

People's attitudes towards paying for water

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People's attitude towards paying for water is a key factor in deciding the success and failure of water supply projects. Hence it is imperative that the prediction of the willingness-to-pay (WTP) for the benefits prior to the implementation of the project is essential. This article reviews the current trends in studies on people's attitude towards paying for water around the world. People's WTP for water is influenced by a number of factors which could be classified into two major groups, regional and individual. Contingent valuation method (CVM), a preferred method of determination of WTP is dealt with in detail. Another associated term affordability to pay (ATP) is also discussed in length, indicating its significance. From the review of literature it has been found that there is considerable significance and interest in predicting the WTP in recent times; however regional factors make it difficult to advocate a uniform methodology for the determination.

Keywords: Affordability to pay, contingent valuation method, people's attitude, water quality, willingness to pay.

WATER is a basic need for survival of humans, animals and plants. Water is used in agricultural, industrial, household, recreational and environmental activities. Ninety seven and a half per cent of water on the earth is salt water, leaving only 2.5% freshwater, of which over two thirds is frozen in glaciers and polar ice caps. The remaining unfrozen freshwater is mainly found as groundwater, with only a small fraction present above ground or in the air. Freshwater is a renewable resource, yet the world's supply of clean, freshwater is steadily decreasing due to population growth, human intervention and climate change. Water demand already exceeds supply in many parts of the world, and as world population continues to rise at an unprecedented rate, many more regions are expected to experience this imbalance in the near future. The framework for allocating water resources to water users (where such a framework exists) is known as water rights¹.

Surface water

Water captured and stored in a river, lake or freshwater wetland is designated as surface water. Surface water is

replenished by surface and subsurface runoff and precipitation and naturally lost through discharge to the oceans, evaporation and subsurface seepage.

Although the only natural input to any watershed is precipitation, the total quantity of water available in that system at any given time is dependent on many other factors. These factors include storage capacity in lakes, wetlands and artificial reservoirs, the permeability of the soil beneath these storage bodies, the runoff characteristics of the land in the watershed, the timing of the precipitation and local evaporation rates. All these factors affect the proportion of water received and lost in a surface water system.

Human activities can have a large impact on these factors. Humans often increase storage capacity by constructing reservoirs and decrease it by draining wetlands. Humans often increase runoff quantities and velocities by altering topography, land use and channelizing stream flow².

Subsurface water

Subsurface water, is freshwater located in the pore space of soil and rocks. The water that is flowing within aquifers below the water table is called ground water. Subsurface water can be thought of in the same terms as surface water: inputs, outputs and storage. The critical difference is that due to its slow rate of turnover, subsurface water storage is generally much larger compared to inputs than it is for surface water. This difference makes it easy for humans to use subsurface water sustainably for a long time without severe consequences. Nevertheless, over a long period the average rate of recharge to groundwater is the upper bound for average withdrawal and consumption of water from that source. Both surface and groundwater are used for drinking, however, the mix varies from place to place. In most of the urban areas like Chennai and peri-urban area, surface water is the predominant source of water supply followed by ground water whereas in rural areas, it is ground water which is most widely used for drinking.

Safe drinking water is scarce in developing countries. Press reports and other published reports indicate that only 20% of operation and maintenance cost is recovered through water tariff. Asian Development Bank (ADB) stipulates a specific tariff system to ensure self-financing of the operation and maintenance cost of the built-up facilities as a condition of financing².

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Water supply services

The abstraction from a water source, conveyance, treatment, storage and distribution of potable water; water intended to be converted to potable water and water for industrial and/or other uses, where such water is provided by or on behalf of a water services authority, to consumers or other water services providers is termed as water supply services. This includes all the organizational arrangements necessary to ensure the provision of amongst others, appropriate health, hygiene and water resource use education, the measurement of consumption and the associated billing, collection of revenue and consumer care³.

Global access to water

In 2004 about 3.5 billion people worldwide (54% of the global population) had access to piped water supply through house connections. Another 1.3 billion (20%) had access to safe water through other means. Finally, more than 1 billion people (16%) did not have access to safe water, meaning that they had to depend on unprotected wells or springs, canals, lakes or rivers to procure water.

A study by the ADB in 2007 showed that in 20 Indian cities, the average duration of supply was only 4.3 h per day. No city had continuous supply. The longest duration of supply was 12 h per day in Chandigarh, and the lowest was 0.3 h per day in Rajkot⁴.

Service provision in India

Urban areas

In urban areas, municipalities called Urban Local Bodies (ULBs) are in charge of operation and maintenance of water supply systems. Some of the largest cities have created municipal water and sanitation utilities. However, these utilities remain weak in terms of financial capacity. Decentralization initiated with a constitutional amendment in 1992 remains far from complete in its implementation. ULBs remain dependent on capital subsidies from state governments and tariffs are also set by state governments, which often even subsidize operating costs⁵.

Rural water supply

There are about 100,000 rural water supply systems in India. At least in some states responsibility for service, provision is in the process of being partially transferred from State Water Boards and district governments to Panchayati Raj Institutions (PRI) at the block or village level. Where this transfer has been initiated, it seems that single-village water schemes are more advanced than complex multi-village water schemes.

Despite their professed role, PRI currently play only a limited role in provision of rural water supply and sanitation. There has been limited success in implementing Swajaldhara with low priority by some state governments to support decentralization⁶.

Cost recovery is low and a majority of the rural water supply systems are defunct for lack of maintenance. Some state governments subsidize rural water supply systems, but funds are scarce and insufficient⁵.

Providing water for environmental purposes is difficult in many parts of the world. Urban and agricultural users often have first priority in water allocation, for legal and economic reasons⁷.

Chennai is a metro with chronic water problems and is dependent mostly on both ground water supply and surface water received from the nearby and tariff catchments. Ground water in Chennai is replenished by rain water and average rainfall in Chennai is 1276 mm. Its surface water supplies which are received from Krishna River, Veeranam Lake, Poondi Reservoir and Red Hills Lake are treated by water-treatment plants located at different places. Chennai receives about 985 million litres per day (mld) from various sources against the demand of 1200 mld. In an effort to bridge the water shortage and alleviate the woes of the people, Tamil Nadu Government has initiated projects to produce freshwater by desalinating sea water⁸.

Economic considerations

Water supply and sanitation require a huge capital investment in infrastructure such as pipe networks, pumping stations and water-treatment plants. International attention has focused upon the needs of the developing countries. To meet the Millenium Development Goals of halving the proportion of population lacking access to safe drinking water and basic sanitation by 2015, the current annual investment of USD 10–15 billion will have to be doubled. This does not include investments required for the maintenance of existing infrastructure. Once infrastructure is in place, operating water supply and sanitation systems entails significant recurring costs to cover personnel, energy, chemicals, maintenance and other expenses. The money sources to meet these capital and operational costs are essentially either user fees, public funds or a combination of the two. But this is where the economics of water management becomes extremely complex as it clashes with social and broader economic policies⁹.

Importance of the study of people's attitudes

According to many authors, studying attitudes and motives is important for understanding how the public values environmental goods¹⁰. Asking participants why they pre-

ferred to pay or not to pay for a given survey price is highly recommended to ensure the reliability of contingent valuation estimates¹⁰.

This fact has been noticed elsewhere. Menegaki *et al.*¹¹ reported that willingness-to-pay (WTP) for recycled water in agriculture, in Crete, Greece, factors such as participants' environmental awareness, income and pricing were found to be influential.

Similarly, Carson and Mitchell concluded that the nation's WTP for clean water in the US was determined by the quality of the water offered, the recreational benefits associated, participant's income, and their environmental attitudes¹².

Some authors argue that socioeconomic and geographic factors influence collective attitudes towards resource management and conservation efforts. These types of parallel examples reinforce the idea that socioeconomic factors can also influence environmental awareness and general attitudes.

Brunson and Shindler¹² argued that citizen's acceptance (attitudes) and knowledge about resource management practices vary across geographic space, time and social affiliations. According to them, collective judgment and acceptance vary from one place to another due to local-specific social and environmental factors that affect local knowledge. On the other hand, Kideghesho *et al.* argue that factors such as history, politics, ecology, socio-demographics, culture and economics play a role in defining local conservation efforts in Serengeti, Tanzania. In a Mexicali context, migration for example is the biggest influencing force that shapes citizens' environmental awareness due to a local working culture, the population's mobility and its consequent underdeveloped attachment to the region. As half of Mexicali's population is migrant, people most likely did not spend their first years in the city looking for opportunities to participate in environmental causes; instead they probably spent their time working and adjusting to the new city. Similarly, Bright *et al.*¹³ argue that attitudes towards urban ecological restoration in Chicago can be predicted from cognitive, effective, and behavioural responses to the object being evaluated. The importance of the object or situation being valued also influences people's responses¹⁴.

Similar results were reported by Bright *et al.*¹³, who studied attitudes in Chicago towards ecological restoration in urban areas and found that positive and negative attitudes were determined by perceived outcomes of restoration initiatives. They also concluded that positive attitudes are related to values whereas negative attitudes are related to emotions¹³.

Commonly, income determines people's WTP¹¹. With a non-parametric analysis of all prices many results did not correspond to this expectation, but were very close to make the relationship of WTP and income significant¹².

Pouta and Rekola¹⁵ tested a sociopsychological model to demonstrate that people's attitudes can predict WTP

(for forest regeneration in Finland), and that people's systems of beliefs determine those attitudes.

According to McConnell¹⁶, contrasting responses between what people state that they will do and what they actually do depict a motivation vs behaviour pattern, where motives such as altruism can play a big role in defining people's WTP. Motives may range from a broad concern for the natural order, to a desire to save large mammals, or to altruism.

According to these authors, cognitive components relate to perceived outcomes and people's objective knowledge of ecological restoration. The effective components represent emotional responses to ecological restoration, whereas behavioural components measure actions related to ecological restoration and the environment¹⁴.

Willingness to pay

There are various definitions of WTP, but the most common one states that: 'WTP is the maximum amount that an individual states they are willing to pay for a good or service' (Department for International Development (DFID), 1997).

Consumers are often willing to pay a higher price for water than the tariffs charged. How much higher depends on how much water is being used. People are willing to pay very high prices for basic minimum water requirements to ensure the survival of the household. WTP diminishes rapidly with non-essential levels of water use, therefore the relationship between WTP and water use can be shown by a downward sloping demand curve¹⁷.

Governments in developing countries have often subsidized water supplies, typically in an attempt to achieve social and health benefits for the low-income household which form a large majority of the rural and urban population.

The amount an individual is willing to pay to acquire some good or service depends on whether the good or service that is bought and sold (a market good), or it may be one that is not bought or sold (a non-market good)¹⁸.

WTP generally refers to the value of a good to a person as what they are willing to pay, sacrifice or exchange for it. Used in contingent valuation to estimate the value of a non-market good, WTP would generally be determined through questionnaires distributed to a representative population asking something like, 'How much would you be willing to pay for a certain improved water supply service'?¹⁹.

In economics, consumer's WTP means the maximum amount that a person would be willing to pay for a service rather than do without it. The demand curve is: (a) based on the idea that the lower the price of a good, the more consumers will be willing to pay. The area below the demand curve as shown in Figure 1 *a* represents WTP. The total WTP is not simply the amount plus the 'consumers' surplus'. In Figure 1 *b* the supply curve shows

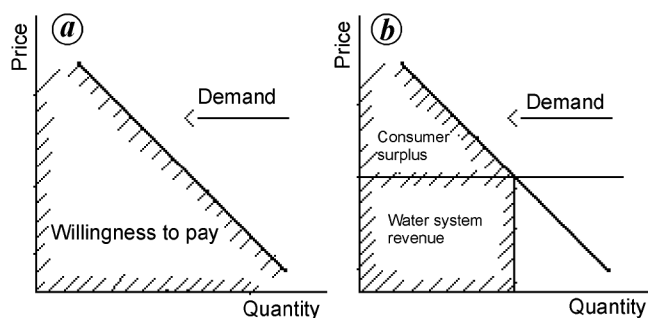


Figure 1. Demand and supply curve related to individual consumer's WTP and consumer surplus.

the production cost of various quantities of the good. The price times the quantity equals the water system revenue. The shaded triangle represents the consumer's surplus which is not revealed²⁰.

Method of determination of WTP

WTP can be estimated indirectly by observing the behavioural pattern of the people and their stated preferences.

1. Observe the prices that people pay for goods in various markets (i.e. water vending, buying from neighbours, paying local taxes).
2. Observe individual expenditures of money, time, labour, etc. to obtain goods or to avoid their loss. This method might involve an assessment of coping strategies and involves observations, focus group discussions and even household surveys.
3. Ask people directly what they are willing to pay for goods or services in the future¹⁷.

WTP is one of the most widely used instruments for measuring environmental quality. This instrument has particularly been employed in conducting contingent valuation method (CVM).

CVM is an established valuation technique that has been used in many environmental measurement studies designed to value the quality of any environmental assets. The method is usually performed by surveying or interviewing a sample of the concerned population. People are presented with hypothetical situations that ask how much they would be willing to pay for a specified environmental improvement, or how much environmental degradation they would be willing to accept.

Contingent valuation method

The economic concept that contingent valuation (CV) surveys are trying to capture is the maximum amount that a respondent would be willing to pay for the proposed improvement in water services in the context of the exist-

ing institutional regime within which households are free to allocate their financial resources¹⁷.

CVM has been increasingly advocated by economists and sector specialists as a useful tool for gathering reasonably accurate data about how much a household can afford and is willing to pay for particular water and sanitation options presented to them. Early research in the 1980s found that 'when the CV method is used to estimate the use of goods and services with which the individuals are familiar, these methods can yield accurate and useful information on households 'preferences' when these are carefully designed and administered'¹⁷.

Good quality contingent valuation surveys require both, a series of skills and knowledge including survey skills, knowledge of how to develop different CV scenarios for population groups with different water supply or housing/income conditions, how to train enumerators, analyse results, etc. A number of steps are advocated in these guidelines for an effective CVM survey and dissemination of results¹⁷.

The following are the various stages and steps involved in the estimation of WTP using contingent method.

Preparation:

- Step 1: Select interview technique,
- Step 2: Develop a sampling strategy,
- Step 3: Develop the CVM scenario,
- Step 4: Decide which elicitation method to use,
- Step 5: Cost the options,
- Step 6: Write household survey and CVM questionnaire.

Implementation:

- Step 7: Enumerator training and pilot testing,
- Step 8: Implement survey.

Data analysis and policy implications:

- Step 9: Data entry and analysis,
- Step 10: Using CVM results to develop tariffs,
- Step 11: Ensuring that WTP studies inform policy¹⁷.

Use of contingent valuation method to measure willingness to pay

The WTP value of a good or service may be elicited: (1) directly by asking consumers, through carefully orchestrated elicitation methods; or (2) indirectly by examining market prices. The CV method is a survey-based elicitation technique to estimate WTP values of a good that is not traded in the conventional market.

The CV method is often referred to as stated preference methods, in contrast to revealed preference methods, which use actual revealed behaviour of consumers in the market. The CV method directly asks consumers' WTP for non-marketed goods under a given condition or a prescribed circumstance. To elicit consumers' WTP values for non-marketed goods, a hypothetical market scenario

should be formulated and described to the survey respondents. Thus, the elicited WTP values of a goods are 'contingent upon' the hypothetical market prescribed in the survey instrument.

Since a CV survey always asks WTP questions, it has been commonly called a 'WTP study'. Subsequently, the key fundamentals of 'contingent' market scenarios are often overlooked by practitioners as the term 'WTP' predominates over 'CV method'²¹.

Affordability to pay

Affordability to pay (ATP) is the extent to which prices (e.g. water supply and sanitation) are within the financial means of users. It is an important consideration in service planning relating to choice of service level and pricing²².

A family of five living on the poverty line (US\$ 9 per capita per month in 2000) which uses 20 cubic metre of water per month would spend 1.2% of its budget if it has a water meter and 2.0% of its budget if it does not have a water meter on its water bill. This percentage lies well below the widely used affordability threshold of 5%.

The US Environmental Protection Agency's Science Forum (EPA) establishes a National Primary Drinking Water Regulation (NPDWR) that, it must consider the impact of regulatory compliance on small community water systems (those with a service population of 10,000 or fewer). Major provisions for dealing with this issue are linked to the concept of 'affordability'. EPA must identify affordable 'small system compliance technologies' for each rule, and if affordable compliance technologies are not available, EPA must identify 'small system variance technologies' in lieu of compliance technologies. Even though the variance technologies may not achieve compliance with the maximum contaminant level (MCL) – the standard or treatment technique in the rule, the variance technology still must achieve the maximum reduction/inactivation that is affordable while considering system size and source water quality. Further, the variance technology must be 'protective of public health'. In addition, states are authorized to grant 'small system variances' from the MCL/treatment technique for the life of the variance technology. Affordability is a concept provided for in the Safe Drinking Water Act to assist in making decisions on the need for variance technologies and variances. EPA developed the National Level Affordability Criterion to be used in making the decision on whether affordable compliance technologies exist for small systems. EPA determines affordability of a rule through the following relationship:

$$EM = AT - B,$$

where *EM* (expenditure margin) is the maximum increase that can be imposed by treatment (and still be considered

affordable). *AT* (affordability threshold) is the upper limit for the cost of water bills including costs for treatment, distribution and operation (the current affordability threshold is 2.5% of median household income – MHI), and *B* (baseline component) is from current annual water bills and median household income²³.

Fujita *et al.*²⁴ conducted estimates of WTP and ATP by beneficiaries of water and sanitation services in Iquitos city, Japan. The main findings are of two categories; WTP is approximately twice the current average payment level, and ATP is higher than the current payment level.

Ability and WTP for water supply service with the important factors that affect water tariff design are the ability and affordability of the citizens to pay for improved water supply service²⁵.

Ghuraiz and Enshassi²⁵ deal with the affordability of electricity, district heating and water for low-income consumers in transition countries. The affordability consequences of tariff reform ultimately depend on the speed of tariff adjustments relative to the growth in household income, the level of tariffs needed for cost recovery, the level of effective tariffs at the outset (tariffs adjusted for non-payment) and the demand response to the tariff increase. It has been also found that delaying tariff reform by a few years makes little difference to affordability constraints, and may therefore not be an effective way to mitigate the social impact of utility reform²⁶.

Significance of affordability to pay

ATP is an important factor influencing the WTP and in some instances it has been observed that the people's WTP exceeds their ATP. A study of willingness to pay for maintenance and operation of Rural Drinking Water Supply (DWS) schemes in Nepal considered the satisfaction level vs willingness to pay. The first objective of the study was whether the satisfaction level of users affects their WTP for the operation and improvement of DWS schemes. The analysis revealed that satisfaction level, affordability and effective Water User Committees (WUC) have significant influence on the probability estimate of WTP. User's satisfaction level, effective water user committee and affordability are crucial indicators. More convenient location of water points need to be provided to further improve both types of DWS schemes (rural markets and village DWS schemes). The results of this study show that the degree of satisfaction highly influences the WTP for maintenance and operation in both the schemes²⁷.

Recent trends in WTP studies

Pearce *et al.*²⁸ studied people's attitudes towards paying for water use in five aboriginal communities in South Australia. They found that strategies such as communication and community involvement in the decision-making processes

around water supply are necessary to facilitate cost recovery and to promote water conservation.

Kim²⁹ concluded that the regional factors were stronger than individual factors in explaining the measures of WTP for water quality.

Imandoust and Gadam³⁰ studied the WTP for improvement of river water quality in Pune city. The CVM was used for valuating the Pavana River. The report shows CVM applicability and the importance of river water quality.

Guha³¹ compiled a weighted average of the WTP for potable water in Kolkata, analysed and compared the cost of providing potable water. The WTP exceeds the production and maintenance cost for the potable water supply scheme, suggesting that a water tariff is economically justifiable.

Ghuraiz and Enshassi²⁵ studied the ability and willingness of customers to pay for improved water supply service in the Gaza strip. The result revealed that the WTP for improved water supply service matches the WHO standard (about 3.0 Nis/m³).

Kontogianni *et al.*³² examined the motivation of those willing to pay and found that a complex combination of consumer and citizen modes of cognition, linked to self-identity and pride as well as moral and ethical concerns determine individual's commitment to the water quality improvement scheme.

Yusuf and Koundouri³³ in Indonesia showed household's value access to safe and improved domestic water sources.

Tu *et al.*³⁴ dealt with the water quality, land use, and population variations over the past three decades in eastern Massachusetts to examine the impact of urban sprawl water quality using GIS and statistical analysis.

Castellano *et al.*³⁵ dealt with establishing water prices and their effects to provide policy makers environmentally and socially optimal largest regional prices for irrigation water.

Brox *et al.*³⁶ dealt with the problem of items of non-response in contingent valuation survey using a payment-card method by applying a grouped data sample selection estimation technique, values conditional upon a respondent's decision to answer a WTP question.

Hensher *et al.*³⁷ showed that the reliability of the water and wastewater service is of value to residential customers. The analysis used stated choice experiment and mixed log-it models to establish the WTP to avoid interruptions in water service and overflows of wastewater, differentiated by the frequency, timing and duration of events. The result of the focus groups, which indicated that the customer's main concern with respect to wastewater overflows and water service interruptions, was hygiene, which was perceived as high priority.

Azu *et al.*³⁸ reviewed the environmental flow valuation techniques and models were proposed to economically value agricultural and urban water uses, and integrate this knowledge with local hydrologic, infrastructure and man-

agement constraints. The results provide insights into economically promising water supplies for restoration activities.

Hite *et al.*³⁹ dealt with the WTP for water quality improvement. The analysis focuses on implementation of a policy to provide farmers with precision application equipment to reduce nutrient runoff.

Mckay and Moeller⁴⁰ dealing with the application of mandatory drinking water standards reported that the authorities should ensure a basic water quality for all communities.

Phillips⁴¹ examined the planning and construction of a piped water system in Bangui.

The WTP concept examines people's attitudes towards river flow restoration efforts in the Colorado River Delta. This study shows that the Colorado River Delta is still an undervalued ecosystem despite its resilience and the many regional benefits it still provides. The study determines factors that influence Mexicali's WTP and compares WTP attitudes between the cities of Mexicali and San Luis Rio Colorado (SLRC); the two neighbouring Mexican cities of different size and economic structure but of similar social, ecologic and geographical conditions. The data is compared with other approaches such as sociopsychological models¹².

Conclusions

The major findings from the review of the literature are as follows.

- The degree of satisfaction levels highly influences the WTP for the maintenance and operation of rural village and market centre DWS schemes²⁷.
- Any water pricing system should take into consideration factors such as financial, socioeconomic situation, WTP ability and affordability, technical, managerial and political factors²⁵.
- The regional factors are stronger than individual factors in explaining the measure of willingness to pay for water quality²⁹.
- The attitudes towards paying for water use in aboriginal communities showed that inability to pay for services is a common factor hindering willingness to pay for water. The strategies such as communication and community involvement in the decision-making processes are necessary to facilitate cost recovery and to promote water conservation²⁸.

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