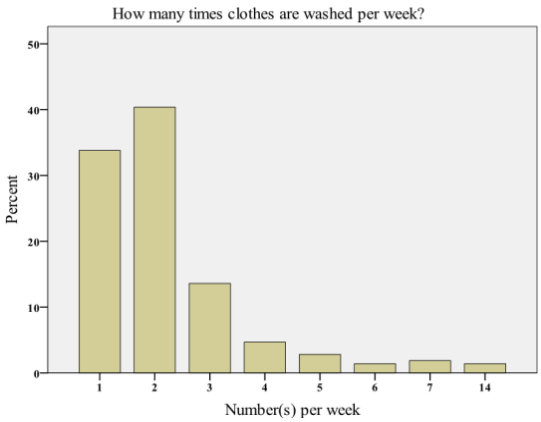

Fig. 4: Times for washing clothes.

Washing clothes is considered as one of the activities which use a portion of indoor water consumption. Traditionally, this task has been done by hand in most cases but today's development of technology has led to penetration of washing machine to the most of houses. In this survey, the amount of washing machine influence was evaluated more than 95 per cent (Figure 3). According to the research, more than 85 per cent of consumers use washing machine up to 3 times per week for washing their clothes. It should be noted that this result depends on some indices such as family size, culture and standards of living (Figure 4).

Washing dishes is the next indoor activity that represented in the following. In contrast with washing machine, just about 20 per cent of consumers in Tehran use dish washer. Compared with developed countries, the number of consumers who use dishwasher in Tehran is significantly less than this number in those countries. For instance, with reference to actual market penetration in the West-EU this percentage is near to 50% (ZVEI, 2008). As a result of research, more than 56 per cent of interviewees mentioned open water tap continuously as their method for washing dishes, while large amount of water would be wasted in this way. Furthermore, it is interesting that less than 5 per cent of people use only cold water for washing the dishes and more than 80 per cent use warm water for this task. In order to achieve general information about quantitative indices, some questions about determination of manner and number of using bath and toilet were considered in questionnaires. Results for shower method are shown in Figure 5. Like the previous part, less than 2.5 per cent of consumers use only cold water for showering (Figure 6). In fact, through reduction in hot water consumption both potable water and huge amount of energy which is used to warm up that water are saved.

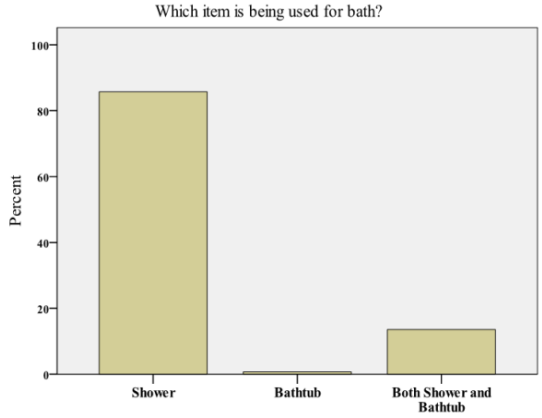

Fig. 5: Methods and types of bath.

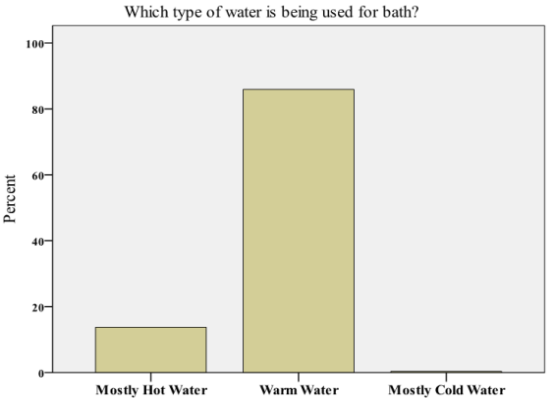

Fig. 6: Types of water for bath.

Conclusion:

According to the results more than 95 per cent of Tehran residences used washing machine but only 23 per cent of them used dishwasher for washing their dishes. One of the most important results that come from this research shows more than 80 per cent of consumers used hot or warm water for indoor uses. Consequently, through reduction in hot water consumption both potable water and huge amount of energy which is used to warm up that water can be saved. More than 80 per cent of interviewees stated that they used potable piping water for their outdoor uses. So it is strongly recommended that decision makers consider a separated green water distribution system for these kinds of activities. According to this survey, only 10 per cent of Tehran

residences using bottle water for drinking use. Low level of using water deductive instruments in houses is another main point of this research.

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