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Full Length Research Paper

The influence of water and sewage networks on residential water consumption

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In this study a real case is used in order to evaluate the effect of the factors controlling the residential water demand in one of the suburb of the state of Kuwait. The study investigates the effect of having or not having water and sewage networks on the water demand. The importance of this study arises from the difference between the two studies residential areas in which one of them contains complete and modern water and sewage networks. The other area under investigation is adjacent to the first area but is lacking similar networks yet. These two residential areas have the same controlling factors for water demands, such as economical conditions, climatic conditions, standard of living, and social life. The method presented is based on a sensitivity analysis of the effect of networks availability on the per capita daily water demand. The analysis of data from both residential areas showed a greater water demands for area without networks, which is contradicting the expectations and experiences.

Key words: water demand, residential water, sewage, network.

INTRODUCTION

The community in Kuwait has unique social life that differs from that in other oil countries in the Gulf region. All Kuwaiti citizens have high income (GDP per capita is USD 56,000, World Fact Book) that minimizes the effect of the water price on the consumption rate. The common luxurious life of citizens requires the use of several faucets in houses. This lavish style of life makes Kuwait one of the top water consuming countries per capita.

Water consumption in Kuwait is about 460 liter/capita/day(lpcd) that is about one and a half times the consumption of an American person and three times the consumption of a European person (Al-Shawaf, 2008). On the other hand, the available water resources in Kuwait is very limited that the demand/resource ratio for water is higher than 20 (ESCWA, 2009). The efficient performance of water resources management depends largely on the accuracy of future water demand estima-tion, which in turn depends on the evaluation of the factors affecting water consumption rate in the city. There are many important factors playing an important role in the estimate of the per capita water consumption rates.

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These factors include, but not limited to, climatic conditions, economical conditions, geographical locations, composition of the community, and the existence of water and wastewater pipe networks system with installed water meters.

Many studies dealing with residential water demand focused on the water consumption modeling for urban and rural areas. Whitford (1972) has developed a fore-casting model based on the use of a formal decision tree to include some of the important controlling factors. Saunders and Warford (1976) determined the most important variables affecting municipal water demand in some metropolitan areas. Narayanan et al. (1987) exa-mined the feasibility of seasonal water pricing considering metering costs.

Mukhopadhyay et al. (2001) collected data from 48 household over a period of 56 weeks to estimate the consumption inside a house in Kuwait. The consumption ranges from 182 to 2018 lpcd with an average of 814 lpcd. The collected data and the followed analysis considered few parameters that affect the water consumption including number of people in residence, number of rooms, number of bathrooms, existence, size, and watering of gardens, and income level of the occupant. The neural network analysis conducted through the study presents the watering of the attached garden is a prime

reason for increasing water consumption.

Keshavarzi et al. (2006) investigated the consumption in rural area of Ramjerd, Fars District, Iran over a 5 year period. The consumption is found dependent on the household size, age of household's head, garden size, greenhouse size, and garden watering frequency. Another study was conducted by Milutinovic (2006) in which he examined several numerical models for the water consumption in Kuwait considering factors such as the household size, family income, existence of a garden, water price, and temperature. Nazerali (2007) conducted a comparison between water resources management in Kuwait and that in Singapore. He elaborated that some factors need to be considered with respect to water management in Kuwait such as the economy of the country, lifestyle of the rural population, and environmental change.

However, none of the available literature examined the effect of water and sewage network availability on the water consumption rate in Kuwait. A comparison is conducted in this study between the water consumption of an established area with water and sewage network and another newer area without similar networks. The comparison considered the area of houses, number of people in the house, age of head of household, and house garden.

RESEARCH OBJECTIVE

The target of this study was to evaluate the effect of the availability of water supply network with installed meters and sewers on the water demand. The investigation was conducted by making a comparison between two adjacent residential areas in one of Kuwait suburb called Sabah Al-Naser located about 25 km from the center of Kuwait city (Figure 1). This modern residential area is a perfect model for applying this study. The location of the studied residents gives the opportunity to evaluate the effect of water and sewage networks on the municipal water consumption rates, particularly the household water consumption rates.

The other important controlling factors affecting residential water consumption rates are considered to have the same effect on both residential areas. It is presumed that factors such as climatic conditions, economical conditions, standard of living, habits and traditions, to have the same effect on both residential areas under investigation.

It was hypothesized that the availability of water and sewage networks in the city will increase the daily per capita consumption rate. However, the efficiency of the existence of such network in Kuwait was the prime target of the study.

METHODOLOGY

It was aimed in this program to evaluate the relationship between household consumption rates and the effect of water and sewage networks. This examination is made by comparing two sets of data collected from two different residential areas.

However data collected from residential area with water and sewage networks (Area-A) were made by day to day direct water meter readings for one hundred and twenty individual houses. The other part of this residential area with no water and sewage networks (Area-B) was getting its water by tankers from water filling stations, and also transporting its wastewater by tankers as needed. A sample of about one hundred and twenty houses was taken. The data collected included, area of house, number of people living in each house, and monthly water consumption.

Each house's daily water consumption rates in Area-B were calculated depending on the size of tankers, the frequency of water supply to these houses, and the volume of tanks placed over each house. Moreover, a monthly bill of water supply by water tankers in houses in Area-B houses was taken to estimate average water daily consumption rates.

In Area-A, houses were of two floors and a basement. Houses were categorized into three groups depending on the area of the house. The numbers of persons living in these houses was considered. There are small variations of number of people living in these houses with a total average of 10 persons in the house. The distribution of number of people living in a household is:

1. 40 houses with a 750 m^2 area with an average of 12 habitants.
2. 40 houses with a 600 m^2 area with an average of 10 habitants.
3. 40 houses with a 500 m^2 area with an average of 8 habitants.

Houses categorization was selected to have the same number and same area for both areas being considered. A time period of one year was selected to follow up the consumption rate of the houses based on monthly basis. Data collection of water consumption started on June 2003 to May 2004. A full record of water meters' reading has been recorded for each month in order to estimate the daily per capita consumption rates.

For Area-B in which there were no networks, an estimation of water consumption for each house has been conducted by considering the effective capacity of the tankers, the volume of tanks located on the top of each house, and average frequency of filling the tanks. Then, the per capita consumption rate was calculated by dividing the total daily consumption of water by the number of people living in each house.

It is worthy to note that all the houses selected in Area-B were getting water from tankers according to contracts that guarantee steady water supply for each house every day on a monthly payment. Also, it is important to keep in mind that all the residents of selected houses are Kuwait national families with high income and they own their houses.

RESULTS AND DISCUSSION

It was found that for similar houses in both areas A and B, the average per capita consumption rate for all the categories in Area-A is less than the corresponding value of Area-B. The average daily water consumption per capita for the houses of 500 m^2 area is 491 lpcd for Area-A, while the corresponding rate in houses of the similar area and number of habitants is about 605 lpcd in Area-B. Also, it was found that a lower water consumption for houses of 600 m^2 area in Area-A than those in Area-B of the same area and number of habitants. These are found to be 418 lpcd for Area- A houses and 523 lpcd for Area-B houses. In addition, a greater water consumption was found in houses of 750 m^2 area in Area-B compared to

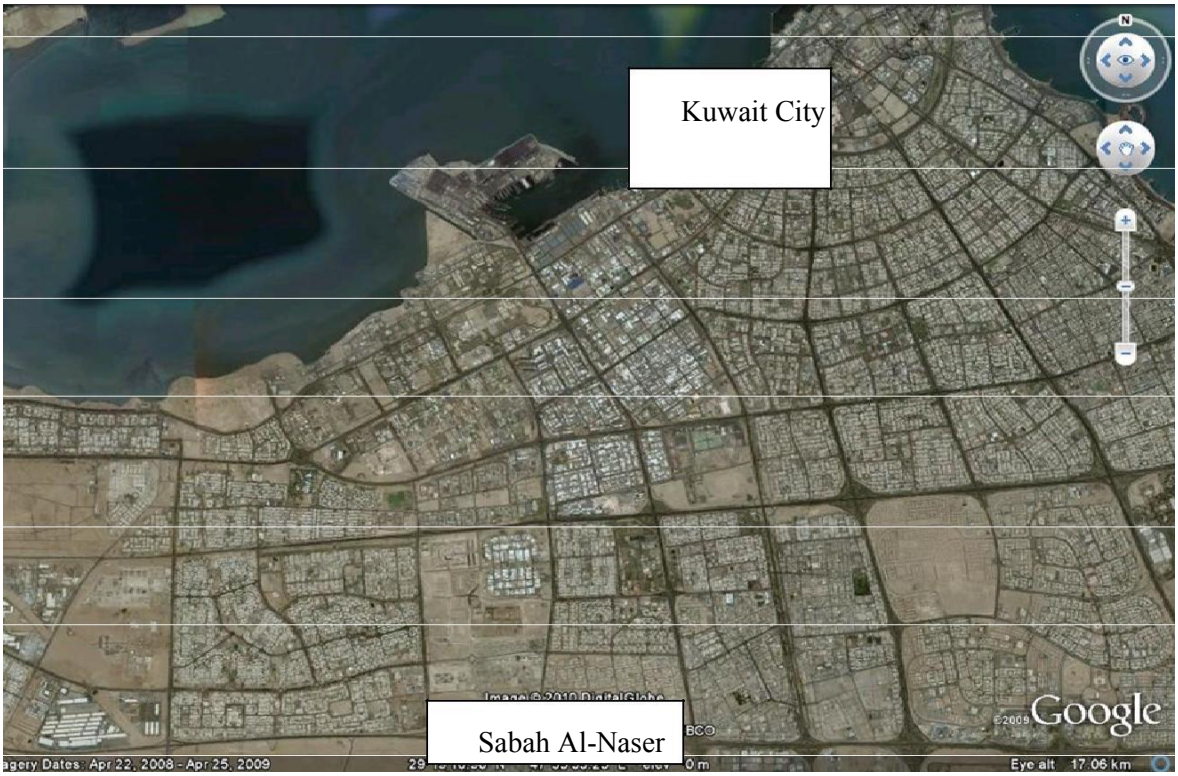

Figure 1. Location of Sabah Al-Nasser region in Kuwait.

Table 1. Water demand in each area of our study (liters per capita per day).

Area of house (m^2)	Residential area (Part A)	Residential Area (Part B)
500	491	605
600	418	523
750	473	568

that of corresponding houses of the same area and number of people in Area- A. There are 568 lpcd for houses in Area-B and 473 lpcd for houses in Area-A (Table 1).

The higher values obtained for water consumption in area without water and sewage networks may be referred to several reasons. The existence or not of the networks is not a prime factor in the consumption difference since the common habits for residents in both areas are the same. All residents do not care about the price of consumed water whether through a fixed network or delivered by tankers. The possible reasons for that difference include the social characteristics of the residents in each area. The residents of the new area are new families with lower ages and lower number of household size. These families with frequent travels abroad in vacations, work, or study have more modernized style of life.

The young age of household parents and children make the family more dynamic more consuming for water. Also, the small number of persons in the house leads to higher rate of water consumption per person since some fixed activities is not dependent on the number of persons such house cleaning and garden watering. Moreover, the luxurious modernized style of living consumes more water because of using en suite rooms, utilizing new machinery for washing and cleaning, having frequent faucets inside and outside bathrooms and kitchens to facilitate cleaning activities.

CONCLUSIONS

The conclusion of this study is contradicting the initial hypothesis, since it is usually presumed that the existence of water and waste water networks for a region will result in an increase of water consumption rates. The study compared two areas in the same district with similar house areas, very close income rates, same climatic con-

ditions, and all houses with gardens. The differences were limited to the existence of water and sewage networks or not and the age of the family members.

The following points are the possible explanation for the obtained results:

1. The water pricing is very low due to the governmental subsidizes and high income rate. Hence, water cost has no effect on the residents' response to water consumption for both areas.
2. Similar to the effect of the pricing factor, the existence of the water and sewage networks has a very limited effect on the consumption since water is required to be available all the time based on contracts with water delivery companies in Area-B without networks.
3. The young age of household parents and children in Area-B makes the family more dynamic more consuming for water. Also, the small number of persons in the house leads to higher rate of water consumption per person since some fixed activities is not dependent on the number of persons such house cleaning and garden watering.
4. Luxurious modernized style of living, which is more applicable in Area-B, consumes more water because of using en suite rooms, utilizing new machinery for washing and cleaning, having frequent faucets inside and outside bathrooms and kitchens to facilitate cleaning activities.
5. Kuwaiti citizens in bad need of awareness of the demand/resource problem in Kuwait to participate in water management conservation process, specially for houses with new families.

REFERENCES

AlShawaf M (2008). Evaluating the Economic and Environmental Impacts of Water Subsidies in Kuwait. Thesis, Louisiana State University, LA, USA.

Economic and Social Commission for Western Asia (ESCWA) (2009). Water Development Report 3 – Role of Desalination in Addressing Water Scarcity. United Nations, New York, USA.

Keshavarzi AR, Sharifzadeh M, Kamgar HAA, Amin S, Keshtkar Sh, Bamdad A (2006). Rural domestic water consumption behavior: A case study in Ramjerd area, Fars province, I.R. Iran. Water Research, 40: 1173 – 1178.

Milutinovic M (2006). Water Demand Management in Kuwait, Thesis, Massachusetts Institute of Technology, USA.

Mukhopadhyay A, Akber A, Al-Awadi E (2001). Analysis of Freshwater Consumption Patterns in the Private Residence of Kuwait. Urban Water, 3: 53-62.

Nazerali NA (2007). Sustainable Water Resources Development in Kuwait: An Integrated Approach with Comparative Analysis of the Case in Singapore. Thesis, Massachusetts Institute of Technology, USA.

Narayanan R, Beladi H, Roger D, Hansen A, Bishop B (1987). Feasibility of Seasonal Water Pricing Considering Metering Costs. J. Am. Water Res. Ass., 23(6): 1091-1099.

Saunders RJ. Warford JJ (1976). Village Water Supply: Economics and Policy in the Developing World. Baltimore: The John Hopkins University Press.

Whitford PW (1972). Residential Water Demand Forecasting. Water Resourc. Research. 8(4): 829-839.

World Fact Book, CIA, www.cia.gov.