

# Estimate Household's Willingness to Pay for Improved Tap Water Quality in Duhok Province

Naz Abdulkareem Arif

## Abstract:

Clean tap water is the general problem facing households in Duhok province due to the poor infrastructure in the tap water supply system. This paper deals with a contingent valuation method (CVM) of improvement in the drinking water quality, based on the household's perception of the tap water quality and relevant health risk avoidance behavior. It contains different factors to analyze, such as factors that determine the household's willingness to pay (WTP) for recovering the quality of tap water. As well as individual avoidance expenditure undertaken by the households to prevent health risk from the tap water consumption. A survey has been collected from 300 participants in Duhok province (Duhok Polytechnic University). The results present the household's satisfaction of payment to recover the quality of tap water. The main results are: about 58% of the respondents are willing to pay, and 42% are not willing to pay for improving water quality. In addition, the results of the regression showed that two factors affect willingness to pay; both are knowledge about water quality and avoidance behavior.



**IJSB**  
Accepted 06 November 2020  
Published 13 November 2020  
DOI: 10.5281/zenodo.4271123

**Keywords:** water quality, willingness to pay (WTP), contingent valuation method (CVM), households and Duhok province.

## About Author (s)

**Naz Abdulkareem Arif**, Business Administration Department, Technical College of Administration, Duhok Polytechnic University. Email: naz.arif@dpu.edu.krd

## 1. Introduction

The main purpose of this research is to explain household's opinion about tap water quality, determine how much they are willing to pay for improving water quality plus which factors are more effective to increase their willing to pay, and showing their avoidance behavior to prevent the risks of unhealthy water in Duhok city. The survey is in quest of finding out the monetary value that households are able and willing for an improved water service. Although water is the "Elixir of Life", it is facing a severe threat due to an increase in pollution. Water, because of its great solvent power, is constantly threatened by pollution easily. The requirement for water by all forms of life, from microorganisms to human beings, has become a serious issue today (Hawrami and Mezuri, 2014). The interesting of this kind of problem is various among the countries due to their capability of solving this problem, Most of the developed countries passed this level of issues, in contrast, developing countries still try to manage it.

In general, the most common problems facing the world today is infection by potentially toxic elements (PTEs) because it has become a global phenomenon and may become a major stress factor in the next few decades (Bárány-Kevei et al., 2005). The main reason for this is that metals cannot be biologically decomposed so they accumulate in living organisms, food chains and the ecosystem (Chuanuwatanakul et al., 2008). Drinking water infection is one of the most important environmental issues. It is a serious environmental problem as it adversely affects human health and the biodiversity of the aquatic ecosystem (Kido et al., 1989). There are a lot of organizations around the world which follow up this kind of problem, the most popular being UN. According to some estimation which has been done by 2010, it is shown that around billion people on earth, more than billion have lack of access to safe drinking water (Lim and Shyamala, 2007). The Goal 7 of Millennium Development Goals (MDG) aims to decreasing the ratio of people who do not get clean water and basic sanitation to halve by 2015. The World Health Organization in 2004 reported that around (1.8) million people in developing countries losing their live each year from diarrhea and cholera, 90% of the total ratio are children under the age of 5 years, while 88% of diarrheal diseases are attributed to unsafe water supply and unsuitable sanitation and hygiene (Khan et al., 2010). In Iraq specifically, World Health Organization (WHO) received a notification from the IHR National Focal Point of Iraq of laboratory-confirmation of cholera in at least five governorates on 23 September 2015. A total of 120 stool samples have been tested positive at the Central Public Health Laboratory of Baghdad for *Vibrio cholera*. Duhok city also records 23 cases of cholera, most of these cases are Syrian and Arab refugees, due to lack of health services and the provision of clear drinking water (world health organization-WHO).

This study focuses on providing clear drinking water for residence through establishing some projects to filter drinking water on the high level of purification by the government or private sector for money. It is well-known that social welfare change may be assumed to be expressed through the willingness to pay as revealed through market prices, provided that a market exists. In the case of environmental goods and services, however, there is no market. Therefore, alternative methods to assess the willingness to pay (WTP) have been developed. The following categories can be distinguished: contingent valuation, depending on consider of responses based on hypothetical situations posed to individuals, and revealed preferences, based on observed choices and expenditures on avoidance behavior.

According to the economic models of an individual choice, we can explain a household's observed trade-off between income and health as a measure of people's willingness-to-pay

(WTP) to develop tools which make them healthier. The contingent valuation method (CVM) is used in this study. It discovered by Davies (1963) for the estimate of enjoyable camping and hunting in the Maine Woods, USA. The CVM has been largely used to measure the use and non-use values of environmental quality, biodiversity, urban green spaces, national parks, and world heritage sites (Carlsson and Johansson-Stenman, 2000). CVM is an immediate valuation method in which respondents are requested to express their WTP or willingness to accept in response to a presumptive market situation (Arif and Afroz, 2013; Carson, 2000). Although, the main resources of drinking water in Dohuk city are the Dohuk dam, Khaber river and Mosul dam reservoir, then the water is filtered and disinfected by chlorine and pumped to the consumers in Dohuk city (Mosher and Nawzet, 2009). Based on coliform index, Duhok city is using chlorine for the process of filtering drinking water. However, many of biological research show that resent public health level for drinking water depended on coliform index fail to predict large numbers of secondary opportunistic pathogens which these systems can sometimes harbor. One research has been done on Khaber's water in which the results showed that post chlorinated water samples bacteria are more effected to chlorine disinfection than pre chlorinated water samples. Mindfully, in Khaber water chlorine concentricity used is 2 ppm and the isolated organisms are fully resistant to chlorine at this concentricity. The most resistant bacterium of all isolates is *Staphylococcus aureus* (Al-Berfkani et al., 2014).

The basic work of this paper is to analyze the major factors, influence the level of the household's avoidance expenditures, and the level of the household's possibility willingness to pay for the drinking water quality improvement. In particular, the study investigates the information affecting the value of the household's willingness to pay (WTP). We also empirically test a standard economic model, explaining the link between the avoidance expenditures and the willingness to pay. The empirical part is based on the data, collected in Duhok Polytechnic University in Duhok city, Iraq. The survey was specially designed to obtain data on the households' willingness to pay (WTP) for the tap-water quality improvement.

## 2. Water Supply and Water Quality in Duhok

Drinking water, like every other substance, contains small amounts of bacteria and gems, most of the germs are usually harmless. Usually chlorine is added to drinking water to prevent the growth of the bacterium. For this reason, drinking water contains a trace of chlorine gas. Dohuk dam reservoir is considered one of the principal water sources for drinking in Dohuk city, in addition to Mosul dam reservoir. Water was transported by pumps from Mosul dam reservoir to big tanks in Khanky Camp, then it is filtered and disinfected by chlorine. Mosul dam water is also transported to Gem parakat camp for treatment, disinfected and pumped to the consumers in Dohuk city. Dohuk dam water was also used as raw water for water supply treatment plants, It is known that impounding water behind dams increases hardness which affect the water uses (Mosher and Nawzet, 2009).

## 3. Economic Valuation of Environmental Goods

Economists have developed different techniques based on individual preferences to value the non-market public goods and cultural services that are regular with the valuation of market goods (Navrud, 2000). Environmental or non-man-made commodity and services, such as clean air, acidifications of water, and forest, are not tradable in any market. Therefore, these goods cannot be valued in monetary forms. Previous questions emerged regarding the valuation of these goods and services to evaluate the cost-benefit of the policy and the

environmental impact. Garrod and Willis (1999) mention that the underlying principles of environmental goods can be given appropriate basis for economic value as market goods through the willingness of people to pay and to accept or reject environmental benefits and degradation. Economic valuation is useful for the comparison of environmental changes. Analysis of financial costs and benefits for different environmental pollution control strategies show the gains in social costs and benefits in different environmental issues. The monetary measures of changes in the well-being of a society are caused by changes in environmental quality. An asset is defined as the total economic value of the changes of the environmental resources. The total economic value is divided into two major parts, namely, "use value" and "non-use value" (Brouwer, 1999). Pearce and Turner (Pearce and Turner, 1990) further categorize "use value" as direct use value in which the individual makes actual use of a resource or recreation, and indirect use value in which the society benefits from ecosystem function. This function consists of option values where individuals are willing to pay for the option of using a resource in the future. In Iraq, specifically Duhok, there is no search or data about measuring the willingness to pay of households by using economic valuation of environmental goods, because of limitation of this kind of specialist.

#### 4. Survey Design and Sampling Methods

The project of this study depends on contingent valuation method (CVM) which is a hypothetical survey-based method that requires the respondents to indicate the value of non-market goods. The utility of the participants depends on their income, socio-economic characteristics, and consumption of market and non-market goods. The non-market good is tap water improvement in the Duhok city. A sample that includes graduate and postgraduate staff was obtained in the Duhok Polytechnic University in Duhok city. Moreover, the main reason for choosing the university staff rather than any specific part of the society, because the staff of the university are more knowledgeable about environmental problems as well as environmental labels that make understanding of the questions easier. Furthermore, the questionnaire has been a quotation from other research (depending on literature review), thus the reliability test has already been done. Then, the questionnaires were distributed among 350 staff and later on collected (Sample of the study was 20% of the total population), 300 were acceptable. Due to the public environment awareness is one of the most important indicators of the various aspects of environmental status, the community must possess knowledge, personal consideration, behavior and attitudes toward sustainable society as a whole. All of the information is useful for decision makers, environmentalists, educators, and businessmen in planning for social sustainable development (Xu, 1999). This study will use contingent valuation method (CVM) to formulate the questionnaire by directly asking residents (state preference) about how much they are willing to pay to increase tap water quality. The questionnaire contains three sections. The first section is on demographics, including questions about age, gender, race, education level, occupation, and income. The second section determines environmental awareness and performances. The third section determines an estimation of the WTP increase of tap water quality.

#### 5. Results and Discussion

##### 5.1. Socio-Economic Characteristics

The sample of this study is taken from all colleges at Duhok Polytechnic University which includes different age ranges, education level, income level as well as female and male as a gender. Table 1 reflects all these various aspects by showing that 51% of the respondents were male and 49% were female. This table also shows the age distribution of the

respondents in the study area. The results clarify that the age range of the respondents was between 20 and above 60 years. Moreover, the age group of between 20 and 30 years had the highest percentage at about 49%, which is almost half, and it is a representative of the respondents in the study area. The age group of between 31 and 45 years had the second highest percentage at around 40%. The last two age groups were between 46 and 60 years and above 60 years, which were at 8% and 3%, respectively. On other hand, regarding the educational status, the majority of the respondents were graduates and post graduates which were around 44% and 34% respectively. Other respondents divided for diploma degree were at 15%, high school 5% of the total percentage.

Table 1: Socio-economic Characteristics of the Households (N=300)

Scio-economic	Frequency	Percent %
<b>Gender</b>		
female	146	48.7
male	154	51.3
<b>Age</b>		
20-30	148	49.3
31-45	119	39.7
46-60	24	8.0
60 &more	9	3.0
<b>Qualification</b>		
High school	17	5.7
Diploma	45	15
Graduate	133	44.7
Post Graduate	104	34.7
<b>Salary</b>		
600,000 &less	76	25.3
601,000 - 1000,000	100	33.3
1001,000 - 1600,000	77	25.7
1601,000 - 2000,000	20	6.7
2001,000 & more	27	9

## 5.2. Knowledge and Consciousness of the Households on Water Quality in Duhok City

The households were asked about their knowledge of the environmentally labelled. The results indicate that around 50% of respondents depend on tap water at home for drinking, although 70% of the respondents knew that tap water in Duhok city is not suitable for drinking. Moreover, 60% of respondents were ready to pay money to improve tap water quality, as shown in table 2.

Table 2: Knowledge and Consciousness of the Households on Water Quality in Duhok City

Questions	Frequency	Percentage
<b>Drinking resources</b>		
Tap water	179	50
Buying water	105	35
Underground water	18	5
<b>Do you know that tap water is not suitable for drinking</b>		
No	92	30.7
Yes	208	69.3
<b>Are you ready to pay money for treatment of the water tap</b>		
No	115	38.1
Yes	185	61.3

### 5.3. Household Avoidance Behavior

As in table 3, it is shown that respondents have been asked about avoidance behavior, the results show 79% of respondents are taking action to prevent the risks of poor water, and 21% do not do anything for that. The other question is about what the respondents do to get clean water for drinking and cooking, most of them use a filter which suggests that about 44%, and 26% are buying bottles of water.

Table 3: household avoidance behavior

<b>1. Are you doing some process to prevent the risks of poor water quality?</b>					
Frequency	No=63	Yes=237	Percent	No=21	Yes=79
<b>2. Are you ready to pay money monthly to improve tap water quality?</b>					
Frequency	No=126	Yes=174	Percent	No=41.7	Yes=57.6%
<b>3. Do you think paying money to improve water quality, your monthly expenditure will be effected?</b>					
Frequency	No=216	Yes=84	Percent	No=52.5	Yes=47.5
<b>4. What are you doing to prevent the risks of poor water quality to be acceptable for drinking or cooking purposes?</b>					
Nothing =12.7%	Boiling water =17%	Using filter =44.3%	buying bottles of water =26%		
<b>5. What form of payment would you prefer?</b>					
	Frequency	Percent			
Water bill	148	85.4			
Tax	9	4.5			
others	17=miss 126 not pay	10			

### 5.4. Willingness To Pay (WTP)

Previously in this paper, all questions in the questionnaire have been described in tables. Here in this part, we are going to explain one of the questions, which factor of the many factories will affect the willingness to pay to improve tap water in houses, this will be done by applying logit regression for factors (gender, age, qualification, income, Knowledge about the quality of water, household avoidance behavior). As shown in table 4, all the factors have sig of more than 0.05 which means those do not influence the willingness to pay. On other hand, knowledge about the quality of water and household avoidance behavior have sig of about 0.03, 0.05. There is a positive relationship between knowledge about the quality of water and household avoidance behavior and willingness to pay to improve water quality, increasing these factors for respondents will increase paying of respondents. Continually, the modes of payment were limited to three categories: tax, water bill, another type. 150 of respondents have chosen water bill. In contrast, 42% of respondent are not willing to pay to solve the problem of the tap water, 50% of those who are not willing to pay recognize that improving water quality is the responsibility of the government.

Table 4: willingness to pay

Variables	B	Dssf	Sig.	Exp (B)
Gender	.382	1	.131	1.465
Age	.285	1	.160	1.330
Qualification	.091	1	.553	1.095
Income	.006	1	.965	1.006
Knowledge about the quality of water.	.574	1	.034	1.775
household avoidance behavior	.576	1	.057	1.779
Constant	-1.477	1	.009	.228

## Conclusion

Demand for environmental goods involving clean drinking water could be higher if income levels are high, and people are/will be more aware of water quality. This study investigated with a contingent valuation method (CVM) as a survey method to achieve the household's willingness to pay (WTP) regarding the improvement of the quality of tap water in Duhok province. This method contains different factors to analyze and determine the household's willingness to pay (WTP) as well as individual avoidance expenditure undertaken by the households to prevent health risk from the tap water consumption. A survey has been collected from 300 participants of universities' staff in Duhok province. The results showed that two factors affect willingness to pay; both are knowledge about water quality and avoidance behavior. Also, it has been found that the knowledge about water quality factor can positively affect avoidance behavior factor in the view point of participants. In conclusive, this is meaning that increasing the knowledge of people through education, advertisements, and media about this problem will automatically increase the avoidance behavior as well as the willingness of people to improve tap water.

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#### Cite this article:

**Naz Abdulkareem Arif** (2020). Estimate Household's Willingness to Pay for Improved Tap Water Quality in Duhok Province. *International Journal of Science and Business*, 4(11), 152-159. doi: <https://doi.org/10.5281/zenodo.4271123>

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