WILLINGNESS TO PAY FOR ACCESS TO IMPROVED AND RELIABLE PIPED WATER: A CONTINGENT VALUATION STUDY IN KUTTANAD TALUK, KERALA

UNIVERSITY GRANTS COMMISSION

MINOR RESEARCH PROJECT REPORT

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ST. ALOYSIUS COLLEGE, EDATHUA
ALAPPUZHA

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DECLARATION

I hereby declare that the report entitled "Willingness to Pay for Access to Improved and Reliable Piped Water: A Contingent Valuation Study in Kuttanad Taluk, Kerala" is a genuine record of research work done by me under the financial support of University Grants Commission and the work presented in this report has not been submitted earlier.

Dr. Jubin Antony

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I remember my parents and all my teachers, for they are the ones behind all the achievements in my life.

It is with deep sense of love I remember the encouragement, support and constant help by my loving wife Tintu.

I place on record my deep sense of gratitude to University Grants Commission for the financial assistance.

I fold my hands thinking of the mysterious but wonderful ways through which the God almighty has led me. Deo gratias.

Dr. Jubin Antony

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EXECUTIVE SUMMARY

Access to safe drinking water is one of the basic human rights. The Millennium Development Goals formulated at the summit of world nations under the auspice of United Nations considers access to safe drinking water as one of the priority goals. According to WHO, compared to the dismal 69% of the people with access to sources of water in 1990, in 2010 overall 92% of the population of India had access to improved sources of water. However, this does not mean all these people have continuous access to required quantity of safe and clean water. Water quality problems, insufficient supply of water and inadequate operation and maintenance are serious concerns which need to be addressed. This is mainly due to the fact that many of the water supply projects are still government-led and fully paid for by government with least beneficiary participation.

The study area Kuttanad, located in Alappuzha district of Kerala is globally acclaimed for its tourism potential. Although Mother Nature has profusely blessed Kuttanad with rivers, back water lakes and paddy fields, it is an example of scarcity among plenty in case of potable water. The existing clean water distribution projects managed by Kerala Water Authority failed to reach every needy household. The issue of access to clean and potable drinking water is a very old issue in this region which is still not resolved. Against this background this research studied the existing water scarcity issues in the Kuttanad taluk and tried to estimate the amount the people of this area are willing to pay for access to clean and potable water in required quantity.

Contingent Valuation, the method used by economists to estimate the value of the non−marketed goods is used here. The method proposes a hypothetical project to the people and enquires their willingness to contribute towards it. Once the data on the respondent's willingness to pay predesigned bid amounts towards the hypothetical project is collected, the actual amount people are willing to contribute is estimated using statistical procedures. Here double bound dichotomous choice survey format was used and the estimation was done in STATA.

As part of this research information on the existing water sources was also collected. Only 36% of the surveyed households had pipeline connection. The fact that 30% of the households depend on public taps indicates the failure of the existing water supply projects in reaching the households. Fifty to fifty five percent of the people depend on the river water for other than drinking and cooking requirements. Several scientific studies have pointed out the alarming level of contamination of rivers in this region. This study reveals that 3 to 4

percent of the respondents rely on river water for drinking and/or cooking purpose.

The respondents are well aware of the pollution of the river water. Around 55 percent of the respondents feel that the water they use for bathing, washing and other purposes is bad. Around 10 percent of the respondents feel even the water they use for drinking and/or cooking is not of consumable quality. During rainy season 13% of respondents and in summer 18% of the respondents buy water for drinking/ cooking requirement. The average monthly expense towards this is around Rs. 430.

Before enquiring the willingness to contribute a specific amount towards the hypothetical project, the respondent was informed about the details of the proposed water supply scheme. It was clearly mentioned that by paying the charge, the respondents will have continuous and sufficient water supply with sufficient pressure, and the water will be of good quality, potable without boiling or any other treatment. 63% of the respondents were willing to contribute towards the project. Almost 95% of the people who did not agree to contribute the specified amount gave higher price as the reason for their negative answer.

The amount people are willing to pay was estimated as Rs.47 per Kilo litre of water. This means a family of four members is ready to pay around Rs. 400 if they can get potable quality of water through pipeline at home for all their requirements. This is a very significant result considering the fact that currently a household pay an average of just Rs. 48 per month for the existing pipeline connection. It is to be noted that 50 percent of the households with pipeline connection are also interested in this project.

The quality of water currently used as perceived by respondent, the need to buy water, presence of pipe connection, gender of respondent, number of years of education of the respondent, whether the respondent is employed and the number of members in the family were found to be influencing the WTP of the respondents. Female respondents were found to be more in favour of the project compared to male respondents. This is in the expected lines as generally the women in households are more concerned about the shortage of water and they are the ones who generally go and collect water in case it is not available in their own premises. The family size was found to be negatively influencing the WTP. This could be due to the fact that in big households there will be people to get water even if it is not readily available in own premises. In a two or three member family although the requirement is less they may not find time to collect water if potable water is not available in own premises. Such people may prefer the project more. One other reason could be for big households the water requirement is more and therefore the amount they need to pay also will be more. It is natural that hearing a high amount, people may not be willing to

participate even if they are interested in the project. Respondents' preferred agency for running the water supply project was local panchayat.

The study points to the serious issue of lack of clean and potable water in Kuttanad taluk. The government and policy makers must pay their urgent attention on this. The fact that people are willing to pay Rs 47/ KL of water which is almost 9 times the amount they currently pay is a very significant indicator. But people expect clean and potable water available throughout the day with required force to pay this amount. This is a good sign as government can plan efficient water supply projects even if they have to invest considerable amount as the people are willing to pay it back through the water tariff.

The funding agencies generally look for the economic viability of any project. World Bank in 2008 estimated the total cost (including capital and maintenance cost) per kilo litre of water in a decentralized community led approach in India as Rs. 43. The cost per kilo litre of water in case of a centralized government led approach was estimated as Rs. 61. The result is also very significant as the government can approach international funding agencies more confidently for loans to implement water supply projects. The result is a clear indication that if the water supply project is properly maintained and people are given quality water throughout the day, they will pay the money back and this amount may be enough for loan repayment.

CHAPTER I: INTRODUCTION

Access to safe drinking water is one of the basic human rights. However, across the globe many of the governments have failed to fulfil the basic responsibility of supplying clean and potable water to all its citizens. The Millennium Development Goals formulated at the summit of world nations under the auspice of United Nations in 2000 at New York consider access to safe drinking water as one of the priority goals. The report to which India also is a signatory commits that by year 2015 half of the people who did not have good and safe drinking water as in 1990 should have access to it (United_Nations, 2000). United Nations recommends that each person daily needs 20-50 litres of safe water for his/ her basic needs of drinking, cooking and cleaning (UN-WWAP, 2003).

The inherent inefficiency of the government system prevents many of the developing and less developed countries to achieve the ambitious goal of ensuring its citizens the access to safe and clean water. Under priced domestic water connections, operations and maintenance issue like the seepages caused by poorly laid pipelines, etc. are leading to the non-profitability of the existing water supply schemes run by the governments in these countries. Fair water tariff is one of the key factors to ensure the long term sustainability of the piped water connections in any democratic setup. The governments try to keep the price low irrespective of the costs involved and thus fail the institutions tasked with water supply schemes to come up with new projects and even expansion plans. A fair pricing will help the water supply projects economically viable and this is even a mandatory criterion to get financial support from international funding agencies. So there is a need to estimate the amount people are willing to pay for efficient water supply schemes.

Providing safe and clean drinking water to over 125 million people living in urban and rural areas is one of the biggest challenges faced by the Government of India. Although 16 percent of the world's population live in India, its share of fresh water resource is only 4 percent (Bagla, 2014). Further, 23 percent of the population does not have access to clean drinking water in India (UNDP, 2010). Government of India policy stipulates a minimum per capita water supply of 70 litres daily in rural and 135 litres daily in urban areas (GOI, 2005). India had taken up the ambitious target of providing water supply, sewage and sanitation facilities to all her urban population by 2012 as a goal for the 11th Five year plan (2007 – 2012). Compared to the dismal 69% of the people

with access to sources of water in 1990, in 2010 overall 92% of the population of India have access to improved sources of water (WHO/UNICEF, 2012).

However, this does not mean all these people have continuous access to required quantity of safe and clean water. Water quality problems, insufficient supply of water and inadequate operation and maintenance are serious concerns which need to be addressed (Vedachalam, 2012). This is mainly due to the fact that many of the water supply projects are still government-led and fully paid for by government with least beneficiary participation (World_Bank, Project Performance Assessment Report. IEG Public Sector Evaluation., 2013). As a response to this challenge government of India initiated sector wise reform measures were in the government's role was limited to that of a facilitator and communities are expected to manage and contribute to the costs of water supply projects. With the advent of these reform measures World Bank and other international funding agency like Asian Development Bank (ADB), Japan bank for international cooperation (JICA), etc. have increased financial assistance to the water supply projects. As of 2007, India has an approved financial assistance of $4,031 million from World Bank and $543 million from ADB (JICA, 2010). As a prerequisite for these foreign investments, to demonstrate the viability of cost recovery and also to ensure the success of the water supply schemes it is necessary to assess the willingness of the communities to participate and contribute towards these projects.

1.1 Drinking Water Scarcity in Kuttanad and Study Motivation

Kerala is one of the smallest states of India with 1.18 percent of the country's area and 3.7 percent of national population. Kerala is known for her enchanting greenery, serene backwaters, beautiful beaches, enthralling monsoon and large numbers of rivers. Although Kerala is among the states which receive one of the highest rainfalls in the country, because of its location in Western Ghats much of the water is runoff into the Arabian Sea. Due to this all of the 44 rivers in the state either dries up or has very low discharge in summer. In Kerala more than 70% of the population get drinking water from their house compound wells and only around 30% population depend on Government sponsored piped water supply schemes (Devi, 2002). Kerala Water Authority (KWA), an autonomous body under government of Kerala established in 1984 is in charge of the water supply projects in the state.

The study area, Kuttanadu is located in Alappuzha district of Kerala. As per the 2011 census the district has a population density of 4,466 per sq km. It is assumed that the name Alappuzha means 'the land between the sea and the network of rivers flowing into it'. The district has a network of rivers, canals and backwaters. The Vembanad lake which boarders Kuttanad taluk extends from Alappuzha and it opens out to Arabian sea in Cochin. The Kuttanad terrain was

formed by reclamation of land from lake for paddy cultivation. Kuttanad, the rice bowl of Kerala is famous for farming below sea level. Farmers in this region could do only two cycles of rice cultivation a year due to the high salinity caused by seawater ingression in summer. The Thanneermukkom Bund (Thannermukkom Salt Water Barrier) was constructed to prevent the intrusion of salt water to the low-lying Kuttanad and hence allowing farmers to cultivate an extra crop per year. However, the bund is alleged to have caused severe environmental problems. The backwaters which were abundant with large number of fish species required a small amount of salt water for its breeding. The barrier prevented sea water intrusion thus affecting the ecosystem of the area and destruction of subsistence fishery on which the local fishermen depended (Ravindran, Appukuttan, Pillai, & Boopendranath, 2006) and (Jayan & Sathyanathan, 2010). During summer when the regulator is closed it creates a stagnant water body resulting in heavy load of pesticides and fertiliser residues and waste accumulation and proliferation of weeds thus affecting water quality in the area (Sreejith, 2013).

During monsoon water from the high ranges of the neighbouring districts flow through the four rivers namely Pampa, Meenachil, Achankovil and Manimala to the low lying Kuttanad causing floods. The project Thottappilli Spillway, was designed as a permanent solution to the flood situation in Kuttanad. The Thottappilli Spillway diverted flood waters from the rivers to the sea before it reaches Vembanad lake. It is a major tourism spot which attracts thousands of tourists from all over the world and thus earning considerable foreign exchange. The houseboats of Kuttanad can be rightly considered as the brand ambassadors of the state's tourism industry. However, kitchen and bathroom wastes and oil and grease discharged from these houseboats are aggravating the pollution of backwaters (Safoorabeevi & Devadas, 2014).

Although Kuttanad is formed by delta swamp reclamation and is surrounded by water, it is an example of scarcity amidst plenty in case of potable water. The yearly recurring floods make the situation worse and push the local people to misery. In summer the water sources become ineffective as sea water permeates the well and other water sources. In addition to this natural disadvantage, sewage disposal in public areas including water bodies and inorganic farming with excessive use of pesticides aggravate the contamination of existing water sources. The existing water supply projects are not reliable and sometimes even beat the purpose itself by supplying contaminated water. Although local bodies have spread awareness and gave subsidies for water harvesting plants, water scarcity is a serious concern in Kuttanad. There is great hue and cry in every monsoon when flood occurs and in summer when water quality deteriorates for new water supply projects. In this project the willingness of the local people to pay for clean and reliable potable water is studied.

The name Kuttanad refers to a large area in Kottayam, Alappuzha and Pathanamthitta districts of Kerala. However, this study is restricted to the Kuttanad revenue taluk.

1.2 Contingent Valuation

Contingent Valuation is a method used to estimate the value of non-marketed goods. By creating a hypothetical market place, Contingent Valuation (CV) estimates the value people place on commodities that are not exchanged in regular markets or when it is difficult to observe regular market transactions under the desired conditions. The approach asks people the amount they are willing to pay (WTP) for a hypothetical project OR the amount they are willing to pay for improvement of an existing service OR the monetary value they assign for public goods. Critics of CV method allege that being stated preference data it always gives much higher estimates compared to actual amount the people are willing to pay. Comparisons of stated and actual willingness to pay for piped water connections in Kerala, found that contingent valuation studies correctly predicted 91% of actual decisions to connect to piped water (Griffin, Briscoe, Singh, Ramasubban, & Bhatia, 1995).

Contingent Valuation studies can be found in large numbers in estimating the amount people are willing to pay for improvement in water quality (Genius & Tsagarakis, 2006), the value of national parks (Lee & Han, 2002), improvement in health care (Bayoumi, 2004), etc. International funding agencies like Asian Development Bank (ADB) and World Bank stipulates a proper tariff system to be in place for funding projects like water supply system. Contingent Valuation Method is the method widely used to assess the economical viability of many such projects. In 80% of the 35 water supply and sanitation projects processed by ADB during 2000-2006 WTP surveys were used to estimate project benefits (Gunatilake, Yang, Pattanayak, & van der Berg, 2006).

There are several survey and estimation techniques available in Contingent Valuation method. (ADB, Tariffs, Subsidies & Development Funding, 2001) cautions the practitioners of the serious flaws that can creep in in this technique if applied without proper knowledge. There is a considerable literature available on different estimation techniques in Contingent Valuation method. A detailed analysis on the existing survey and estimation methods are given in the next chapter on Literature Review.

1.3 Project Overview

The project is carried out by Department of Statistics, St. Aloysius College, Edathua with the funding support of UGC. The project is aimed at estimating the amount people of Kuttanad taluk are willing to pay for better water supply

scheme. The project started in August 2014. The initial phase of the project was literature survey to review the existing studies to come up with the best suited methodology. Later questionnaire was designed. The questionnaire was vetted by experienced Economist Prof. Ramachandra Bhatta, Scientist G, National Centre for Sustainable Coastal Management, Chennai.

The sample size was fixed at 650 and survey area was decided as the entire Kuttanad taluk comprising 12 panchayats. For the quick and efficient data collection four data enumerators were recruited and proper training was given to them. Pilot survey was started in January 2015. After making the changes in the questionnaire based on the pilot survey the final data collection began in February, 2015 and completed by end of May, 2015. The data entry, analysis and final report preparation were completed by March 2016.

1.4 Objectives of the Study

This project is to estimate the amount the people of Kuttanad are willing to pay for a superior water supply project with reliable and quality potable water. Contingent Valuation method was applied to estimate the WTP amount. Although it is a hypothetical project this has great relevance in the current situation of the Kuttanad region where availability potable water is a major concern. The factors which influence people to support or not support a new water supply project was also identified. This can be used to identify the group of people who are ready to support the project if implemented in a later stage.

The project is designed as an application oriented study. However, an analysis of the different estimation techniques in Contingent Valuation was also carried out as a part of the project. There are several parametric, semi-parametric and non-parametric techniques to estimate WTP value from Contingent Valuation studies.

The objectives of the project are;

a. Estimate the amount people are willing to pay for better quality potable water in Kuttanad region
b. Identify the factors which drive the willingness of people to participate in the project

St. Aloysius College, Edathua is the only Government aided College in the rural Kuttanad taluk. Knowledge of the study area together with the past experience of the researcher on Contingent Valuation methods helped in conducting the CV survey well and estimating the WTP value accurately.

A detailed survey of existing literature was conducted as a part of the project. Chapter 2 describes related studies in contingent valuation. It also gives the details of the studies on the water quality and accessibility. Chapter 3 discusses the economic validity of Contingent Valuation. Chapter 4 describes the

sampling methodology, survey instrument and WTP estimation techniques. Results of the descriptive analysis of survey data is given in chapter 5. WTP estimates and the factors identified to influence the people to participate or not to participate are given in chapter 6. The main findings of the study are discussed and policy suggestions are spelt out in chapter 7.

CHAPTER II: LITERATURE REVIEW

An extensive literature survey was carried out as a preparatory step for the project. This included research articles and reports of studies on the water quality of Kuttanad in addition to the Contingent Valuation literature. A large number of research articles on applications of Contingent Valuation were studied. In addition to the Contingent Valuation application studies theoretical studies related to the survey format and estimation techniques were also reviewed.

The name Kuttanad used in this section indicates the larger Kuttanad area including the Kuttanad taluk which is the area of our study unless it is specifically mentioned. This is because most of the existing literature are based on the studies they have carried out in larger Kuttanad area spread across three districts of Alappuzha, Kottayam and Pathanamthitta.

2.1 Water Pollution and Related Issues in Kuttanad

The promiscuous use of pesticides and fertilizers for paddy cultivation has caused severe contamination of the water bodies and damage to the ecosystem of Kuttanad (Thomas, 2002). (Varghese & George, 2013) quotes a study conducted by Alappuzha medical college which found that 27% of deaths reported during 2005 -2009 in Kainakary, a Village located at the lowest tip of Kuttanad taluk were due to cancer. Alarming number of cancer cases in this low lying village by the bank of Vembanad Lake is attributed to the toxicity of water due to the presence of pesticides and other wastes.

Water samples from Kuttanad are observed to have relatively higher fluoride concentration (James & Thomas, 2014). Fluoride concentrations above 1.5 ppm in drinking water cause dental fluorosis and much higher concentration cause skeletal fluorosis. In Kuttanad most of the houses are by the banks of rivers and waste water is often discharged into the nearby water bodies. Many households use these water bodies for washing and cleaning. The detergents used for this is reported to cause serious pollution problems. Enzymes present in detergent cause several types of allergies (Mathew, Sunitha, & Philip, 2013).

Water bodies contaminated by faeces will contain E. coli bacteria. (Thomas, 2002) and (Kumar, 2007) reported that pollution from human sewage or animal waste is severe in Kuttanad. This can also be confirmed by the high

incidence of acute diarrhoeal diseases and other water borne infections among the people especially the poor sections of the community. In 2002, there were 23,214 reported cases of diarrheal diseases in the Alappuzha District in Kuttanad (Gregory, 2002). The analysis of water samples in Kuttanad carried out by (Christina, 2009) confirmed that five out of ten tap water samples are contaminated. Apart from the rainwater sample, all the remaining water samples from public tap and water bodies failed the E. coli count test under the drinking water standards. The study states that the E. coli levels in the sample ranges from 40 to 460 per 100 ml of water, far exceeding the WHO drinking water standard of zero E. coli per 100 ml of water (WHO, Guidelines for Drinking Water Qualit.y Volume 1:Recommendations, 2004).

The WHO guidelines say that presence of intestinal enterococci greater than 500 per 100ml in bathing water can lead to illness (WHO, Guidelines for safe recreational water environments. Volume 1: Coastal and Fresh Waters, 2003). The water samples from rivers in Kuttanad contain an average of 1,600 E. coli per 100 ml of water which has not included the count for other coliforms (Christina, 2009). In a sample survey conducted in Kuttanad in 2001, 7% of households still report drinking from the river, which is not even suitable for bathing (Gregory, 2002).

A study conducted by M. S. Swaminathan Research Foundation reported that pipe water only reaches 25% of the population in Kuttanad (MSSRF, 2007). (Suchitra, 2003) quotes a study by Centre for Water Resources Development and Management (CWRDM) which estimated that more than 80% of the people in Kuttanad rely on contaminated river water for their daily water requirements. However, Kerala Water Authority and local government (panchayat) failed to supply clean water to meet the demand of the people. (Christina, 2009) estimated that when Kerala Water Authority's pipe water bill for 5,000 litres consumption is Rs 20 per year, an average household in rural area without pipe water connection spends Rs 1,800 per year to purchase water from private vendors as on 2008.

In the prevailing local culture it is usually the women or children in a household who hurry towards the public water taps and fill their pots until the taps run dry. As women and children are responsible for collecting sufficient water for household consumption, the insecure water provision imposes a disproportionately large social burden on them. All studies call for an urgent attention of government to provide access to clean and safe water to the people of Kuttanad. Thus the current research to discover the interest of the local population towards a water supply project and estimate their willingness to pay towards a better water supply scheme strikes the chord.

2.2 Contingent Valuation: Origin and Development

Broadly there are two ways of estimating the economic value of non-marketed goods, viz., revealed preference technique and stated preference technique. In revealed preference technique, we use the existing transactions associated with a public commodity to estimate the value of it. Travel cost and hedonic pricing method are the two common approaches in revealed preference technique. Among stated preference techniques Contingent Valuation (CV) is the most widely used method. In CV method researchers ask hypothetical questions to elicit the amount the respondents are willing to pay for a hypothetical project or for the improvement in the quality of service or commodity they are receiving.

(Bowen, 1943) and (Ciriacy-Wantrup, 1947) were the first to propose the use of opinion surveys as a method to estimate the value of public goods. However, experts consider (Davis, 1963) attempt to estimate the benefits of outdoor recreation in Maine backwoods area using questionnaires for his PhD dissertation as the first application of CV method we see around now. Later (Knetsch & Davis, 1966) used contingent valuation method to study the recreation value of Maine Woods and compared CV estimate to a corresponding estimate based on the travel cost method. (Bishop & Heberlein, 1979) drove the methodological growth of CV by incorporating the dichotomous format also called referendum method in CV surveys. The dichotomous format soon got a wider acceptance because it substantially simplified the cognitive task faced by respondents. The theoretical formulation of CV as a scientific method for estimating the value of non-marketed goods came through (Hanemann, Welfare Evaluations in Contingent Valuation Information with Discrete Responses, 1984), (Cameron & James, Efficient Estimation Methods for Closed-Ended Contingent Valuation Surveys, 1987) and (Cameron, A New Paradigm for Valuing Non-Market Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression, 1988).

CV method got a wider publicity after its use in quantifying the environmental damages caused by the Exxon Valdez oil spill in Prince William Sound in USA in 1989. The State of Alaska claimed multibillion-dollar natural resource damages based on this CV survey. This led to a heated debate on the validity and reliability of using CV method in damage assessments. Opponents of the method argued that the estimates from CV method are erroneous and misguiding (Diamond & Hausman, 1994). This dispute led the National Oceanic and Atmospheric Administration (NOAA) in US to form a panel consisting of Nobel prize winners Keneth Arrow and Robert Solow to examine the validity of using CV as a method for determining the lost economic value from natural resource damages. (Arrow, Solow, Portney, Leamer, Radner, & Schuman, 1993) concluded that the CV method can produce reliable estimates provided the surveys are carefully designed and controlled. The panel also recommended a set

of guidelines for CV studies in order to be reliable. This report was a major endorsement for CV method for its use in environmental policy analysis (Rosenbaum, 1998). This high-profile use of contingent valuation, and its subsequent federal endorsement, helped to make CV a broadly accepted method of environmental valuation. Since then CV methods are widely used to estimate the value of all kinds of environmental goods such as water quality, biodiversity, wildlife, etc. International organizations like World Bank, Asian Development Bank, etc. also started using CV studies there after more frequently to ensure the economic viability of projects by estimating the amount people are willing to pay for the project under consideration (Singh, Ramasubban, Bhatia, Briscoe, Griffin, & Kim, 1993), (Whittington & Swarna, 1994).

2.3 Applications of Contingent Valuation

There is a vast and rapidly growing literature on CV methods and its applications. (Carson & Hanemann, Contingent Valuation, 2005) states that published literature on CV studies are available from twenty-nine out of the thirty current OECD countries and 80 developing countries. Here we list some of the relevant and interesting CV applications. (Tambour & Zethraeus, 1998) used CV to estimate WTP for a health care program in a Swedish hospital. Using bootstrap procedure they estimated confidence interval for nonparametric mean WTP estimates. (Krishnan, Birthal, & Venugopalan, 1999) used CV to study consumer preference for seafood. (Bishai, Pariyo, Ainsworth, & Hill, 2004) used CV to assess willingness to pay for HIV/ AIDS vaccine among adults in Uganda. (Kramer & Mercer, 1997) study of the value of tropical rain forest protection is a good example of the contingent valuation method used in the valuation of environmental goods. (Xie, Shah, Capannelli, & Wang, 2004) estimated maximum willingness to pay (WTP) for staying on the road and minimum compensation willing to accept (WTA) for staying off the street using a contingent valuation study for designing economic incentives to phase out polluting motorcycles in Bangkok. (Mattia, Oppio, & Pandolfi, 2010) tested the use of CV for property valuation in real estate market. The study reports that there are only negligible differences between the WTP values and the market values estimated by the traditional real estate appraisal methods.

There are many examples of CV studies conducted for and by World Bank. World Bank used contingent valuation to estimate WTP for piped water connections in Kerala, India (Singh, Ramasubban, Bhatia, Briscoe, Griffin, & Kim, 1993). World Bank and Bangladesh Rural Advancement Committee (BRAC) jointly conducted a WTP study on safe drinking water in Bangladesh (Ahmad, Goldar, Misra, & Jakariya, 2003). CV study to assess willingness to pay for water in rural Punjab, Pakistan conducted under UNDP/ World Bank Water and Sanitation Programme is given in (Altaf, Jamal, & Whittington, 1992).

(ADB, Report and recommendation of the President to the Board of Directors on a proposed loan to India for the urban water supply and environmental improvement in Madhya Pradesh, 2003) used Contingent Valuation method to estimate the benefit of water supply in Madhya Pradesh. (Gunatilake & Tachiiri, Willingness to Pay and inclusive tariff designs for improved water supply services in Khulna, Bangladesh, 2012) conducted a detailed WTP study under ADB to analyze the impact of heterogeneous water tariff structure across households in Khulna Bangladesh.

(Arin & Kramer, 2002) in their study use CV to examine the diver demand for visits to protected coral reef areas. (Vaughen, Russell, Rodriguez, & Darling, 1999) reported that at the Inter-American Development Bank (IDB), CV has become the method of choice for estimating the benefits of investment projects aimed at improving water quality. (Chase, Lee, Schulze, & Anderson, 1998) and (Walpole, Goodwin, & Ward, 2001) examine the pricing policies of national parks in Costa Rica and Indonesia respectively using Contingent Valuation. (Alemu, 2000) used the CV method for the valuation of community forest in Ethiopia. (Lin, Somwaru, & Tuan, 2005) used CV method to estimate consumers' willingness to pay for biotic foods in China. (Leong, Zakaria, AbdGhani, & Mohd, 2005) used CV method to estimate non- market benefits of highland forest accrued to local residents in Malaysia. (Herath & Kennedy, 2004) used the travel cost and contingent valuation methods for estimating the economic value of Mount Buffalo National Park.

Comparisons of stated and actual willingness to pay for piped water connections in Kerala, found that contingent valuation studies correctly predicted 91% of actual decisions to connect to piped water (Griffin, Briscoe, Singh, Ramasubban, & Bhatia, 1995). Researchers have even tried different payment vehicles for Contingent Valuation surveys (Echessah, Swallow, Kamara, & Curry, 1997). Experts say that respondents are more likely state a higher mean WTP when the valuation is based on a labor payment vehicle rather than a monetary payment vehicle. (Hung, Loomis, & Thinh, 2007) compared money and labour payment vehicles by conducting a CV survey to elicit WTP values for forest fire prevention in Vietnam. (Antony & Rao, Economic valuation of cultivation of Mangroves: A willingness to work study using zero inflated Poisson distribution, 2011) studied the willingness of coastal fishermen community in Karnataka, India to contribute towards the cultivation of mangroves through labour. They have used Zero Inflated Poisson model to estimate the number of days fishermen were willing to work. (Vondolia, Eggert, Navrud, & Stage, 2011) states that although different payment vehicles may result in different mean WTP values, increased familiarity with the payment vehicles will reduce these differences.

One can easily expand this list of CV studies where in researchers around the globe assessed the value respondents' place on various natural resources or utilities. These all indicates the widespread popularity and acceptance gained by Contingent Valuation method.

2.4 Contingent Valuation Survey Formats

In the initial phases of contingent valuation method researchers used open ended questions to elicit respondent's WTP. However, for the respondent it is extremely difficult to come up with a monetary value for a hypothetical project or for a natural resource under study. Due to this difficulty this survey method used to report many missing values of WTP. To overcome this, different elicitation techniques were suggested and the four major techniques among them are the bidding game, the payment card, the discrete choice and discrete choice with a follow-up.

The **bidding game** approach (Randall, Ives, & Eastman, 1974) was extensively used in CV studies in its initial periods because the process is similar to normal auctions and therefore is likely to be familiar to the respondents. This is an iterative process in which the interviewer keep on increasing or decreasing the bid amount until the respondent say a YES or NO (dependent on what was his/ her initial answer) to the WTP question. (Rowe, d'Arge, & Brookshire, 1980) found that here the starting point had an undue influence on the final estimate of willingness to pay. Also the repeated questioning may irritate the respondent and may result in terminating the survey (Whitehead, 2006)

Payment card method was developed by (Mitchell & Carson, An experiment in determining willingness to pay for national water quality improvements, 1981) in order to avoid the starting point problem that can arise in traditional bidding applications. In payment cards technique range of values are displayed starting from zero and increasing at fixed intervals. The respondent is asked to choose his WTP/WTA from these values which best represented their maximum willingness to pay. (Cameron & Huppert, OLS versus ML estimation of non-market resource values with payment card interval data, 1988) say that in this case the actual amount respondent willing to pay lie between the chosen amount and the next higher amount.

(Bishop & Heberlein, 1979) developed **discrete choice** method or the **dichotomous choice** method. In this approach interviewer asks the respondent whether he is willing to pay a predetermined price for the project under discussion. Although we ask only one question to each respondent, the valuation amount will be varied across respondents, randomly with a set of pre-assigned alternative values. In this approach we need to estimate the WTP amount using a suitable statistical technique as from the survey result we can only infer that

the respondents' WTP amount is greater than the bid amount (if respondent agree to pay the requested amount) or is less than the bid amount (in case the respondent disagree)

The fourth widely used elicitation method is the **discrete choice with a follow-up** introduced by (Carson, Hanemann, & Mitchell, Determining the demand for public goods by simulating referendums at different tax prices, 1986). Here, if the respondent answers affirmative to the initial bid amount the question will be repeated for a higher bid amount. In case the respondent answers NO to the initial bid his or her opinion to pay a lower amount will be sought. (Hanemann, Some issues in continuous- and discrete-response contingent valuation studies, 1985), (Carson & Steinberg, Experimental design for discrete choice voter preference surveys, 1990) and (Hanemann, Loomis, & Kanninen, Statistical efficiency of double bounded dichotomous choice contingent valuation, 1991) were to further develop this concept into what is now known as the double-bounded approach. (Hanemann, Loomis, & Kanninen, Statistical efficiency of double bounded dichotomous choice contingent valuation, 1991) proved that the double bound DC-CVM is asymptotically more efficient than the single bound model. It was suggested that the double bound model allows for correction of a poor choice of the initial bid amounts. (Calia & Strazzera, 2000) analyzed the bias of the ML estimates produced by both single and double bounded model in dichotomous choice contingent valuation experiment using Monte Carlo analysis. They concluded that double bound approach has greater efficiency.

Some researchers also tried an extension of the discrete choice or single bound method in which a pair of options are presented before the respondent and the opinion is sought from them. Here the question could be "Do you prefer – Program 1, which involves paying A1 and obtaining outcome X1, or Program 2, which involves paying A2 and obtaining outcome X2?". The approach is called **paired comparisons.** (Magat, Viscusi, & Huber, 1988) used paired comparison method for eliciting consumer valuations of morbidity risk reductions associated with safer chemical products. (Brown & Peterson, 2003) gives a detail review of the method.

2.5 Contingent Valuation Estimation Methods

Initially when economists used open ended elicitation method to assess WTP of respondents, people were asked directly the monetary amount they were willing to pay for a specific project or natural resource. Obtaining the WTP value from such surveys was as simple as to calculate the mean and median values or could use ordinary least squares (Edward & Anderson, 1987) (Loomis, 1987). But with the introduction of referendum format respondents' willingness to pay a specific

pre-selected amount was assessed instead of asking directly the amount they were willing to pay. Here we cannot give the arithmetic mean or any simple OLS estimate as their true WTP. So we have to adopt econometric techniques based on some parametric approach to estimate the true WTP.

Non-parametric techniques which do not rely any distributional assumptions are always attractive due to its simplicity in concept and easiness in calculation. That is the reason why we can still find research articles with new non parametric approaches for calculating WTP In the midst of different parametric techniques. (Crooker & Kling, 2000) presented a new non parametric method for estimating upper and lower bounds on each consumer's willingness to pay. (Boman, Bostedt, & Kristrom, 1999) discussed a simple non-parametric technique on the estimation of mean WTP and its variance. In both cases the performance of the estimators were evaluated using Monte Carlo Simulation. (Huhtala, 2000) suggested that nonparametric estimation could offer a solution for accounting for preference heterogeneity regarding the public goods to be valued in binary choice contingent valuation studies. (Antony & Rao, On comparison of model-based and design-based estimators of mean for count data with excess zeros, 2010) compared the performance of model-based (maximum likelihood) estimator with design-based estimators in a discrete CV set up using the zero inflated distribution to tackle zero spike.

In parametric approach first we need to specify the functional form of the WTP distribution. Here to fix the range of the distribution, we can restrict the left tail to ≥ 0 as in most cases a negative WTP is implausible. (Haab & McConnell, Referendum models and negative willingness to pay: Alternative solutions, 1997) proposed truncated distributions to overcome the issue. As a next step we need to deal with spike at zero WTP. This may be due to respondents' indifference to the given project or may be protest zeros. Finally we need to treat the right tail of the WTP distribution. By applying suitable economic theory one can limit the maximum WTP amount to a percent of the respondents' total income. (Haab & McConnell, Referendum models and economic values: theoretical, intuitive, and practical bounds on willingness to pay, 1998) discusses the effect of imposing bounds on WTP distributions. While the possibility of negative values prevent the use of Normal distribution, due to the long right tail of log normal it is also not promoted to be used as WTP distribution for estimation. With the shorter right tail and spike configuration Weibull distribution performs well (Kristrom, 1997).

There is a considerable literature available on different estimation techniques in Contingent Valuation method. The estimation method is also dependent on the WTP elicitation approach used for a given survey. (Cameron & James, Efficient estimation methods for 'close-ended' contingent valuation surveys, 1987) developed maximum likelihood estimation procedure for closed

ended contingent valuation surveys. (Langford, Bateman, Jones, Langford, & Georgiou, 1998) discusses Quasi-likelihood methods for estimating parameters in CV method. (Werner, 1999) used a mixture distribution to model a dichotomous-choice contingent-valuation data. (Antony, Rao, & Bhatta, Use of generalized estimating equations in contingent valuation studies, 2003) used Generalized Estimating Equations to estimate WTP. (Langford, Kontogianni, Skourtos, Georgiou, & Bateman, 1998) used a multivariate binomial - lognormal mixture model to estimate WTP by including explanatory variables. (An, 2000) attempted the estimation of WTP distributions semi parametrically using the proportional hazard specification for the distribution. (Leon & Vazquez-Polo, 1998) proposed a Bayesian approach to model double bounded contingent valuation data. In a discrete setup (Antony & Rao, Economic valuation of cultivation of Mangroves: A willingness to work study using zero inflated Poisson distribution, 2011) applied zero inflated Poisson model and effectively tackled zero spike in WTP estimation.

Here in this project an attempt is made to estimate the amount people of Kuttanad taluk, a severe drinking water scarce area are willing to pay for a superior water supply scheme. Double bound dichotomous choice method is used for eliciting the WTP response from the survey respondents.

CHAPTER III: ECONOMIC THEORY OF CONTINGENT VALUATION

As with any value estimation methods it is necessary to check the economic validity of Contingent Valuation method. While providing a benefit estimation method Contingent Valuation also satisfies the rigorous requirement of economic theory. The economic theory behind Contingent Valuation method can be explained with the concepts of the standard consumer surplus and the Hicksian compensating surplus.

3.1 Compensating Surplus

The customary standard measure of consumer benefit is the Consumer Surplus which is defined as the area under the Ordinary (Marshallian) demand curve and above the price line (Mitchell & Carson, Using Surveys to Value Public Goods: The Contingent Valuation Method, 1989). The Marshallian demand curve does not hold utility level constant but instead it holds income level constant. In a CV survey respondents are asked to express a value for a change in the quality of a good. In other words, a respondent is asked to determine what change in his income (coupled with the change in the level of the public good) leaves his utility level unchanged (Johansson, 1994). For this reason the concept of compensating surplus rather than the consumer surplus becomes more relevant here. The compensating surplus (CS) is one of the measures of gain or loss, suggested by (Hicks, 1943) which hold utility level constant at the initial level. (Mitchell & Carson, Using Surveys to Value Public Goods: The Contingent Valuation Method, 1989) stated that "for a quantity increase such as raising the level of air visibility, the compensating surplus measure can be interpreted as the consumer's maximum willingness to pay in order to gain the quantity increase and still maintains his initial level of utility. In case of quantity decrease it is the minimum compensation the consumer is willing to accept in return for receiving the decreased quantity".

The compensating surplus of the Hicksian measure can be interpreted as the consumer's maximum WTP in order to secure an increased quality of public good and still maintain his initial level of utility. Using a CV survey the correct theoretical measure of aggregate compensating surplus for a sample of individuals who are associated with a discrete change in public good provision can be obtained. This will give us the total benefits the individuals consider for the good being valued. Hence for a discrete change in provision which is desired

for a decision making the contingent valuation method is capable of obtaining the appropriate Hicksian measure without having to estimate directly any form of demand curves. Thus Contingent Valuation method enjoys a strong advantage of theoretical validity over the commonly used indirect methods of benefit measurements such as the Travel Cost technique which rely on estimations of some type of demand curves.

3.2 Economic Theoretical Basis of the CVM

The goal of a contingent valuation survey is to measure either the compensating or equivalent variation for the good in question. If the individual must purchase the good, the appropriate measure is compensating variation — the maximum amount the person will pay and keep his utility constant. If an individual owns a good that may be taken away from him (e.g., if he may suffer environmental damage) the appropriate measure is equivalent variation — the minimum compensation the individual requires to keep his utility at its original level when he loses the good. Compensating variation for an increase in a commodity from q_0 to q_1 or equivalent variation for a decrease in the commodity from q_1 to q_0 can be defined using the individual's expenditure function. Let E denote the expenditure function, P the vector of prices for market goods, q the quantity of the non-market good consumed, Q a vector of other nonmarket goods and U_i the individual's utility when he consumes q_i. Then the compensating variation (WTP) and equivalent variation (WTA) are given by:

$$WTP = E(P,q_0,Q,U_0) - E(P,q_1,Q,U_0)$$

$$WTA = E(P,q_1,Q,U_1) - E(P,q_0,Q,U_1).$$

In theory, the two measures may yield very different values for the same commodity change. Hence it is important to determine which valuation concept is the appropriate one. The amount by which WTA exceeds WTP varies directly with the income elasticity of demand for q and inversely with the elasticity of substitution between q and other goods (Hanemann, Willingness to pay and willingness to accept: how much can they differ?, 1991). If the income elasticity of demand for q is zero, or if q is a perfect substitute for a private good, WTP should equal WTA. However, if the elasticity of substitution between q and marketed goods is zero, the difference between WTA and WTP can be infinite.

3.3 Methodological Issues

One of the objections in the use of CV survey technique is that the people may not give responses which reflect their true values. They may not have incentives to answer correctly when confronted with an imaginary situation. More frequently the problem arises in the case of choices between goods which people are not familiar with leading to 'hypothetical bias' (Cummings, Brookshire, &

Schulze, 1986). However, CV elicited for public utilities such as water supply which are familiar to respondents are expected to exhibit greater reliability and predictive validity than those elicited for other public goods (Dixon, Scura, Carpenter, & Sherman, 1994).

The other major criticism of contingent valuation method is the possibility of strategic bias in the method. That is depending on how the respondent perceives the consequences of the hypothetical condition, they may not reveal their true preferences. They may understate their true WTP if they feel that they have to pay the amount they answer or overstate their true WTP if they feel this brings about the improvement and they do not have to pay. However, researchers have pointed out that this free riding problem is rather low (Cummings, Brookshire, & Schulze, 1986), and in properly designed CV surveys the strategic problem is even lower (Mitchell & Carson, Using Surveys to Value Public Goods: The Contingent Valuation Method, 1989).

To conclude, asking people what they are willing to pay for a hypothetical good may not be the same as confronting them with a well understood and recognised market and observing what they actually pay. However, based on various reviews on its empirical applications, comparisons with alternative methods, using experiments actually and in laboratory, it is strongly argued that the contingent valuation method gives meaningful values.

CHAPTER IV: STUDY DESIGN AND ANALYTICAL FRAMEWORK

In this section the survey instrument, sampling survey design and analytical tools used for this project are discussed. WTP estimation steps are described together with the other analytical procedure applied in this report.

4.1 Questionnaire Design

The reliability and accuracy of a CV survey is critically dependent on the ability of the survey instrument to clearly explain the project under study, the ability to present the project appear plausible and on the creation of realistic payment method for the project (Carson, Flore, & Meade, Contingent Valuation: Controversies and Evidence, 2001). Although all the three things are done by the enumerator in the field it is initially conceptualized and put on record in the questionnaire. In this way questionnaire should be designed with atmost care.

As a first step a meaningful and simple CV questionnaire relevant to the local realities was designed to collect WTP information from the local population of Kuttanad taluk. The questionnaire prepared in English was translated to local dialect, Malayalam to be used in the field. Questionnaire used for the survey is given in appendix. The questionnaire was broken down into four parts as:

- a short section on the contact details of interviewee
- a section to assess the present water situation and the attitude of the respondent
- a section to elicit respondent's WTP value
- a section on socio-economic characteristics of the respondent

Complete information on the hypothetical project, the benefit it will bring to the local population, amount required to pay for getting the connection and the payment mechanism if the project is implemented was documented in the questionnaire itself. It was clearly documented that by paying the charge, the respondents will have continuous and sufficient water supply with sufficient pressure, and the water will be of good quality, potable without boiling or any other treatment. The respondents' opinion on who should be given charge of maintaining the water supply project was sought and when the WTP amount was elicited it was mentioned that the preferred agency will run the water supply scheme.

Also carefully a market for the fresh water was created by mentioning about the reduction in expenditure in terms of less cost for health and more

income by more productive days. The plan to develop piped infrastructure for the water supply which needs investment capital was thus related to the need for drinking safe and quality water for overall health maintenance and how it could reduce their morbidity and economic cost in terms of loss of wages due to sickness, medical expenditure on water borne diseases.

4.2 Bid Amounts

The bid amount which includes both monthly tariff and connection cost was randomly assigned to each household covered under the survey. The monthly charge to be used for the survey was finalized after a lot of research and by looking into the existing tariffs of various state water authorities. Everywhere the charges are levied per kilo litre (1000 litre) of water. Also the tariffs changed based on the consumption band. In Delhi for domestic consumption the monthly tariff rate varies from Rs.2.93 to Rs.36.61 per kilo litre based on the consumption pattern (DELHI_JAL_BOARD, 2015). 60% of the water volumetric charge is levied as sewer maintenance charge. Also for new domestic connection Delhi Jal Board charges Rs. 400 as meter security. In Mumbai the charges depends upon the area. Overall we can say that the charges are in the range of Rs. 10 to Rs. 40 (MJP, 2015). In Kerala, also the charges vary depending on the water usage. The minimum is Rs. 4 and maximum is Rs. 40 per kilo litre. All BPL card holders are given free water if their consumption is below 16 Kilo litres per month. The water tariff for domestic consumption as on March 2016 is given in the below table (Kerala Water Authority, 2016);

Table 4.1: Water tariff charged by Kerala Water Authority for domestic consumption as on March 2016

Water Usage	Tariff
Upto 5 Kilo litres	Rs. 4 per 1 KL with Minimum Rs.20
5 to 10 KL	Rs. 20 plus Rs.4 per 1 KL in excess of 5 KL
10 to 15KL	Rs. 40 plus Rs.5 per 1 KL in excess of 10 KL
15 to 20KL	Rs. 6 per every KL for the entire consumption (0 to 20KL)
20 to 25 KL	Rs. 7 per every KL for the entire consumption (0 to 25KL)
25 to 30 KL	Rs. 9 per every KL for the entire consumption (0 to 30KL)
30 to 40 KL	Rs. 12.00 per every KL for the entire consumption (0 to 40KL)
40 to 50 KL	Rs. 14.00 per every KL for the entire consumption (0 to 50KL)
Above 50 KL	Rs. 700.00 plus Rs.40.00 per every KL in excess of 50KL

In a 2008 study, World Bank estimated total cost of producing a kilo litre of water from water treatment plant in Kerala. The Cost as estimated by World Bank is given in table 4.2.

Table 4.2: Total cost of water per Kilo Litre in Kerala

Approach	Capital Cost	O&M Cost	Other Cost	Total Cost
Decentralized, Community-led	20.3	6	16.8	43.1
Centralized, Government-led	20.6	6.3	34.3	61.2

Source: (World_Bank, Review of the Effectiveness of Rural water Supply and Sanitation Schemes in India, 2008)

For this study instead of differentiating the capital cost and water tariff (operations and maintenance cost) the method of combining the two and offering a single amount as bid amount is adopted. It was made clear that at the time of taking new water connection the consumer may have to pay security charge, but it will not be more than Rs. 1000. From the above water tariffs and World Bank study the first bid amounts to be offered was selected as one among; Rs. 20, Rs. 40, Rs. 60, Rs. 80, Rs. 100, Rs. 120 and Rs. 140 per kilo litre of water. If the respondent answered yes to the first bid amount their willingness to pay 1.5 times the original amount was asked. In case of the respondents who were not willing/ able to pay the first bid amount their willingness to pay the half of the first bid amount was asked. The bid amounts are given in table 4.3.

Table 4.3: Bid amounts

	Bid 1	Bid 2	Bid 3	Bid 4	Bid 5	Bid 6	Bid 7
First Bid (Rs/ KL)	20	40	60	80	100	120	140
Second Bid (To those who agreed to pay first Bid) (Rs/ KL)	30	60	90	120	150	180	210
Second Bid (To those who are not ready to pay first Bid) (Rs/ KL)	10	20	30	40	50	60	70

Instead of asking respondents' willingness to pay per kilo litre charge their willingness to pay total amount based on the water they may require was asked. For estimating the total amount average per capita consumption of 70 litres as suggested by GOI for rural areas is assumed (GOI, 2005). The interviewer calculated the total amount based on the per capita consumption (70 litres per day), number of family members in the house and the randomly chosen bid amount. Children irrespective of age were counted for the survey. The theoretically obtained bid values were tested during the pilot survey. During the pilot survey it was found that most respondents answered positively to the lower offered bid price, and negatively to the highest offered price. Hence it was decided to continue with the derived amounts.

4.3 Sample Survey

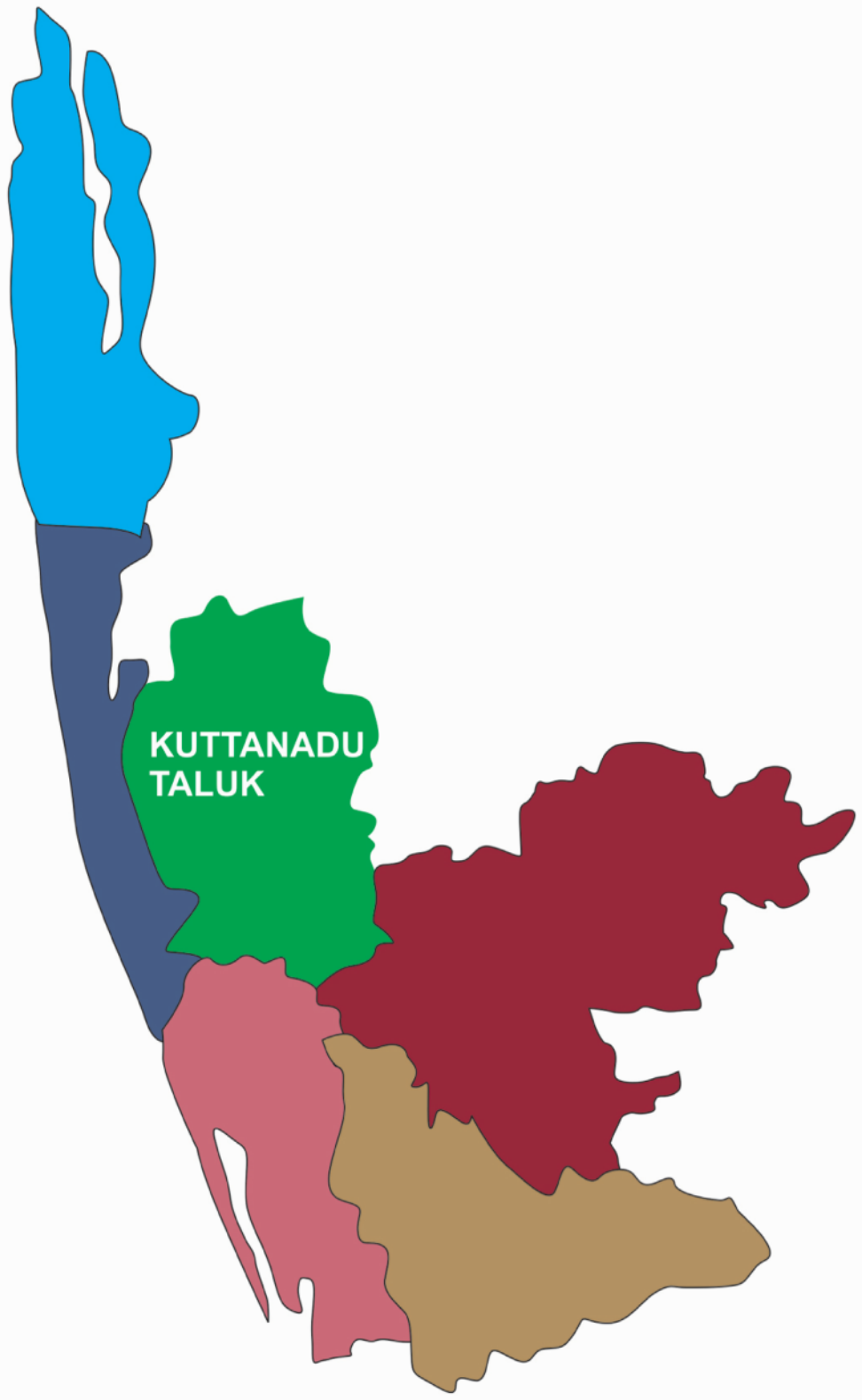
Kuttanad Taluk comprises of Edathua, Thakazhi, Champakulam, Thalavady, Nedumudy, Kainakary, Kavalam, Pulincunnu, Neelamperoor, Muttar, Ramankary and Veliyanad panchayaths. The total geographical area of the taluk is 265.93 sq km and the population here is estimated to be 2.1 lakhs (GOK, 2016).

A pilot survey was carried out to test the survey instrument. About 25 households were interviewed in this stage. Based on the results of pretests, some questions were rephrased, and the bid distribution was finalized. The enumerators were trained particularly to propose contingency questions in a proper manner. Some respondents were randomly chosen and the records were verified through repeated survey by the principal investigator.

Due to the bad experience of poor service from the existing water supply scheme some respondents' had a prejudiced attitude towards our survey also. Also there was an unfounded fear that the hypothetical water supply scheme will have unbearable charges. So as part of the survey we made it sure to properly educate the respondents that by paying the charges, they will have sufficient and good quality water supply with adequate pressure. Also we informed that the future hikes in tariff will be subject to the government approval. Properly trained enumerators were deployed to collect survey data explaining all these facts. The map of the study area is given figure 4.1.

KERALA

ALAPPUZHA DISTRICT



KUTTNADU TALUK

4.4 Sampling Design

A stratified two stage sampling was used for the survey. The administrative division of Kuttanad taluk as 12 panchayats is considered as the stratas here. From each panchayat (strata) wards were selected randomly in the first phase. Once the wards were identified, from each ward individuals were identified randomly. The total sample size for the study was fixed at 650. The number of samples from each ward was kept between 15 to 20. The number of wards surveyed depends on the required sample size.

4.5 Willingness to Pay Estimation

If the contingent valuation survey was as simple as to ask each individual the amount they are willing to pay for the project a simple arithmetic mean would have given the average willingness to pay amount. However, in a dichotomous choice method we only know that the respondent is agreed/ disagreed to pay the given amount for the project. If the respondent says yes then we can say that the actual amount the respondent willing to pay (WTP) is in between the bid amount and a maximum limit (theoretical infinity). And when the respondent disagrees, it need not mean that the respondent is actually not willing to pay for the project, but just that he is not ready to pay the given bid amount (b). In this case he may be willing to pay an amount in the interval $0 \leq WTP \leq b$.

In the dichotomous choice with follow-up method we have two bid amounts and the estimation is more complex. Here if the respondent is willing to pay the initial amount we ask whether he is willing to pay a higher amount. In case the respondent is not ready to pay the initial bid amount a lower amount is offered. Let b^1 be the first amount offered and b^2 the second amount offered. Then the actual amount a person is willing to contribute may be any of the following based on his answer to first and second bid questions.

1. If the individual answers YES to the first question and NO to the second, then his WTP is in the interval $b^1 \leq w < b^2$
2. For an individual answers YES to the first question and YES to the second the actual WTP is l $b^2 \leq w < \infty$
3. If an individual answers NO to the first question and YES to the second his WTP is $b^2 \leq w < b^1$.
4. Finally if the individual answers NO to the first and again NO to the second question the actual WTP lies in the interval $0 \leq w < b^1$.

This section describes how the amount people are willing to pay for the given project can be estimated from the Double Bound dichotomous choice Contingent Valuation survey data.

The unknown value the respondent willing to pay, 'w_i'can be estimated using the WTP function

$$w_i = Z_i(X_{wi}, \beta_w) + \epsilon_i \quad (1)$$

where β_w represents a vector of parameters, X_{wi} denotes the influencing variables, and ε_i represents error term with mean zero and SD σ. The subscript w refers to the fact that these are variables used in modelling the WTP distribution.

To the question to contribute given amount for the project under discussion the person will respond,

$$\text{Yes if } z_i'\beta + \epsilon_i \geq b_i$$

$$\text{and No if } z_i'\beta + \epsilon_i < b_i \quad (2)$$

where b_i denotes the bid amount offered to i^{th} respondent.

This can can also be written as;

$$P(\text{Yes}) = P(\epsilon_i \geq b_i - z_i'\beta)$$

$$P(\text{No}) = P(\epsilon_i < b_i - z_i^i\beta) \quad (3)$$

If we assume that $\epsilon_i \sim N(0, \sigma)$ the equation becomes;

$$P(\text{Yes}) = P(v_i > \frac{b_i - z_i'\beta}{\sigma})$$

$$= 1 - \phi(v_i > \frac{b_i - z_i'\beta}{\sigma})$$

i.e., $$P(\text{Yes}) = \phi(\frac{z_i'\beta}{\sigma} - \frac{b_i}{\sigma}) \quad (4)$$

where $v_i \sim N(0,1)$ and $\phi(x)$ is the distribution function of standard normal distribution.

In a double bound dichotomous choice format, the probability for each of the four cases are as follows.

(1) $$P(\text{Yes, Yes}) = P(w_i > b_i^1, w_i > b_i^2)$$

$$= P(z_i'\beta + \epsilon_i \geq b_i^2)$$

$$= P(\epsilon_i \geq b_i^2 - z_i'\beta)$$

$$= 1 - \phi(v_i > \frac{b_i^2 - z_i'\beta}{\sigma}) \quad \text{where } v_i \sim N(0,1)$$

$$P(Yes, Yes) = 1 - \phi(\frac{b_i^2 - z_i'\beta}{\sigma}) \quad (5)$$

(2) $$P(\text{Yes, No}) = P(b_i^1 \leq w_i < b_i^2)$$

$$= P(b_i^1 \leq z_i'\beta + \epsilon_i < b_i^2)$$

$$= P(b_i^1 - z_i'\beta \leq \epsilon_i < b_i^2 - z_i'\beta)$$

$$= P(\frac{b_i^1 - z_i'\beta}{\sigma} \leq \frac{\epsilon_i}{\sigma} < \frac{b_i^2 - z_i'\beta}{\sigma})$$

$$= \phi\left(\frac{b_i^2 - z_i'\beta}{\sigma}\right) - \phi\left(\frac{b_i^1 - z_i'\beta}{\sigma}\right)$$

$$\text{P(Yes, No)} = \phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^1}{\sigma}\right) - \phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^2}{\sigma}\right) \qquad (6)$$

(3)

$$\begin{aligned}\text{P(No, Yes)} &= P(b_i^2 \le w_i < b_i^1)\\ &= P(b_i^2 \le z_i'\beta + \epsilon_i < b_i^1)\\ &= P(b_i^2 - z_i'\beta \le \epsilon_i < b_i^1 - z_i'\beta)\\ &= P\left(\frac{b_i^2 - z_i'\beta}{\sigma} \le \frac{\epsilon_i}{\sigma} < \frac{b_i^1 - z_i'\beta}{\sigma}\right)\\ &= \phi\left(\frac{b_i^1 - z_i'\beta}{\sigma}\right) - \phi\left(\frac{b_i^2 - z_i'\beta}{\sigma}\right)\end{aligned}$$

$$\text{P(No, Yes)} = \phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^2}{\sigma}\right) - \phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^1}{\sigma}\right) \qquad (7)$$

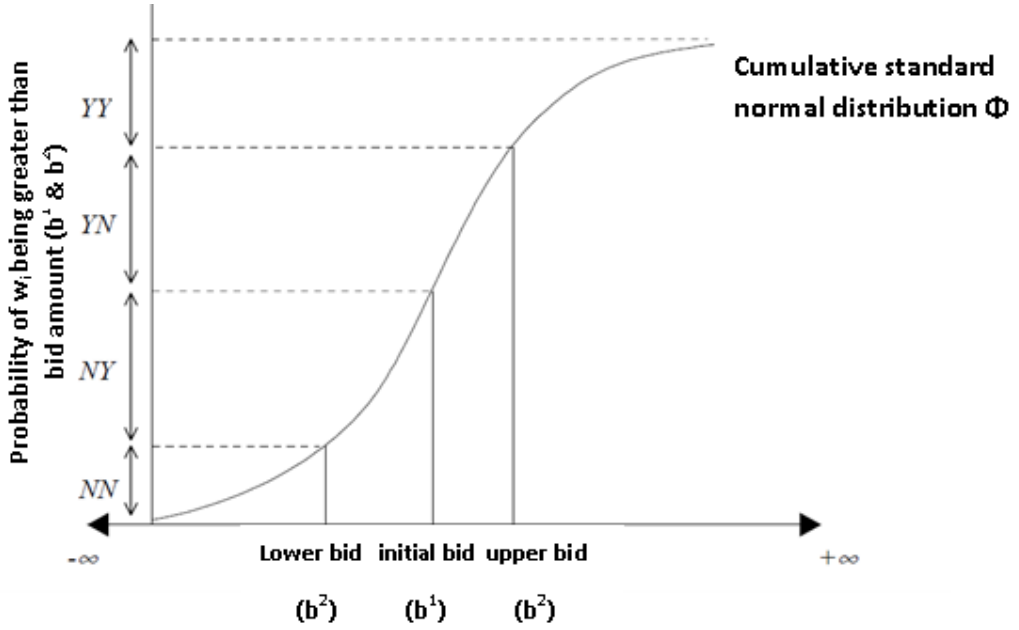
(4)

$$\begin{aligned}\text{P(No, No)} &= P(w_i < b_i^1,\ w_i < b_i^2)\\ &= P(z_i'\beta + \epsilon_i < b_i^2)\\ &= P(\epsilon_i < b_i^2 - z_i'\beta)\\ &= P\left(\frac{\epsilon_i}{\sigma} < \frac{b_i^2 - z_i'\beta}{\sigma}\right)\\ &= \Phi\left(\frac{b_i^2 - z_i'\beta}{\sigma}\right)\end{aligned}$$

$$\text{P(No, No)} = 1 - \Phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^2}{\sigma}\right) \qquad (8)$$

The probabilities defined in equations (5) to (8) represent the intervals illustrated in Figure 4.2.

Figure 4.2: WTP Intervals in Double Bounded Dichotomous Choice Model



The log-likelihood function can be build by combining the expressions in equations (5) to (8).

$$\text{Log } L = \sum_{i} \left[I_i^{yy} \ln\left(\phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^2}{\sigma}\right)\right) + I_i^{yn} \ln\left(\phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^1}{\sigma}\right) - \phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^2}{\sigma}\right)\right) + I_i^{ny} \ln\left(\phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^2}{\sigma}\right) - \phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^1}{\sigma}\right)\right) + I_i^{nn} \ln\left[1 - \phi\left(z_i'\frac{\beta}{\sigma} - \frac{b_i^2}{\sigma}\right)\right)\right] \quad (9)$$

where I_i^{yy}, I_i^{yn}, I_i^{ny} and $I_i^{nn}$are indicator variables taking the value 1 or 0 depending on the response of the ith individual. I_i^{yy}takes the value 1 if the respondent answered yes to both WTP questions and the value 0 otherwise. I_i^{yn}takes the value 1 if the respondent answered yes to the first question and no to the second question, and the value 0 otherwise. I_i^{ny}takes the value 1 if the respondent answered no to the first question and yes to the second question, and the value 0 otherwise. Finally I_i^{nn}takes the value 1 if the respondent answered no to both WTP questions, and the value 0 otherwise.

4.6 Estimation of WTP

We can estimate the coefficient value $(\hat{\beta})$ by maximizing the log likelihood function. Once $\hat{\beta}$ is estimated WTP value can be obtained as

$$\text{WTP} = \tilde{z}'\hat{\beta} \quad (10)$$

Finally the average WTP figures can be totalled up by multiplying the estimated WTP amount with the total population size.

Model estimation and calculation of WTP was carried out in STATA using the command DOUBLEB (Lopez-Feldman, 2010)

CHAPTER V: SOCIO-ECONOMIC PROFILE AND SOURCE OF WATER FOR RESPONDENTS

During the survey it was made sure that samples are selected almost equal across the 12 panchayats of Kuttanad taluk. The sample size from different panchayats are given in the below table.

Table 5.1: Sample size across panchayats

Panchayat	Sample size
Champakulam	52
Edathua	54
Kainakary	52
Kavalam	50
Muttar	50
Nedumudi	52
Neelamperoor	54
Pulincunnu	52
Ramankary	50
Thakazhy	55
Thalavady	56
Veliyanad	50
Total	**627**

5.1 Respondents' Characteristics

Table 5.2 shows the demographic details of the survey data. Of the people who have responded to the survey 43% were the heads of the family. Also 39% of the respondents were working people. The average number of years of education of the respondents is 10. Considering the rural background of Kuttanad taluk this reflects the population average. The median household size is 4 (Arithmetic mean 4.35). This closely matches with the 2011 census data where the average household size in Alappuzha district is given as 4.59. We had also collected information on the income of the respondents. However, most of the respondents under reported their income. This is very evident by 76% claiming that their monthly income is below Rs. 2000. So we did not consider the income variable for any analysis.

Table 5.2: Respondents Characteristics

Characteristics	# of respondents
Gender	
Male	295 (47%)
Female	332 (53%)
Respondents who are also head of the family	267 (43%)
Working respondents	244 (39%)
Median household size	4
Avg. age in years	49
Avg. no. of years of education	10

5.2 Water Source & Quality

Table 5.3 gives the source of water for the respondents in rainy and summer season. Multi response was allowed for this question as there could be multiple sources of water for the households. During both rainy season and summer more than 50% of the people depend nearby river/creek for water used for all purpose other than drinking and cooking. During rainy season 11% of the respondents buy purified water or can water for cooking and drinking purpose. The same is 16% during the summer. 32% of the respondents use pipe water from their house connection for cooking and drinking. However, only 19% of these households use the water from pipeline for other purpose. The reason for this is that the households are not getting enough water for all household requirements through the existing pipeline. The fact that 30% of the households depend on public tap indicates the failure of the existing water supply projects in reaching the households.

Table 5.3: Water Source (Multi-response is permitted)

Source	Rainy Season		Summer Season	
	Drinking & Cooking	Other Purpose	Drinking & Cooking	Other Purpose
Water from personal pipeline	32%	19%	32%	19%
Water from Public tap	30%	5%	30%	5%
Own well	9%	11%	7%	9%
Neighbours well	6%	3%	7%	2%
Purified water bought from treatment plants	6%	0%	10%	0%
Bottle/ Can water	5%	0%	6%	0%
Rain water	3%	0%	2%	0%
Creek	3%	51%	4%	55%
Public bore well	1%	3%	1%	3%
Personal bore well	1%	7%	1%	6%

Water purified at home	0%	0%	0%	0%
Public well	0%	0%	0%	0%
Others	3%	0%	0%	0%
TOTAL	**688**	**704**	**678**	**684**

Table 5.4 give the respondents' perception about the quality of water currently available for them. It is interesting to note more than 50% of the respondents feel that the water they use for other than cooking and drinking is bad. From the previous table it is clear that more than 50% of the respondents depend on river water for bathing, washing and other purposes. So this indicates the respondents feeling that the river water is polluted and is not suitable for any domestic purposes. Only 10% of the respondents feel that the water they use for drinking and cooking is also not good.

Table 5.4: Water Quality

Water Quality	Rainy Season		Summer Season	
	Drinking & Cooking	Other Purpose	Drinking & Cooking	Other Purpose
Very good	0%	0%	0%	0%
Good	48%	18%	45%	15%
OK	43%	30%	45%	28%
Bad	9%	52%	10%	58%
Very bad	0%	0%	0%	0%
TOTAL	**627**	**627**	**627**	**627**

Table 5.5 shows that during rainy season 13% of the respondents and during summer 18% of the respondents buy water for drinking and/or cooking purpose. The average monthly expenditure is Rs. 430 during rainy season and Rs. 450 during summer season.

Table 5.5: Buying water for drinking or cooking (other than pipe connection)

	Rainy Season	Summer Season
Households buying water	82 (13%)	114 (18%)
Avg. Monthly expense in Rs.	Rs. 430	Rs. 450

Table 5.6 indicates that 36% of the respondents have pipe connection to their homes. The average amount they pay per month is just Rs. 48. During the survey we found that most of the respondents with pipe connection pay monthly tariff of Rs. 42 or Rs. 72. For all BPL card holders free water is provided if their consumption is less than 16 Kilo litres per month. Among the respondents who have pipeline connection at home 36% are not happy with the quantity or quality of the pipe water they receive.

Table 5.6: Pipe water Connection

Particulars	# of respondents
Households with pipeline connection	223 (36%)
Avg. monthly charge in Rs.	Rs.48
Respondents happy with quantity and quality of pipe water (Households with pipe connection only)	143 (64%)

The quality as perceived by the respondents about their existing pipeline water is given in table 5.7. Consistent with the result on the number of respondents who are happy about the quantity and quality of water from existing pipeline 61% answered that the water they get through pipeline now is good. 14% mentioned that the water they get through the pipeline tastes bad.

Table 5.7: Pipe water quality (multi response permitted)

Water Quality	Respondents
Good	61%
High Chlorine Content	6%
Muddy	7%
Tastes bad	14%
Others	12%
TOTAL	**226**

Table 5.8 gives information on how frequent respondents receive water through existing pipeline. More than 40% of the respondents receive water through pipeline daily in both rainy and summer season. Only 15% answered that they receive water through pipeline only once in 3 days. Most of the respondents are more or less happy with the current frequency of water through pipeline.

Table 5.8: Pipe water frequency

Pipe Water Frequency	Rainy Season	Summer
Daily in specified time	45%	41%
Once in two days	37%	40%
Once in 3 days	14%	15%
Once in a week	3%	3%
Irregular	1%	1%
TOTAL	**223**	**223**

For 48% of the households water is not available in their house premises and need to carry it from other places. The travel required here could be very small as in the case of getting water from neighbours well or may be few kilometres as in the case of getting drinking water from water treatment plants. From earlier table we came to know that only 36% of the households have pipeline connection. This together with the result that 48% of households are

carrying water from other places shows grave need for good pipeline connection in the region.

Table 5.9: Households who need to travel to get water

Households who get water from other places	303 (48%)

CHAPTER VI: WILLINGNESS TO PAY

During the survey we made sure that all bid amounts are repeated similar number of times in each panchayat. Table 6.1 gives the distribution of bid amounts by panchayat. From each panchayat around 50 people were taken into the sample.

Table 6.1: Distribution of bid amounts by panchayat

Panchayats	Bid Amounts							ALL
	20	40	60	80	100	120	140	
Champakulam	9	7	7	8	8	6	7	52
Edathua	9	8	8	7	6	9	7	54
Kainakary	6	8	9	9	7	7	6	52
Kavalam	7	9	7	9	6	6	6	50
Muttar	9	9	8	6	6	6	6	50
Nedumudi	9	9	9	6	6	6	7	52
Neelamperoor	9	7	8	9	8	6	7	54
Pulincunnu	7	9	8	8	7	6	7	52
Ramankary	7	9	7	7	7	7	6	50
Thakazhy	6	7	7	8	9	9	9	55
Thalavady	9	7	9	8	7	8	8	56
Veliyanad	6	8	9	7	8	6	6	50
ALL	**93**	**97**	**96**	**92**	**85**	**82**	**82**	**627**
	15%	15%	15%	15%	14%	13%	13%	

6.1 Willingness To Pay

Table 6.2 gives the percentage of respondents answered yes to the first bid amount. In any contingent valuation survey we must ensure that the respondents are sensitive to the bid amount. That is as the bid amount increases the percentage of respondents ready to contribute towards the project should decrease. In our survey overall 29% of the respondents answered positively to the first bid. To the lowest bid amount of Rs 20, 76 % answered YES. As the bid amount increased to Rs. 40 the YES respondents were 49% and at the bid amount of Rs. 60 the YES response was only 32%. The YES respondents for bid amounts Rs 80, 100 120 and 140 were 17%, 12%, 6% and 4% respectively.

Table 6.2: First bid response

Bid Amount	# of respondents to whom the willingness to pay the given bid amount was enquired	# of respondents answered YES	% of respondents answered YES
20	93	71	76%
40	97	48	49%
60	96	31	32%
80	92	16	17%
100	85	10	12%
120	82	5	6%
140	82	3	4%
TOTAL	**627**	**184**	**29%**

Table 6.3 gives the overall and group wise percent of people willing to contribute for the proposed potable pipe water connection project. Overall 63% of the respondents are willing to contribute at least some amount for the project. This includes those why said YES to the first bid and those who said NO to the first bid, but YES to the low bid amount. While 67% of the female respondents were willing to contribute towards the project the same is 57% in case of male respondents. This is in expected lines as the women in the household are mostly affected by the scarcity of water and they are the ones who get water in case of any shortage. 64% of the working respondents are ready to contribute towards the project. This is almost in same line as of the overall sample percent of 63%. Most of our respondents are locally employed and they might not be finding it much difficult to collect the water compared to those who are employed far off places. This could be the reason why there is not much difference in the percent of working respondents agree to contribute for the project compared to overall sample. 70% of respondents who carry water from other places and 84% of the respondents who buy water are willing to contribute towards the project. As expected both percentages are more than the overall sample percent of 63%.

Among the respondents with an existing pipeline connection only 51% are willing to contribute towards the project. Also it is interesting to note that among those respondents who are not happy with the quality or quantity of water they receive through existing pipeline connection 71% are ready to contribute towards the proposed project.

Table 6.3: Respondents willing to pay for new project

	Willing to Pay for new project
Respondents willing to contribute for new project	392 (63%)
Gender	
Male	168 (57%)
Female	224 (67%)
Working respondents	157 (64%)
Respondents who get water from other places	211 (70%)
Respondents who buy water in rainy or summer season	97 (84%)
Respondents with pipe connection	114(51%)
Respondents with pipe connection	
Respondents who are not happy with the existing pipe connection	57 (71%)
Respondents who are happy with the existing pipe connection	57 (40%)

Table 6.4 gives the percent of respondents by their sources of water, ready to contribute towards the proposed water supply project. As expected among the major groups (atleast 10 or more respondents) respondents who get water from treatment plants or buy bottle/ can water or those who depend on river water or rain water for cooking and drinking purpose are more interested to participate in the project. In all these cases 80% or more are ready to contribute towards the project. Among those who depend on public tap and depend on neighbours well 62% each are willing to contribute.

Table 6.4: Source of water for drinking and cooking purpose (summer) and respondents' willingness to contribute towards new project (multi-response permitted)

Source	# of respondents who use this as source in summer	Of these respondents % of people who are willing to pay
Water from personal pipeline	217	52%
Water from Public tap	205	62%
Purified water bought from treatment plants	65	88%
Own well	50	58%
Neighbours well	47	62%
Bottle/ Can water	40	83%
Creek	29	83%

Rain water	11	82%
Public bore well	5	60%
Personal bore well	4	50%
Water purified at home	1	100%
Public well	1	100%
Others	1	100%
TOTAL	**676**	**63%**

Table 6.5 gives the relative frequency of respondents' perception on the existing pipe water and their willingness to pay for the new pipeline project. Of the 63 respondents who said that the water they get through the existing pipeline is bad, 79% are ready to contribute towards the project.

Table 6.5: Water quality (summer) and respondents' willingness to contribute towards new project

Pipe Water Quality	# of respondents answered	Of the students who have answered, % of people who are willing to pay
Very good	1	100%
Good	281	61%
OK	281	60%
Bad	63	79%
Very bad	1	100%
TOTAL	**627**	**63%**

6.2 Amount Willing To Pay

As discussed in chapter 4 DOUBLEB command in STATA was used to estimate WTP amount. Table 6.6 gives the coefficient estimates and z-statistics for the estimated model. The Wald test statistic indicates failure to accept the null hypothesis that all estimated coefficients jointly equal to zero at one percent level. This indicates the validity of the model.

The quality of water currently used as perceived by respondent, indicator to denote the need to buy water, presence of pipe connection, gender of respondent, no. of years of education of respondent, indicator variable to denote whether the respondent is employed and the number of members in the family were used as explanatory variables for the model. All these 7 variables were found to be statistically significant at 10 percent level. Variables like satisfaction on the existing pipeline and indicator variable to denote whether the respondent is the head of the family were not considered, as they almost duplicate the variables presence of pipe connection and gender respectively. Variable indicating need to carry water from other place or premises was included initially. However, since the variable was found to be insignificant it was later removed.

Variable water quality was a rank variable with 1 indicating very good quality and 5 indicating very bad quality. As expected the coefficient has positive sign which means that the respondents who are not getting good water prefer more to contribute towards the proposed project. The positive sign of the indicator variable buying water denotes those respondents who have to purchase water prefer the project. Reflecting the tabular analysis results the variable indicating presence of pipe connection is negatively related to the bid values. Male respondent is negatively related in the model. This is expected as generally the women in households are more concerned about the shortage of water and they are the ones who generally go and collect water in case it is not available in their own premises. Education is found to be positively related. Working respondents are found to be more supportive of the project as indicated by positive sign for its coefficient. The variable family size has a negative sign. This could be due to the fact that in big households there will be people to get water even if water is not readily available in own premises. In a two or three member family although the requirement is less they may not find time to collect water if potable water is not available in own premises. Such people may prefer the project more. One more reason could be, for big households the water requirement is more and therefore the amount they need to pay also will be more. The amount which was asked during the survey was calculated based on the total household water requirement. It is natural that hearing a high amount people may not be willing to participate even if they are interested in the project.

Table 6.6: WTP Double Bound model coefficient estimates

Variable	Coeff. Estimate	z-stat
Constant	28.68*	2.94
Water Quality (Summer)	8.08*	3.31
Buying water	40.93*	9.32
Pipe Connection	-10.92*	-3.17
Gender (Male)	-7.55*	-2.12
Education of respondent	0.81*	1.78
Work respondent	5.94*	1.64
# of family members	-2.72*	-2.56
Wald	118.83	
p-value	<0.001	

Note: * indicates significance at ten percent level

Table 6.7 gives the WTP amount calculated based on the model. It shows that the people on an average are willing to pay Rs 47 per kilo litre of water if they get quality potable water in the required quantity. This means a four member family is ready to pay Rs. 395 monthly for getting quality water.

Table 6.7: WTP Amount

	Coeff.	Std. Err.	95% Confidence Interval
WTP Amount (Rs.)	47	1.56	[45 51]

6.3 Project Preferences and Reasons for No Interest in the Project

Table 6.8 gives the respondents' preference on who should maintain the new pipeline project when it becomes operational. Majority, 49% preferred that the project should be run by the local panchayat. 29% said that the water authority should be entrusted with the job of maintaining and running the project. As of now in Kerala all the water supply projects are owned and maintained by Kerala Water Authority. It is interesting to note that only 10% preferred, the consumers association running the project which is even less than the percent (12%) of respondents who preferred private company in charge of the project.

Table 6.8: Respondents preference on who should run the water supply project

Agency	% of respondents
Panchayat	49%
Water authority	29%
Private company	12%
Consumers association	10%
TOTAL	**392 (100%)**

Table 6.9 indicates the reasons why the 37% of the respondents are not willing to participate in the project. From the table we can understand that the high tariff rates deter the respondents to say YES for the new project. The respondents who have pipeline connection expressed the feeling that they get water at much cheap rates compared to the higher bid amounts. So it is natural that they won't be willing to pay high rates. Also some of our respondents with BPL card who get free water mentioned that they are not interested to join the hypothetical project. For 95% of the NO sayers the high cost prevents joining the project. Also it is to be noted that none of the respondents protested against the project proposal.

Table 6.9: Reasons for not willing to pay

Reasons	% of respondents
High rate & Financial constraints	48%
Water available at less tariff	47%
Good water is available	5%
TOTAL	**235 (100%)**

CHAPTER VII: SUMMARY OF FINDINGS AND POLICY IMPLICATIONS

7.1 Summary of Study Findings

Access to safe drinking water is one of the basic human rights. The lack of clean and potable water is a serious issue in the study area of Kuttanad taluk. In this research the existing water scarcity issues in the Kuttanad taluk was studied and the amount people of this area are willing to pay for access to required quantity of clean and potable water was estimated. Contingent Valuation method was used to estimate the amount people are willing to pay.

As part of the project information on the existing water sources was also collected. The fact that 30% of the households depend on public taps indicates the failure of the existing water supply projects in reaching all the required households. Fifty to fifty five percent of the people depend on the river water for other than drinking and cooking requirements. Several scientific studies have pointed out the alarming level of contamination of rivers in this region. This study also reveals that 3 to 4 percent of the respondents rely on river water for drinking and/or cooking purpose.

The respondents are well aware of the pollution of the river water. Around 55 percent of the respondents feel that the water they use for bathing, washing and other purposes is bad. Around 10 percent of the respondents feel even the water they use for drinking and/or cooking is not of consumable quality. During rainy season 13% of respondents and in summer 18% of the respondents buy water for drinking/ cooking requirement. The average monthly expense on this was around Rs. 430. Only 36% of the surveyed households had pipeline connection. Of the people who have pipeline connection 64% are happy with existing pipeline connection. The average amount the households pay monthly for the pipeline connection is just Rs. 48.

Before enquiring the willingness to contribute a specific amount towards the hypothetical project, the respondent was informed about the details of the proposed water supply scheme. It was clearly mentioned that by paying the charge, the respondents will have continuous and sufficient water supply with sufficient pressure, and the water will be of good quality, potable without boiling or any other treatment. 63% of the respondents are willing to contribute towards the project. Almost 95% of the people who did not agree to contribute the specified amount give higher price as the reason for their negative answer.

The amount people are willing to pay was estimated as Rs.47 per Kilo litre of water. This means a family of 4 members is ready to pay around Rs. 400 if they get required quantity of quality water through pipeline at home. This is a very significant result considering the fact that currently a household pay an average of just Rs. 48 per month for the existing pipeline connection. It is to be noted that 50 percent of the households with pipeline connection are also interested in this project.

The variables quality of water currently used as perceived by respondent, the need to buy water, presence of pipe connection, gender of respondent, no. of years of education of respondent, employment status of the respondent and the number of members in the family were found to be influencing the WTP of the respondents. Female respondents were found to be more in favour of the project compared to male respondents. This is in the expected lines as generally the women in households are more concerned about the shortage of water and they are the ones who generally go and collect water in case water is not available in their own premises. The size of family was found to be negatively influencing the WTP. This could be due to the fact that in big households there will be people to get water even if it is not readily available in own premises. In a two or three member family although the requirement is less they may not find time to collect water if potable water is not available in own premises. Such people may prefer the project more. One other reason could be for big households the water requirement is more and therefore the amount they need to pay also will be more. It is natural that hearing a high amount people may not be willing to participate even if they are interested in the project. Respondents' preferred agency for running the water supply project was local panchayat.

7.2 Policy Implications

The study points to the serious issue of lack of clean and potable water in Kuttanad taluk. The government and policy makers must pay their urgent attention on this. The fact that people are willing to pay Rs 47 per KL of water which is almost 9 times the amount they currently pay is a very significant indicator. But people expect clean and potable water available throughout the day with enough force to pay this amount. This is a good sign as government can plan efficient water supply projects even if they have to invest considerable amount as the people are willing to pay it back through the water tariff.

The funding agencies generally look for the economic viability any project. World Bank in 2008 estimated the total cost (including capital and maintenance cost) per kilo litre of water in a decentralized community led approach in India at Rs. 43. The cost per kilo litre of water in case of a centralized government led approach was estimated as Rs. 61. The result is also very significant as the

government can approach international funding agencies more confidently for loans to implement water supply projects. The result is a clear indication that if the water supply project is properly run and people are given quality water throughout the day they will pay the money back through tariffs and this amount may be enough for loan repayment.

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APPENDIX

സെന്റ് അലോഷ്യസ് കോളേജ്

എടത്വാ, ആലപ്പുഴ - 689573

CONTINGENT VALUATION SURVEY

അക്കാദമിക ഗവേഷണത്തിന്റെ ഭാഗമായി നടത്തുന്ന സർവേയ്ക്കുവേണ്ടിയുള്ള ചോദ്യാവലി

Questionnaire for UGC sponsored Academic Project - "Willingness to Pay for Access to Improved and Reliable Piped Water : A Contigent valuation study in Kuttanad Taluk, Kerala"

Investigator :**Dr. Jubin Antony**

Interviewer Name:..... Location :.....

Date : ..... Day: ..... Time:.....

A. CONTACT DETAILS

A1 പേര്

A2 സ്ത്രീ / പുരുഷൻ

A3 സർവേയിൽ പങ്കെടുക്കുന്ന ആൾ കുടുംബത്തിന്റെ തലവനാണോ? അതെ ☐ അല്ല ☐

A4 മേൽവിലാസം:

വീട്ടുപേര് / വീട്ടുനമ്പർ :

സ്ഥലം:

പോസ്റ്റ് ഓഫീസ് :

പിൻകോഡ് :

A5 മൊബൈൽ നമ്പർ

B. INFORMATION ON PRESENT WATER SOURCES AND STATUS

B1 നിലവിൽ വരൾച്ചയില്ലാത്ത സമയത്തുള്ള ജലസ്രോതസ്സുകൾ (ഒന്നിൽ കൂടുതൽ ശരിയുത്തരം ആകാം ഉത്തരം √ ചെയ്യുക)

സ്രോതസ്സ്	കുടിവെള്ളം	പാചകം	കുളി	തുണികഴുകൽ	മറ്റുള്ളവ
വിലകൊടുത്തു വാങ്ങുന്ന കാൻ/കുപ്പിവെള്ളം					
വിലകൊടുത്തു വാങ്ങുന്ന ശുദ്ധീകരിച്ച വെള്ളം					
വീട്ടിൽ യന്ത്രം വച്ച് ശുദ്ധിചെയ്ത വെള്ളം					
വീട്ടിലേക്ക് എടുത്തിട്ടുള്ള പൈപ്പ്ലൈനിന്നും വരുന്ന വെള്ളം					
പബ്ലിക് ടാപ്പ്					
സ്വന്തമായുള്ള കുഴൽകിണർ					
പബ്ലിക് കുഴൽകിണർ					
സ്വന്തമായുള്ള കിണർ					
അയലത്തുള്ള കിണർ					
പബ്ലിക് കിണർ					
തോട്					
മറ്റുള്ളവ					

B2 വേനൽക്കാലത്തുള്ള ജലസ്രോതസ്സുകൾ (ഒന്നിൽ കൂടുതൽ ശരിയുത്തരം ആകാം ഉത്തരം √ ചെയ്യുക)

സ്രോതസ്സ്	കുടിവെള്ളം	പാചകം	കുളി	തുണികഴുകൽ	മറ്റുള്ളവ
വിലകൊടുത്തു വാങ്ങുന്ന കാൻ/കുപ്പിവെള്ളം					
വിലകൊടുത്തു വാങ്ങുന്ന ശുദ്ധീകരിച്ച വെള്ളം					
വീട്ടിൽ യന്ത്രം വച്ച് ശുദ്ധിചെയ്ത വെള്ളം					
വീട്ടിലേക്ക് എടുത്തിട്ടുള്ള പൈപ്പ്ലൈനിന്നും വരുന്ന വെള്ളം					
പബ്ലിക് ടാപ്പ്					
സ്വന്തമായുള്ള കുഴൽകിണർ					
പബ്ലിക് കുഴൽകിണർ					
സ്വന്തമായുള്ള കിണർ					
അയലത്തുള്ള കിണർ					
പബ്ലിക് കിണർ					
തോട്					
മറ്റുള്ളവ					

B3 ഇപ്പോൾ നിങ്ങൾക്കു ലഭിക്കുന്ന വെള്ളത്തിന്റെ ഗുണനിലവാരം

വെള്ളത്തിന്റെ ഗുണമനുസരിച്ച് താഴെകൊടുത്തിരിക്കുന്ന നമ്പർ യഥാസ്ഥാനത്ത് രേഖപ്പെടുത്തുക.

1. വളരെ നല്ലത് 2. നല്ലത് 3. കുഴപ്പമില്ല 4. മോശം 5. വളരെ മോശം

	കുടിവെള്ളം	പാചകം	കുളി	തുണികഴുകൽ	മറ്റുള്ളവ
മഴക്കാലം					
വേനൽക്കാലം					

B4 നിങ്ങൾ വെള്ളം വിലകൊടുത്ത് വാങ്ങാറുണ്ടോ? ഉണ്ടെങ്കിൽ ഒരുമാസം ശരാശരി എത്രരൂപാ ഇതിനായി ചിലവഴിക്കുന്നുണ്ട്.

	കുടിവെള്ളം മാത്രം	പാചകത്തിനും കുടിക്കുവാനുമുള്ള വെള്ളം മാത്രം	മുഴുവൻ വെള്ളവും വാങ്ങുകയാണ്
മഴക്കാലം (വെള്ളം വാങ്ങുന്നുണ്ടെങ്കിൽ√ മാർക്ക് ചെയ്യുക)			
ശരാശരി ഒരു മാസത്തെ ചെലവ് രൂപയിൽ (മഴക്കാലം)			
വേനൽക്കാലം (വെള്ളം വാങ്ങുന്നുണ്ടെങ്കിൽ √ മാർക്ക് ചെയ്യുക)			
ശരാശരി ഒരു മാസത്തെ ചെലവ് രൂപയിൽ (വേനൽക്കാലം)			

B5 നിങ്ങൾക്ക് നിലവിൽ പഞ്ചായത്ത് / വാട്ടർ അതോറിറ്റിയുടെ പൈപ്പ് കണക്ഷൻ ഉണ്ടോ?

ഉണ്ട് ☐ ഇല്ല ☐

ഇല്ല എന്നാണ് മറുപടിയെങ്കിൽ ചോദ്യംനമ്പർ B 11 ലേക്കു പോവുക

B6 നിലവിൽ പഞ്ചായത്ത് / വാട്ടർ അതോറിറ്റി പൈപ്പ് കണക്ഷനിലൂടെയുള്ള ജലത്തിന്റെ ലഭ്യത (√ മാർക്ക് ചെയ്യുക)

	മഴക്കാലം	വേനൽക്കാലം
1. 24 മണിക്കൂറും ലഭ്യമാണ്		
2. ദിവസേന നിശ്ചിത മണിക്കൂർ മാത്രം		
3. 2 ദിവസത്തിലൊരിക്കൽ		
4. 3 ദിവസത്തിലൊരിക്കൽ		
5. ആഴ്ചയിലൊരിക്കൽ		
6. വല്ലപ്പോഴും (.....)		

B7 നിലവിൽ പഞ്ചായത്ത് / വാട്ടർ അതോറിറ്റി പൈപ്പ് ലൈനിലൂടെ നിങ്ങൾക്കു കിട്ടുന്ന വെള്ളത്തിന്റെ **അളവിൽ** നിങ്ങൾ സംതൃപ്തനാണോ?

അതെ ☐ അല്ല ☐

B8. നിലവിൽ പഞ്ചായത്ത് / വാട്ടർ അതോറിറ്റി പൈപ്പ് ലൈനിലൂടെ നിങ്ങൾക്കു കിട്ടുന്ന വെള്ളത്തിന്റെ **ഗുണത്തിൽ** നിങ്ങൾ സംതൃപ്തനാണോ?

അതെ ☐ അല്ല ☐

B9 നിലവിൽ പഞ്ചായത്ത് / വാട്ടർ അതോറിറ്റി പൈപ്പ് ലൈനിലൂടെ നിങ്ങൾക്കു ലഭിക്കുന്ന വെള്ളം എങ്ങനെയുള്ളതാണ്. (ഒന്നിൽ കൂടുതൽ ഉത്തരം ആകാം √ മാർക്ക് ചെയ്യുക)

1. നല്ലത് ☐
2. ഉപ്പുവെള്ളം ☐
3. മണമുള്ളത് ☐
4. ചെളിവെള്ളം ☐
5. രുചിമാറ്റമുള്ള വെള്ളം ☐
6. ക്ലോറിൻ അധികമുള്ളത് ☐
7. .....
8. .....

B10 നിലവിൽ പൈപ്പ് കണക്ഷനായി നിങ്ങൾ എത്രരൂപ ചിലവഴിക്കുന്നുണ്ട്(6 മാസത്തെ ചാർജ്ജ്). Rs.....

B11 നിലവിൽ കുടിവെള്ളത്തിനോ മറ്റേതെങ്കിലും ആവശ്യത്തിനു വെള്ളത്തിനു വേണ്ടി നിങ്ങൾക്കു യാത്ര ചെയ്യേണ്ടതുണ്ടോ? (നടന്നോ വാഹനത്തിലോ ആകാം)

ഉണ്ട് ☐ ഇല്ല ☐

B12 നിങ്ങളുടെ കുടുംബത്തിലെ ആർക്കെങ്കിലും കഴിഞ്ഞ ആറുമാസകാലത്തിൽ ജലമലിനീകരണം മൂലമുണ്ടാകുന്ന രോഗങ്ങൾ (വയറിളക്കം, മഞ്ഞപ്പിത്തം, etc.) ഉണ്ടായിട്ടുണ്ടോ?

ഉണ്ട് ☐ ഇല്ല ☐

C WILLINGNESS TO PAY

പരിസരമലീനീകരണം മൂലം ഇപ്പോൾതന്നെ നമ്മുടെ തോടുകളിലെയും ജലാശയങ്ങളിലെയും ജലം വളരെയധികം മലിനപ്പെട്ടിരിക്കുന്നു. ഇതു തുടർന്നാൽ താമസിയാതെ നമ്മുടെ വീടുകളിലെ കിണറുകളിലെയും കുളങ്ങളിലെയും ജലംവരെ ഉപയോഗിക്കാൻ കഴിയാത്തവിധം മലിനമായി പോകുമെന്നാണ് പറയപ്പെടുന്നത്.

നമ്മുടെ പ്രദേശത്തെ വീടുകളിൽ ശുദ്ധജലം എത്തിക്കാനുള്ള ഒരു കുടിവെള്ള പദ്ധതിയുണ്ട് എന്നു കരുതുക. ഈ പദ്ധതിയിൽ പങ്കാളികളാകുന്നവർക്ക് 24 മണിക്കൂറും ശുദ്ധജലം ലഭ്യമാകും. നിങ്ങളുടെ വീടിന്റെ മുകളിൽ ഉള്ള ടാങ്കിൽ (അത്ര ഉയരത്തിൽ) നേരിട്ട് വെള്ളം എത്താൻ തക്ക ശക്തിയിലായിരിക്കും വെള്ളം പമ്പുചെയ്യുക. അതോടൊപ്പം വെള്ളം പൈപ്പിൽ നിന്ന് നേരിട്ട് കുടിക്കാൻ തക്കവണ്ണം ശുദ്ധമായിരിക്കും. ഒരു കുടുംബത്തിന് കുടിക്കാനും പാചകം ചെയ്യാനും, കുളി, തുണികഴുകൽ എന്നിവയ്ക്കാവശ്യമുള്ള വെള്ളം പൈപ്പ് ലൈനിൽകൂടി ലഭ്യമാകും. നിങ്ങളുടെ വീട്ടിൽ മീറ്റർ സ്ഥാപിച്ച് ഉപയോഗത്തിനനുസരിച്ചായിരിക്കും നിങ്ങൾ പൈസ അടയ്ക്കേണ്ടത്. ഒരു കാര്യം ഓർക്കുക നിലവിലുള്ള ഒരു പദ്ധതിയെപ്പറ്റിയല്ല മറിച്ച് നിങ്ങളുടെ ഗ്രാമത്തിൽ വരുംകാലത്തിൽ നടപ്പാക്കാനാകുന്ന ഒരു പദ്ധതിയെപ്പറ്റിയാണ് നമ്മൾ പറയുന്നത്.

ശുദ്ധജലം കുടിക്കാനും പാചകം ചെയ്യാനും ഉപയോഗിക്കുന്നതുവഴി ഒട്ടനവധി രോഗങ്ങളെ തടയാനും കുടുംബത്തിന്റെ ആരോഗ്യം സംരക്ഷിക്കാനും കഴിയും. ഇതുവഴി നിങ്ങൾ ആശുപത്രിയിൽ ചിലവഴിക്കുന്ന പൈസ ലാഭിക്കാനും രോഗിയായി തൊഴിൽ ദിനങ്ങൾ നഷ്ടപ്പെടുന്നതുമൂലമുണ്ടാകുന്ന വരുമാന നഷ്ടമുണ്ടാകാതിരിക്കാനും സഹായിക്കുന്നു. ഇതുപോലെ ഒരു പദ്ധതിവരുകയാണെങ്കിൽ വെള്ളം എടുക്കുവാൻവേണ്ടി നിങ്ങൾ ചിലവഴിക്കുന്ന സമയം ലാഭിക്കുവാനും സാധിക്കും. കൂടാതെ മഴക്കാലത്തും വേനൽക്കാലത്തും വെള്ളത്തിന്റെ ലഭ്യത ഉറപ്പാക്കാനും കഴിയും.

നിലവിലുള്ള കുടിവെള്ള പദ്ധതികളേക്കാൾ മെച്ചപ്പെട്ട സേവനം ഉറപ്പാക്കുന്ന ഈ പദ്ധതിയുടെ ചിലവു സ്വാഭാവികമായും കൂടുതലായിരിക്കും. ഇതിൽ പങ്കുചേരുന്ന ഒരാൾ വെള്ളത്തിന്റെ ഉപയോഗമനുസരിച്ച് മാസ വരിസംഖ്യ അടച്ചാൽ മതിയാകും. നിലവിലുള്ള കുടുംബചെലവിനു പുറമേയാണ് നിങ്ങൾ ഇത്രയും രൂപ ചിലവിടേണ്ടിവരുന്നത് എന്ന കാര്യം പ്രത്യേകം ഓർക്കുക.

C1 നിങ്ങളുടെ കുടുംബത്തിൽ കുട്ടികളടക്കം ആകെ എത്ര അംഗങ്ങളുണ്ട്? .....

നമ്മുടെ നാട്ടിൽ ഒരാൾ ഒരു ദിവസം 70 ലിറ്റർ വെള്ളം ഉപയോഗിക്കുന്നു എന്നാണ് കണക്ക്. അങ്ങനെയെങ്കിൽ.....അംഗങ്ങളുള്ള താങ്കളുടെ കുടുംബത്തിൽ ഒരു മാസം ഏകദേശം .....ലിറ്റർ വെള്ളം ആവശ്യമായി വരും.

C2 നമ്മൾ പറഞ്ഞ ഈ കുടിവെള്ള പദ്ധതിയിൽ പങ്കുചേരാൻ ഓരോമാസവും .....രൂപ വെള്ളക്കരമായി അടയ്ക്കുവാൻ താങ്കൾ തയാറാണോ?

(ഈ സംഖ്യ കുടുംബത്തിലെ അംഗങ്ങളുടെ എണ്ണത്തെ ആസ്പദമാക്കി കണക്കുകൂട്ടിയ തുകയാണ്).

അതെ ☐ അല്ല ☐

Interviewer please write the bid amount used here: Rs.....

C3 (പ്രതികരിക്കുന്നയാൾ സമ്മതമാണെങ്കിൽ മാത്രം ചോദിക്കുക)

കുടിവെള്ള പദ്ധതിയിൽ ചേരുന്നതിനുള്ള മാസവെള്ളക്കരം അൽപ്പംകൂടി ഉയർന്ന് Rs.....ആണ് എങ്കിൽ താങ്കൾ ഈ പദ്ധതിയിൽ പങ്കാളിയാകുമോ? ആകും ☐ ഇല്ല ☐

Interviewer please write the bid amount used here: Rs.....

C4 (C2 ചോദ്യത്തിന് അല്ല എന്നാണ് ഉത്തരമെങ്കിൽ മാത്രം ചോദിക്കുക)

കുടിവെള്ള പദ്ധതിയുടെ മാസക്കരം താങ്കളുടെ കുടുംബത്തിന് Rs.....ആണ് എങ്കിൽ ഇതിൽ താങ്കൾ പങ്കാളിയാകുമോ? ആകും ☐ ഇല്ല ☐

Interviewer please write the bid amount used here: Rs.....

C5 C2,C4 ചോദ്യങ്ങൾക്ക് ഇല്ല (പദ്ധതിയിൽ താല്പര്യമില്ല) എന്നാണ് ഉത്തരമെങ്കിൽ- കാരണങ്ങൾ

1.

2.

3.

4.

C6 ഇങ്ങനെയുള്ള ഒരു കുടിവെള്ള പദ്ധതിയിൽ പങ്കുചേരാൻ താല്പര്യപ്പെടുന്നുവെങ്കിൽ ഈ പദ്ധതി ആരുടെ നേതൃത്വത്തിലായിരിക്കണം നടപ്പാക്കേണ്ടത്?

1. പ്രൈവറ്റ് ☐
2. പഞ്ചായത്ത് / മുനിസിപ്പാലിറ്റി ☐
3. വാട്ടർ അതോറിറ്റി ☐
4. ഉപഭോക്താക്കളുടെ അസോസിയേഷൻ ☐
5. മറ്റുള്ളവർ.....

D. DEMOGRAPHIC DETAILS

D1 കുടുംബത്തിലെ അംഗങ്ങളുടെ വിവരങ്ങൾ

അംഗം	വയസ്	വിദ്യാഭ്യാസം	ജോലി
പിതാവ്			
മാതാവ്			
ഭർത്താവ്			
ഭാര്യ			
മകൻ			
മകൻ			
മകൾ			
മകൾ			
മരുമകൾ			
മരുമകൾ			
.....			
.....			
.....			

- വീട്ടിൽ താമസിക്കുന്നവരുടെ മാത്രം വിവരങ്ങൾ രേഖപ്പെടുത്തുക
- സർവ്വേയിൽ പങ്കെടുക്കുന്ന ആളുടെ നേരെ, ഉദാഹരണത്തിന് ഭർത്താവ് √ മാർക്ക് ചെയ്യുക

D2 നിങ്ങളുടെ കുടുംബത്തിന്റെ ഏകദേശമാസവരുമാനം

1. 2000 രൂപയിൽ താഴെ 2. 2000 - 4000 3. 4000- 6000 4. 6000 - 10000
5. 10000 - 20000 6. 20000 - 40000 7. 40000 - 1 ലക്ഷം 8. > 1 ലക്ഷം