Estimation of Willingness-to-Pay (WTP) for Water and Sanitation Services through Contingent Valuation Method (CVM) — A Case Study in Iquitos City, The Republic of Peru —[1]

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Abstract

This study conducted estimates of Willingness to Pay (WTP) and Affordability to Pay (ATP)of beneficiaries for water and sanitation services in Iquitos City, Peru as part of Special Assistance for Development Policy and Projects (SADEP) "The Role of Private Sector Participation (PSP) for Sustainable Water Supply and Sanitation Sectors- The Case of Latin America-" in 2004.

The WTP was estimated through a questionnaire survey in line with Contingent Valuation Method (CVM), while the ATP was computed with reference to available data including the household survey data in the area. The main findings are: (i) WTP is approximately twice of the current average payment level; and (ii) ATP is roughly in the range from 10% - 20%lower to 20% higher than the current average payment level. The implication of this result is that although the beneficiaries' valuation on the improvement of the water and sanitation services is high, the room for increasing the tariff level for financing a portion of the project cost would be small due to their limited payment capacity. Therefore, other means of revenue generation, such as strengthening of payment collection to realize the expressed high WTP, cost reduction through more efficient operation and management, and regional development activities contributing to the increase of income would be necessary in order to improve the sustainability of the services in the city.

The estimated WTP through CVM is expected to be utilized as useful information of the demand side on tariff level of services with consideration to its limitations.

Introduction

JBIC conducted a study, "The Role of Private Sector Participation (PSP) for Sustainable Water Supply and Sanitation Sectors - The Case of Latin America -" as Special Assistance for Development Policy and Project (SADEP) in Japanese fiscal year 2003. It analyzed the problems of water supply and sanitation sectors in Latin American countries from the view of point of enhancing sustainability of the sectors, and examined the possibility of solving the problems by introduction of PSP. In the study, it was pointed that it is sometimes difficult to set water and sanitation tariffs at appropriate levels due to political reasons, and that tariff increase after introducing PSP caused problems in some cases. In order to improve the sustainability of the sectors and ensure successful PSP, it is important to set appropriate tariff levels with sufficient justifications.

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1 This study was made from a part of the "The Role of Private Sector Participation (PSP) for Sustainable Water Supply and Sanitation Sectors - The Case of Latin America -" as conducted through Special Assistance for Development Policy and Project (SADEP) in Japanese fiscal year 2003 (The study was commissioned to KRI International Corp. and Nippon Koei, co. Ltd.). The study team received valuable advice and comments by Mr. Hitoshi Ikuma, Deputy Director, Center for the Strategy of Emergence, The Japan Research Institute, Limited; and Professor Yoshiaki Kaoru, School of Business Administration, Nanzan University (In particular from prof. Kaoru on this CVM study).

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There are a variety of methodologies for setting tariffs of water and sanitation services in developing countries. This study attempted to collect basic data in order to examine amount to be paid by beneficiaries for the services (i.e. tariff levels), through estimating Affordability-to-Pay (ATP) of beneficiaries based on household's income and expenditures, and Willingness-to-Pay (WTP) of beneficiaries.

This study implemented a questionnaire survey using the "Contingent Valuation Method" (CVM) in the city of Iquitos, Peru, from November 2003 to January 2004. It aimed at estimating appropriate tariff levels to ensure the sustainability of the projects taking a water and sanitation project in the city as a case. The CVM is a technique that uses questionnaires to measure WTP for water and sanitation services, from which the value of environmental improvement is estimated. This study used the CVM for "estimating WTP of Iquitos residents for environmental improvement in the form of upgrading of the water supply and sanitation services" through in a water and sanitation development project[3]. The results of the study would enable appropriate water and sanitation service pricing options to be suggested with reference to the estimated WTP for water and sanitation services.

Chapter 1: Study Methodology

(1) What is Contingent Valuation Method (CVM)?

In the field of environment economics, a variety of methods are developed to measure benefits of improvement of environmental quality and infrastructure such as public works. While Alternative Method, Travel Cost Method (TCM), Hedonic Price Method (HPM), and Contingent Valuation Method (CVM) are used to evaluate values of these non-market goods, CVM is the most popular method in recent years because it can cover wide range of themes.

The CVM measures project benefits (e.g. improvement of envionmental resourus, and provision of public goods) in monetary terms by directly asking people's WTP for such projects through a questionnarie survey with assuming that they will be implemented. It is said that there have been more than 2000 CVM studies conducted since a CVM survey on Forest Recreation Activities conducted in the State of Maine of USA. Since 1980s in the United States, due to growing concerns on environmental issues, CVM studies were conducted very frequently in order to assess social impacts of environmental conservation policies[4]. In Japan, more CVM studies are conducted to analyze cost and benefits of public investment projects.

(2) Considerations in theory and application of CVM

The CVM assesses, by using a questionnaire, how much in maximum they are willing to pay to conserve or improve environment. The concept of WTP is originated from economic theory (consumer theory). WTP is expressed in currency to represent effects in accordance with the variance in indifference curves between two points of time—the present, at which the environment has not undergone improvement, and a future time, at which it is supposed that environment is improved—and the variance in the effects.

①WTP depends on person.

Since WTP reflects people's different valuations on environment and public goods, the amount varies depending on person. The CVM decides WTP of the survey area through estimating a representative value of different WTPs among people.[5]

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3 The SADEP study focused on Mexico, Peru, Costa Rica and Panama. Especially in three countries, Mexico, Peru, and Panama, the case study on Yen Loan Project about the feasibility of Private Sector Participation was executed. In Peru the Yen Loan Project in Peru, "Provincial cities water supply and sewerage improvement and expansion project II", Iquitos was chosen for this case study. (Date of the loan agreement: September 2002; Amount of the JBIC ODA loan 7,636million yen. This project includes sub-projects in Iquitos, Cuzco and Sicuani). The CVM study is a part of the case study in Iquitos and analyzes the tariff level of water and sanitation services was in detail. Although sanitation water project was not included in this project of Iquitos, both of water and sanitation services were investigated because of the potential needs for sanitation services.

4 See Kuriyama (1998) and Kuriyama (2000)

②WTP is decided only from demand side.
WTP is decided only from demand side. Therefore, it can be said that CVM is a demand oriented method. As for supply side, CVM can only assess benefits arising from the investment in services, not costs borne by the service providers. The supply side is indicated as a supply curve of the services provided and the supply cost, and the equilibrium point is derived from the demand and supply curves. Estimation of WTP provides basic information for tariff setting.

③Existence of biases
The representative WTP value derived from the CVM analysis cannot be used, as it is, as a basis for revising actual tariff. The WTP includes certain biases, and therefore it is no more than an estimation derived from the CVM analysis based on a hypothetical situation communicated to the respondents. Specifically, there is a gap between the WTP derived from the CVM and the WTP in actuality where one has to pay according to the current tariff. This is called the "budget constraint" bias among those caused by scenario transmission errors. The hypothetical WTP at the time of answering the questionnaire is different from the actual WTP because the former may fail to account for effect of paying the tariff on the affordability of other goods and services (=budget constraint). In other words, the demand curve derived from the CVM analysis results is hypothetical and has certain deviations from reality, and the CVM results cannot necessarily be applied to the actual tariff as they are.

④Uniqueness of the CVM Analysis Results
CVM provides an estimate of how a certain group of respondents living in a certain area at a given time value their environment. It should be noted that the results of this CVM survey cannot be applied to the other areas in Peru, since the results represent nothing other than the present WTP of existing and potential water and sanitation users in Iquitos city.

In consideration of these characters and limitations of CVM, this study estimates beneficiaries' WTP which gives a basis for appropriate tariff.[6]

Chapter 2: CVM Research in Iquitos City, Peru

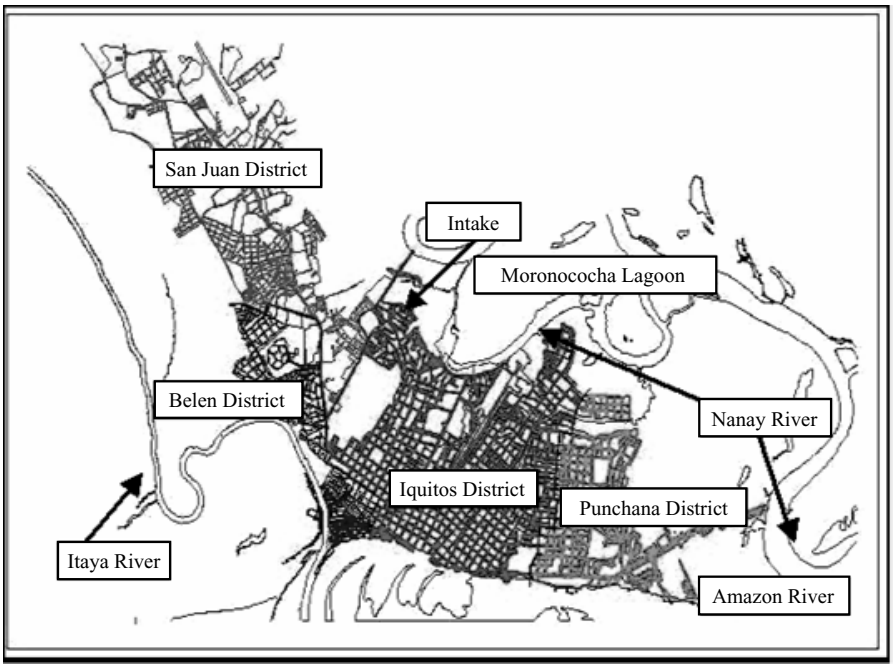
The procedures of this CVM study consisted of the following seven steps: (i) collection of information to be evaluated, (ii) determination of the population and sampling, (iii) development of scenarios, (iv) preparation of the questionnaire, (v) implementation of focus group meetings and pretests, (vi) implementation of the full-scale survey, and (vii) analysis of the study results and estimation of WTP. In this study, we began with identifying, the survey population and setting an appropriate scenario in consideration of the plan of the water and sanitation service project in Iquitos.

(1) Beneficiaries and Study Area[7]

This study covered the city of Iquitos, the capital of the Department State of Loreto. In 2003, Iquitos had an estimated population of approximately 420,000 in 2003. It is divided into four administrative districts: the Iquitos District, Punchana District, Belen District and San Juan District (Figure 1). Its major industries are tourism, small-scale farming, small-scale fishing, agricultural processing, and lumber processing. Iquitos has no large industry. The city is surrounded by the Amazon River and two of its tributaries, the Nanay River and the Itaya River; the Nanay River provides the residents' drinking water. The residents also use the Nanay River for swimming, and some make a living from small-scale fishing on it. Sewage

5 There are several CVM models for double-bound data sets, such as "Random utility model," "WTP function model," and "Survival analysis." to estimate a represetative value of WTP. The CVM 2002 adopts the survival analysis. See Kuriyama (1998) for details.
6 In the main part of this SADEP study, benefits of the water and sanitation project in Iquitos is measured with reference to the estimated WTP here.
7 In this paper, we describe the survey results of general household users conducted in this study. The survey results of commercial users are indicated in the appendix at end of this paper.

Figure 1: Conceptual diagram of the city of Iquitos



Source:SADEP Study Team

from Iquitos is discharged untreated to the surrounding water basin via existing sewer pipes. The topography of Iquitos places it on an incline from the Amazon River to the Nanay River; most of the city's sewage flows into the Nanay River through a water basin known as the Moronococha Lagoon. Because of this, there is marked pollution in the Nanay River and in the lagoon, where sewage concentrates. The lagoon suffers from foul odors, and there are reports of skin problems caused by eating fish from it.

Only about 60% of Iquitos households are registered as residents, making the resident registry inadequate for our purposes. We therefore received information on about water and sanitation service beneficiaries from the "registry of users and potential users" maintained by the Iquitos Water and Sanitation Public Corporation. This registry lists approximately 52,000 households that are either current users or potential users in the near future. It is considered the most reliable beneficiary list available. The list enables confirmation of water and sanitation access, head of household names and addresses for almost the entire territory of Iquitos. However, the San Juan District, located in the northwest of the city near the Iquitos Airport, lacks either water or sewer pipes, so most of the households in the District are not included as potential users on the registry. We therefore supplemented the list with data for the San Juan District from the resident registry (approximately 5,800 households).

(2) Population and Sampling

In CVM, the population should be, in principle, all beneficiaries of the environmental values to be evaluated (in this case, all beneficiaries of water and sanitation services). For this survey, the scope of the population was deemed to be all beneficiaries of water services and sanitation services provided by a water and sanitation construction project for the city of Iquitos. As described above, the beneficiary list for the CVM survey consisted of a list of approximately 58,000 user and potential user households obtained from the Loreto Water and Sanitation Public Corporation, to which was added a list of approximately 5,800 households for the San Juan District, which was obtained from the Iquitos City resident registry[8]. The combined lists provided a list of beneficiary candidates to comprise the population required for sample extraction.

8 Covers most of San Juan District.

Table 1 Status of water service beneficiary households in Iquitos (Oct. 2003)

Type of service	*Services available (1)*	*Services suspended (2)*	*Households registered (1)+(2)*
24-hour basis	12,700	2,399	15,099
Time restriction	19,777	7,440	27,217
Total	32,477	9,839	42,316

Source: Department of Loreto Water and Sanitation Public Corporation

①Population of the water service beneficiary area

The water service covers all of Iquitos except the San Juan District, but there are problems throughout the entire city area (described below), leading us to categorize beneficiaries of the water service area into the following two groups[9]. Table 1 shows the status of water service beneficiary households in Iquitos.

i) Group 1: Areas not currently connected to the water mains and not receiving any water services

ii) Group 2: Areas provided with water services but only incompletely because of restricted times or low water pressure

There are problems with the water supply virtually throughout Iquitos. JBIC provides an ODA loan to assist the water supply project in Iquitos under "Provincial Cities Water and Sewerage Improvement and Expansion Project Ⅱ". In Iquitos, the project includes new construction and rehabilitation of water supply facilities, such as water intakes transmissions, treatment plants, and distribution system.This project will provide water services for virtually the entire San Juan district, bring 24-hour water services throughout the city and assure sufficient water pressure, thereby providing some form of benefit for the entire city. We therefore considered the population to be all user and potential user households on the lists. Chart 3 shows the conceptual diagram of water supply hours for different areas of Iquitos.

②Population of sanitation service beneficiaries

Most of the central part of the city is connected to the sanitation service, but there is no sewage treatment. As described above, raw sewage is discharged untreated into the rivers that surround Iquitos: the Amazon and two tributaries (the Nanay and the Itaya). Sanitation service beneficiaries were categorized into the following three groups:

i) Group 1: Areas not currently connected to the sewer mains and not receiving any sanitation services

ii) Group 2: Areas connected to the sewer mains but receiving incomplete services due to, for example, overflow of sewage during rainfalls

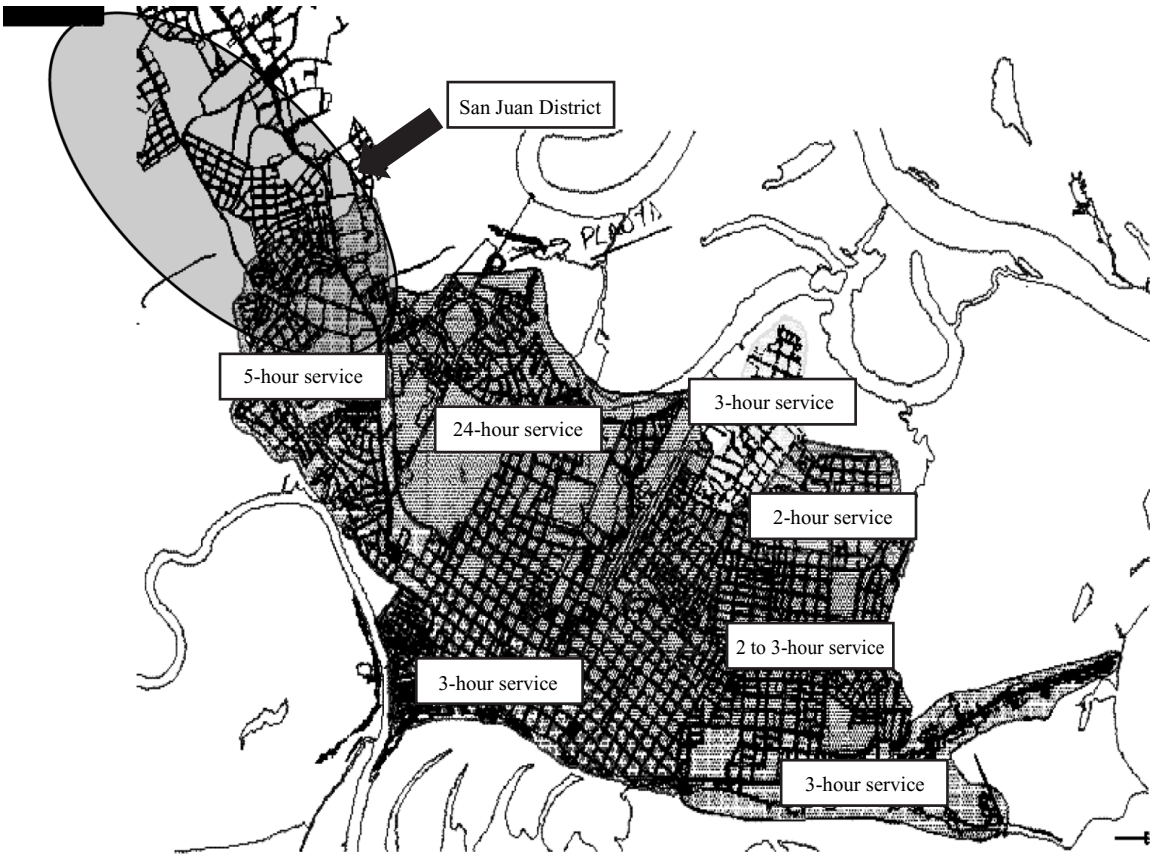
iii) Group 3: Areas connected to the sewer mains and receiving services in the aspect that sewage is removed sewage from households to a safe place, but nonetheless the services are incomplete because they are concerned about risk of environmental degradation due to discharge of raw sewage into surrounding rivers. The Table 2 shows status of sanitation service beneficiary household in Iquitos.

The loan does not cover the Iquitos city sewerage project, but the Loreto Water and Sanitation Public Corporation envisions three options for the sanitation construction project, which are shown in Table 3. Of these three, Option 2 would discharge raw sewage into the Amazon without treatment. The flow of the Amazon River is reportedly 300 times that of the Rhine River in Germany, and there are no factories in Iquitos that discharge chemical substances, so there is no problem with the Amazon's purification capacity (from an engineering perspective), which perhaps makes a sewage treatment plant less urgent. However, even focus group meeting members who do not reside near the Moronococha Lagoon or the Nanay River, where most of the raw sewage is discharged, were of the opinion that the practice: (i) harms the scenery (some argued that it had an impact on tourism resources), (ii) smelled bad, and (iii) resulted in raw sewage being discharged near drinking water intakes. Obviously, most residents from the area around the Nanay River, where the drinking water intakes are located, commented on the need for sewage treatment.

9 Please note that this grouping of beneficiaries is important in the implementation and analysis of this CVM and frequently referred to in this paper.

Therefore, in order to avoid pollution of the Amazon, we assumed Option 1, a project that would cover the entire city and include a sewage treatment plant, not just a sewer mains and pumping station, and we deemed the population to be all users connected to the sanitation service, including those households that were satisfied with current conditions.

Figure 2: Conceptual diagram of water supply hours for different areas of Iquitos



Source: SADEP Study Team

Table 2: Status of sanitation service beneficiary households in Iquitos

Type of household	No. of households
Households with connections	32,498
Registered households without connections due to aging facilities, etc. (Rehabilitation needed)	2,444
Total number of registered households	34,942

Source: Department of Loreto Water and Sanitation Public Corporation

Table 3: Options of the assumed sanitation project

Option	*Sewage Treatment Plant*	*No. of Pumping stations*	*Total project cost*
Option 1	With plant	6	808 million dollars
Option 2	Without plant	6	460 million dollars
Option 3	With plant	3	470 million dollars

Source:Department of Loreto Water and Sanitation Public Corporation

③ Sampling

The most important factor to be taken into account when determining the sample number, n, of samples is whether statistical errors for the estimated WTP will be within a tolerable range. Obviously, estimation errors tend to decrease as the number of samples increases, but it is known to almost cease decreasing after the number of samples when n

exceeds 1,000. According to recent research, at least 600 samples are needed for single bound and at least 400 samples for a double bound in order to ensure the statistical reliability of WTP estimations. As described above, water and sanitation services cover multiple groups, so we decided to extract 1,000 samples in order to ensure a minimum number of samples for each group.

There are four main methods before extracting choosing samples: simple random sampling, systematic sampling, multistage sampling, and stratified sampling. Stratified sampling has the greatest precision but requires the creation of strata for the areas covered. Being unable to obtain in advance the household information required for this, we elected to use simple random sampling, relying on random numbers to select samples from the population list.

(3) Scenario formulation

The scenario is the most basic component of the questionnaire. It was formulated by positing an envisioned status for the water and sanitation construction project. For this scenario, the "current status" was deemed to be "no supply of water and sanitation services" and "not supplying unsatisfactory water and sanitation services" due to limited water supply and low water pressure, the envisioned status was defined as, "supplying satisfactory water and sanitation services" (by implementation of a water and sanitation construction project). The important point here is that the respondents are the ordinary residents of Iquitos and it was therefore necessary to communicate the current status and envisioned status in a way that could be easily understood. To do this we obtained publicity materials meant for the general public from SUNASS (Superintendencia Nacional de Servicios de Saneamiento) and the Loreto Water and Sanitation Public Corporation and used them in for explaining the scenario.

(4) Questionnaire

Like the scenario explanation, the questionnaire were designed to be as easily to understand as possible because of the general public of Iquitos would be asked to respond and it was desirable to reduce response stress. We also took full account of not only of the local circumstances in Iquitos, but also of the results from a focus group meeting and pre-tests (explained in detail below) and revised the questionnaires as appropriate. The final version of the questionnaire contained the following questions.

① Present status of water supply
② Present status of sewege treatment
③ Evaluation of present water supply services
④ Present status of supply periods and pressure of water supply
⑤ Evaluation of current sanitation services
⑥ Water consumption and demand
⑦ Status of waterborne diseases
⑧ WTP for water services
⑨ WTP for sanitation services
⑩ Payment for other public utilities
⑪ Understanding of scenarios
⑫ Basic profiles of the head of household and interviewee
⑬ Total monthly income and savings of household

Questions on WTP were the most important part of the CVM questionnaire, and there were several techniques possible: "free response" , "pricing game", "payment card" or "choice of two options." For this survey, we used the "choice of two options" technique, which is the most commonly used technique. There are two forms that this technique can take: single bound and double bound. In the "single bound" form, the respondent is provided with a price only once; in the "double bound" , he/she is provided with prices twice. We used the double bound version because it enables comparatively good estimation results even with a small number of samples.

The survey was implemented with direct interviews since it was possible to hire enough survey staff. The quality of the survey staff has a significant impact on the results of interview surveys, and staff training must therefore be emphasized. We hired 10 university students from Iquitos and gave them sufficient training.

(5) Focus Group Meeting and Pre-test

Focus group meetings and pre-testing prior to the main survey are absolutely essential in CVM studies.

Meetings and tests confirm matters issues related to questionnaire surveys in general as well as matters peculiar to CVM. Examples of the former would include checks of: (i) whether there were any misunderstandings of the questions by respondents, (ii) whether respondents understood the questions, (iii) whether the alternatives were appropriate, (iv) whether there were large numbers of unanswered questions, and (v) whether all respondents gave the same answers to particular questions. Examples of the latter would include: (i) whether respondents were able to understand the evaluation scenario, (ii) whether the prices suggested were appropriate, and (iii) the extent of resistance responses.

① Focus group meeting

The focus group consisted of 10 heads of household selected at random from the population (one of the selected was absent on the day of the meeting). It used a free discussion format to elucidate problems with the questionnaire; for example, how well the participants understood the purpose of the survey and the scenarios presented. The meeting had two parts: a group discussion held once all participants assembled and followed by one-on-one interviews with individual heads of household.

② Pre-testing

We conducted two pre-tests, asking beneficiaries randomly selected from the population to fill in a draft questionnaire. Each pre-test covered 50 households and was conducted in interview format.

(6) Revision and finalization of Questionnaires

We created the final version of the questionnaire based on results from the focus group meeting and the two pre-tests. The final version of the questionnaire was translated into the Iquitos dialect of Spanish.

Iquitos residents, who participated in the focus group meetings and pre-tests were extremely aware of these issues and had a good understanding of the systems used to provide water and sanitation services, so it was deemed unlikely that there would be any problems understanding the scenarios. However, circumstances differ for the two water service groups and three sanitation service groups (described above), and so the final scenarios posited envisioned circumstances described conditions for "satisfactory services" based on the current baselines for each of these groups (two water and three sanitation groups). Here, we explain the three issues to which we paid special attention in conducting the final survey in consideration of results of the focus group meetings and pre-tests: method of presenting prices in questions to different groups; questions about the presented amount of WTP; and elimination of biases.

① Method of presenting prices in questions to different groups

The following questions were designed to present prices according to the scenarios for the two water and three sanitation groups due to their differences in circumstances.[10] Multiple versions were applied to each of the groups by combining the first and second prices set at appropriate levels as evidenced by pre-test findings. (The prices are shown in (②))

(i) Water services

Group 1 households: Your household currently does not receive water services so you do not pay water tariffs to the Water and Sanitation Public Corporation. If you were to receive "satisfactory water services" as we explained, would you be for or against paying _____ sols per month in new water tariffs? Note that this amount would be in addition to your current monthly household expenditures, but if you are paying money to purchase water from a source other than the Water and Sanitation Public Corporation, that amount would be deducted from your current monthly household expenditures.

Group 2 households: Your household currently pays _____ sols per month in water tariffs to the Water and Sanitation Public Corporation. However,

10 Please note that the questions intend to ask new water tariffs and/or amount to be added to current payment due to improvement of service. "Sol" is the currency unit of Peru. In this study: 1 USD = 3.45 sols = 105 yen (Exchange rates as of January 31, 2004)

water availability times and water pressure etc. are not satisfactory. If you were to receive "satisfactory water services" as we explained, would you be for or against paying an additional _____ sols per month? Note that this amount would be in addition to your current monthly household expenditures, but if you are paying money to purchase water from a source other than the Water and Sanitation Public Corporation, that amount would be deducted from your current monthly household expenditures.

(ii) Sanitation services

Group 1 households: Your household is not currently connected to the sanitation system so you do not pay sanitation tariffs to the Water and Sanitation Public Corporation. If you were to receive "satisfactory sanitation services" as we explained, would you be for or against paying _____ sols per month in new sanitation tariffs? Note that this amount would be in addition to your current monthly household expenditures. Please also note that all sewage would be treated in a sanitary manner before being discharged into the Amazon River.

Group 2 households: Your household currently pays _____ sols per month in sanitation tariffs to the Water and Sanitation Public Corporation. However, current sanitation services are not satisfactory because, for example, sewage overflows during rainfall. If you were to receive "satisfactory sanitation services" as we explained, would you be for or against paying an additional _____ sols per month? Note that this amount would be in addition to your current monthly household expenditures. Please also note that all sewage would be treated in a sanitary manner before being discharged into the Amazon River.

Group 3 households: Your household currently pays _____ sols per month in sanitation tariffs to the Water and Sanitation Public Corporation. You are satisfied with current services in the sense that sewage from your household is transported to a safe place. However, the sewage is not treated before being discharged into the surrounding rivers. If all sewage were to be treated in a sanitary fashion before being discharged into the Amazon River, would you be for or against paying an additional _____ sols per month? Note that this amount would be in addition to your current monthly household expenditures.

② Questions about the presented amount of WTP and applicable versions

In Iquitos City, most households are classified into a very small number of wealthy class, and a great number of general middle class. According to the individual interviews and pre-tests during the focus group meeting, the WTP for water supply and sanitation charges was concentrates within a narrow range. Therefore, the dominant such a view was that "if high amounts are indicated, all the answerers except some major users will answer "No." since the residents' WTP is limited. Taking this view into account and based on the aforementioned pre-test results, various versions of amounts used for the WTP questions were determined for each water supply group and each sanitation service group as shown in Tables 4 and 5.

Table 4: Versions of prices suggested in WTP question (Water services)

Group	*Group 1*			*Group 2*		
No. of samples	295			705		
Connection to water system	Unconnected			Connected		
Satisfaction with services	Dissatisfied			Dissatisfied		
Version	Ver. 1	Ver. 2	Ver. 3	Ver. 1	Ver. 2	Ver. 3
The first suggested price (sol)	20	25	30	5	10	15
The second (When yes)	25	35	40	10	15	20
The second (When no)	10	15	20	3	5	10

Source:SADEP Study Team

Table 5: Versions of prices suggested in WTP question (Sanitation services)

Group	*Group 1*			*Group 2*			*Group 3*		
No. of samples	383			274			343		
Connection to sanitation system	Unconnected			Connected			Connected		
Satisfaction with services	Dissatisfied			Dissatisfied			Dissatisfied (as for discharging sewage to surrounding rivers)		
Version	Ver. 1	Ver. 2	Ver. 3	Ver. 1	Ver. 2	Ver. 3	Ver. 1	Ver. 2	Ver. 3
The first suggested price (sol)	10	15	20	5	10	15	4	6	8
The second (When yes)	15	20	25	10	15	20	6	8	10
The second (When no)	5	10	15	3	5	10	2	4	6

Source:SADEP Study Team

③ Elimination of biases

Table 6 summarizes the possible biases concerned about when conducting this CMV research. In this survey, there are two types of possible bias. First, such information as "a yen loan project will be implemented by JBIC" may induce a so-called strategic bias that causes "an incentive to underestimate the WTP". Second is a so-called start-point bias that is specific to the double-bound type questions and makes "the amount initially shown by the questioner influence the answer as a downward bias". To eliminate these biases, it was checked whether there was any bias or not during the pre-tests, and the questionnaire was modified so that biases can be eliminated as much as possible.[11]

(7) Research results analysis method

The full-scale research was implemented after training 10 staff and furnishing them with (i) a questionnaire kit, (ii) a research area map and list of addresses of subjects, (iii) a research manual, (iv) an official ID card (with a signature of the Mayor of Iquitos City), etc. Where the questionnaire could not be recovered, sampling was repeated, achieving 100% of recovery rate from the target samples, i.e., a sample of 1000 general users and 200 commercial users.

After the data collection, the local consultants checked and encoded the results of the questionnaire , completed the classified total, and constructed a data base of the survey. The results of the research were analyzed in the following procedure:

① Simple totalization, cross totalization, basic statistical calculation (understanding of the interviewees' profiles)
② Estimate of the WTP
③ Examination of the reliability (examination of the appropriateness of the WTP by statistical test)
④ Analysis of factors influencing the WTP

The data were analyzed by a statistics package called "CVM2002" that supports the data collected using double-bound questions. There are several CVM estimation models for double-bound data sets, such as "Rondam utility model", "WTP function model", and "Survival analysis". The CVM 2002 adopts the survival analysis and does not require programming. The CVM2002 performs basic statistical value calculations, cross totalization, estimation of the average and median of the WTP, examination of the reliability, WTP factor analysis (regression analysis using attributes), etc. for the double-bound data set.

The estimate using the CVM2002 applies "parametric" methods that assume and analyzes specific distribution functions. To be more precise, the estimates lead from the acceptability curve that assumes the Weibull distribution or other distribution functions. (See Box below)

11 In the survey, the study team placed, in order, respondents selected through random sampling (with a random number table) from the registry of users, and applied to them ver. 1, ver. 2, and ver. 3 in a cyclic manner (i.e. ver 1 for sample 1, ver 2 for sample 2, ver 3 for sample 3, ver 1 for sample 4,ver 2 for sample 5, ver 3 for sample 6, ver 1 for sample 7…..). This method allows the survey team to apply each version on a random basis.

BOX: Weibull Model

In CVM survey, estimation of WTP can be done through two methods: the Parametric Model in which a distribution function, such as a logarithmic function, is assumed as the decay curve (i.e. acceptability curve); and the Non-Parametric Model in which no distribution is assumed. Although the parametric model has certain disadvantages such as it may be affected by the distribution curve, it has major advantages: a point estimation of WTP's median value is available, and an analysis of the reasons for the WTP (based on the full model) is possible.

The parametric models include three: the Log-logarithm Model, in which a log-logarithm distribution is used to define the WTP distribution; the Log-Normal Model, in which a log-normal distribution is used to define the WTP distribution; and the Weibull Model, in which a Weibull distribution is used to define the WTP distribution. The density function for the Weibull distribution is defined as follows:

$$f(WTP)=p.\gamma / p.\lambda\,(WTP / p.\lambda)^{p.\lambda-1} \exp\{-(WTP / p.\lambda)^{p.\gamma}\}$$

Where WTP stands for Willingness to Pay and $p.\gamma$ and $p.\lambda$ are parameters for the assumed distribution.

It should be noted that the log-logistic model tends to have a wide distribution area and a relatively high average value, while the Weibull model is known to have a high flexibility and derives excellent results.

Table 6 : Anticipated biases and measures taken

Bias type			*Possibility*	*Measure*
Biases caused by the incentives for distorted answers				
	Strategic bias	An incentive for the underestimation that will be made if the charges are determined in accordance with the answered charges although supply of an environmental service was already determined.	○	It was explained that the research was neutrally held by a Japanese research organization, so information that a yen loan project would be implemented was shut out, eliminating bias.
	Flattery bias	An incitement for flattery answers. There are a research agency bias and a questioner bias.	△	No flattery bias was seen.
Biases caused by the information that gives evaluation clues				
	Start-point bias	The amount initially shown by the questioner could influence the answers.	○	There was a possibility of this, but no influence of a start-point bias could be seen since the answerers fully understood the scenario.
	Range bias	If shown, the range of WTP could influence the answers.	×	The bias had no relation since double-bound type questions were made.
	Relation bias	If indicated, relationship between the evaluation target and the other assets could influence the answers.	×	Relations with any other public assets were not shown.
	Importance bias	If suggested by the questions, the importance of the evaluation target could influence the answers.	△	The evaluation target was objectively explained based on facts only.
Biases caused by scenario transmission errors				
	Theoretical transmission error	The scenario is not appropriate economically or politically.	△	The water and sanitation system construction project was politically appropriate.
	Evaluation target transmission error	The answerers receive the information unintended by the questioner.	△	The answerers extremely accurately understood the scenario.
	Status transmission error	The explained virtual market status differs from that intended by the researcher.	△	The answerers extremely accurately understood the scenario.
Sample design and sample implementation biases				
	Population selection	The selected target population is not appropriate in relation to the benefits and costs of the service to be provided.	△	The target population covered all the beneficiaries.
	Sampling limit	The data used for sampling do not reflect the population as a whole.	△	The nearly entire population was reflected.
	Sample selection	There is a tendency that the number of effective answers increases as interest in the evaluation target increases.	△	Interest in the evaluation target was high, and no difference in interest was seen among residents.

Note: ○: Bias concerned about, △: Possible bias, ×: Least possible bias

Source: SADEP Study Team

Chaper 3: Analysis of the survey results

(1) Basic statistical values and general situation

The basic statistical values for sample of 1,000 sample general users were calculated as shown in Table 7. The basic statistical values were calculated, totalizing the samples for each user profile questioned in the questionnaire, and computing the minimum, maximum, average and standard deviation values for each of the water supply groups, sanitation groups and four districts.

Table 7: Basic statistical values for 1,000 sampled general users

Class.	*Basic statistical value*	*Sample total*	*Water service group*		*Sanitation service group*			*District*			
			1	*2*	*1*	*2*	*3*	*Belen*	*Iquitos*	*Punchana*	*San Juan*
No. of samples		1,000	295	705	383	274	343	251	498	151	100
Age (year)	Minimum	14.0	14.0	15.0	14.0	15.0	15.0	18.0	15.0	14.0	15.0
	Maximum	100.0	81.0	100.0	81.0	82.0	100.0	81.0	100.0	79.0	75.0
	Average	41.3	38.7	42.4	38.3	39.8	46.0	44.2	42.6	39.3	36.0
	Standard deviation	15.7	14.7	15.9	13.9	15.0	16.9	14.7	16.4	15.2	12.1
Family size (person)	Minimum	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Maximum	20.0	18.0	20.0	15.0	20.0	18.0	12.0	18.0	20.0	13.0
	Average	5.8	5.8	5.8	5.9	5.9	5.7	5.6	5.8	6.2	5.3
	Standard deviation	2.7	2.4	2.8	2.5	2.8	2.8	2.4	2.7	2.8	2.4
Monthly income (sols)	Minimum	60.0	60.0	80.0	60.0	100.0	82.0	80.0	82.0	74.0	60.0
	Maximum	5,000.0	2,000.0	5,000.0	4,500.0	5,000.0	5,000.0	2,500.0	5,000.0	4,500.0	4,500.0
	Average	852.4	578.3	958.8	619.2	1042.3	944.8	656.1	983.1	713.0	903.1
	Standard deviation	753.4	408.0	825.9	490.5	918.4	771.2	456.1	868.5	661.6	713.0
Monthly savings (sols)	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	3,000.0	600.0	3,000.0	2,000.0	3,000.0	1,000.0	1,000.0	3,000.0	3,000.0	600.0
	Average	46.9	36.5	51.0	42.7	71.1	32.0	31.3	41.3	66.3	69.6
	Standard deviation	218.5	92.7	250.8	157.0	350.4	108.0	109.8	226.6	316.8	144.1
Water usage volume (liters/person/ month)	Minimum	21.0	38.0	21.0	38.0	21.0	26.0	113.0	26.0	21.0	38.0
	Maximum	8,700.0	8,700.0	7,500.0	8,700.0	7,500.0	6,000.0	6,000.0	7,500.00	8,700.0	6,000.0
	Average	952.0	965.3	944.5	802.0	1,017.2	1,093.3	958.1	985.7	1,006.7	682.7
	Standard deviation	1,105.8	1,098.1	1,110.0	930.7	1,247.1	1,179.5	887.7	1,273.0	1,060.8	820.5
Water availability time (hour)	Minimum	1.0	n.r.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Maximum	24.0	n.r.	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
	Average	12.7	n.r.	12.7	12.4	14.5	11.3	6.1	15.9	7.3	11.3
	Standard deviation	9.1	n.r.	9.1	9.0	9.1	8.9	4.8	8.8	7.7	8.2
Monthly water tariff (sols)	Minimum	3.0	n.r.	3.0	3.0	7.0	4.2	7.7	7.0	4.2	3.0
	Maximum	154.0	n.r.	154.0	45.0	154.0	93.8	38.0	154.0	52.4	45.0
	Average	20.8	n.r.	20.8	19.9	21.1	21.0	18.4	21.6	20.1	20.2
	Standard deviation	10.2	n.r.	10.2	6.0	12.9	9.2	3.8	12.1	5.6	8.4
Monthly sanitation tariff (sols)	Minimum	1.3	3.7	1.3	n.r.	2.0	1.3	2.3	2.0	1.3	3.7
	Maximum	46.0	13.0	46.0	n.r.	46.0	31.3	12.0	46.0	15.7	8.8
	Average	6.5	6.1	6.5	n.r.	6.5	6.4	5.6	6.7	6.2	6.1
	Standard deviation	3.5	1.7	3.5	n.r.	4.1	2.9	1.4	4.0	1.9	1.1
Electricity tariff payment (sols)	Minimum	3.0	4.6	3.0	3.0	5.8	6.0	3.0	5.0	4.0	6.0
	Maximum	400.0	185.0	400.0	400.0	220.0	350.0	185.0	400.0	200.0	143.0
	Average	49.2	31.3	55.6	32.1	58.5	58.6	41.6	58.0	40.9	36.4
	Standard deviation	43.4	28.3	46.0	34.4	46.1	44.0	37.8	48.6	35.8	28.9

Source: SADEP Study Team

The profiles of the average beneficiaries read from these quantitative data and cross-totalized qualitative data can be summarized as follows:

(i) The average age of the answerers is 41.3 years old, and the average family size is 5.8 people.
(ii) The monthly household income is 852.4 sols, about 5.5% (46.9 sols) of which is saved.
(iii) Monthly water consumption and payment for the water supply service for each family member are 952 liters and 20.8 sols respectively. This amount corresponds to 2.44% of monthly income.[80]
(iv) Water supply service is limited to 12.7 hours a day. In other words, water is not supplied for about

half of a day.
(v) The monthly sanitation service charge to pay per family member is 6.5 sols. This amount corresponds to 0.76% of monthly income.
(vi) As another public utility charge, 49.2 sols, is paid for electricity service, about twice the water supply and sanitation service charges

In addition to the basic profiles above, the major profiles that can be read from the cross-totalization are shown below.

① Current status of water supply and sanitation services

70.7% of all the households are connected to the water supply system. In sanitation group 1, of the households that were not connected to the sanitation system, 38.3% of them are connected to the water supply system. The rate is extremely low compared with the other groups. As such, it can be seen that the households that are not connected to the water supply service are related to those that are not connected to the sanitation service. Water leakage rate was only little, 3.1%. Water meter installation rate was only 22.7%. As a substitute water supply for group 1, of which households has not been connected to the water supply system, 60.3% of the households in group 1 use wells. Also, 61.5% of them have not been connected to the sanitation system, and 69.9% of them have a lavatory inside the home. As a matter of course, only a few, 23.0%, of the sanitation group 1 households that are not connected to the sanitation system have a lavatory inside the home. (Table 8)

Table 8: Status of water and sanitation services of 1,000 sampled general users

Item	*Explanation of index*	*Entire beneficiaries*	*Water service group*		*Sanitation service group*		
			1	2	1	2	3
No. of samples		1,000	295	705	383	274	343
Connection to water system	Water service diffusion rate (%)	70.7	0.0	98.9	38.3	92.3	89.2
Water leakage	Rate of water leakage occurrence (%)	3.1	-	3.1	4.7	2.4	2.9
Meter	Rate of mater installation (%)	22.7	-	32.2	5.7	33.2	33.2
Use of well	Rate of use of well (%)	20.7	60.3	4.1	41.5	4.0	10.8
Connection to sanitation system	Sanitation service diffusion rate (%)	61.5	21.4	78.3	1.0	98.9	99.1
Indoor toilet	Rate of indoor toilet installation (%)	69.9	41.0	82.0	23.0	99.0	99.1

Source: SADEP Study Team

② Evaluation of the current water supply service

30.4% of the group 1 households that are not connected to the water supply system and 20.5% of the group 2 households that were being connected to the water supply system answered "relatively unsatisfied" or "very unsatiafied". The reasons for the dissatisfaction were mostly limited water pressure and limited water supply time. (Table 9)

80 Water and sanitation tariffs in the city of Iquitos

Water service	*Monthly usage volume (cubic meter)*	*Tariffs applied by the city of Iquitos (sol/cubic meter)*	*Minimum usage volume (cubic meter/month)*
General users	0-20	0.956	8.0
	21-30	1.463	
	31-	1.558	
Commercial users	0-30	0.684	12.0
	31-	1.109	
Industrial users	0-60	0.661	24.0
	61-	1.051	
Sanitation services	Charged at the rate of 30% of water tariffs across the board		

Source: Department of Loreto Water and Sanitation Public Corporation

Table 9: Evaluation of current water services of 1,000 sampled general users

Item	*Group 1*		*Group 2*	
	No. of responses	*Ratio (%)*	*No. of responses*	*Ratio (%)*
No. of samples	295		705	
Evaluation of current water services	273	100.0	700	100.0
Very satisfied	48	17.6	74	10.6
Relatively satisfied	51	18.7	156	22.3
Average	91	33.3	327	46.7
Relatively unsatisfied	54	19.8	109	15.6
Very unsatisfied	29	10.6	34	4.9

Source: SADEP Study Team

③ Evaluation of the current sanitation service

More than a half, 54.5%, of the group 1 households that are not connected to the sanitation system answered "relatively unsatisfied" or "very unsatisfied". The group of the households that are not connected to the sanitation system evaluated the sanitation service to be less satisfactory than the group of households that are not connected to the water supply system, indicating that they are forced to live in an unsatisfactory hygienic environment. (Table 10)

Table 10: Evaluation of current sanitation services of 1,000 sampled general users (By sanitation service group)

Item	*Group 1*		*Group 2*		*Group 3*	
	No. of responses	*Ratio (%)*	*No. of responses*	*Ratio (%)*	*No. of responses*	*Ratio (%)*
No. of samples	383		274		343	
Evaluation of current water services	367	100.0	274	100.0	343	100.0
Very satisfied	57	15.5	7	2.6	330	96.2
Relatively satisfied	31	8.4	42	15.3	7	2.0
Average	79	21.5	118	43.1	4	1.2
Relatively unsatisfied	135	36.8	80	29.2	2	0.6
Very unsatisfied	65	17.7	27	9.9	0	0.0

Source: SADEP Study Team

Table 11: Morbidity of water-borne diseases of 1,000 sampled general users

Disease	*1,000 sampled general users*
No. of samples	1,000
Dermatitis	55.4
Malaria	453.0
Cholera	60.6
Typhoid fever	23.9
Dengue	343.3
Chronic diarrhea	111.7
Others	133.6
Total	1,181.5

Source: SADEP Study Team

The lack of sanitation system has a close relationship with waterborne diseases. The questionnaire also contained questions about waterborne diseases. Based on the answers, Table 11 shows the annual morbidity of the waterborne diseases (revealed by the pre-tests.) per 100,000 persons around Iquitos City.

According to the report by WHO[13], for example, annual morbidity of typhoid fever per 100,000 persons in rural areas in Latin America is about 20 persons. The results of this research were therefore found to be largely reliable since the numbers revealed by this research were in the average of 23.9

13 WHO Department of Communicable Disease Surveillance and Response. CSR, 2003

persons. Besides, the morbidities of malaria and dengue fever, which are carried by mosquitoes, are high, indicating that sanitation system construction is a matter of urgency. Reduction of the waterborne diseases is one of important benefits that would be brought about by the sanitation construction project. Generally, quantification of this benefit is difficult. If the situation of the waterborne diseases in this CVM research area is additionally investigated, however, the benefits of the sanitation construction project can be quantified from a viewpoint different from the total amount of WTP for the sanitation service.

④ Status of water availability time period and water pressure

34.7% of the total households enjoyed 24-hour water supply service. The average water availability time was 12.7 hours. The average water availability time for the households under water supply restrictions was only 6.6 hours. As high as 61.1% of the households have water supply service at the minimum water pressure.

⑤ Water consumption[14]

Water consumption of interviewees who are connected to the water supply service and were able to confirm the bills from the Water Supply and Sanitation Public Corporation is based on the water consumption indicated in the bills. Water consumption of those who are not connected to the water supply service is based on the water consumption estimated by the answerers themselves (Table 12). From these answers, water consumption for each district and each group was calculated.

Generally, it is said that minimum required water is 30 liters/day/person. Calculation of the sufficiency rate for each district and each group based on this standard shows that only sanitation group 3 is supplied with more water than the minimum volume. It is considered that the short water supply availability time and low water pressure significantly influence the water consumption by the researched households.

Table 12: Status of water consumption of 1,000 sampled general users

Item	*District*				*Water service group*		*Sanitation service group*			*Total*
	Belen	*Iquitos*	*Punchana*	*San Juan*	*Group 1*	*Group 2*	*Group 1*	*Group 2*	*Group 3*	
No. of samples	251	498	151	100	295	705	383	274	343	1,000
Monthly water usage volume (liters/month/household)	5,335.0	4,702.3	4,630.6	3,114.1	4,785.8	4,636.3	4,008.5	5,071.7	5,275.7	1,689.8
Average family size (person)	6.2	5.8	5.6	5.3	5.8	5.8	5.9	5.9	5.7	5.8
Daily water usage volume (liters/day)	177.8	156.7	154.4	103.8	159.5	154.5	133.6	169.1	175.9	156.3
Minimum required volume (liters/month/person)[note]	186.9	172.5	167.1	160.2	174.3	174.0	177.0	175.8	169.8	174.0
Rate of sufficiency (%)	**95.1**	**90.9**	**92.4**	**64.8**	**91.5**	**88.8**	**75.5**	**96.2**	**103.6**	**89.8**

Note: Figuires of minimum required volume (liters/mouth/person) involve differences due to round-off despite identical numer of family members.
Source: SADEP Study Team

14 In addition to the questions about current water consumption, the questionnaire of this CVM research included questions about on (i) WTP for the "satisfactory" water supply and sanitation services and (ii) expected water consumption (multiples of the current water consumption) when such "satisfactory" water supply and sanitation services are available. It is therefore possible to numerically show the demand for water supply (or sewage volume) and the corresponding service prices (WTP). That is, where the x-axis represents demand for water supply (wv)(or sewage sv), and the y-axis shows WTP for water supply service (wp) (or WTP for sanitation service (sp)), the demand curves of water supply and sanitation services can be respectively determined by plotting the combinations of the 1,000 samples (wv^n, wp^n) and (sv^n, sp^n). In addition, by drawing the supply curves of the water supply and sanitation service facilities, it is possible to estimate appropriate theoretical service prices based on the price theory. However, since it is beyond the scope of this study, it can be done in the future.

(2) Estimation of WTP

The most important purpose of this CVM research was to estimate WTP for water supply service and sanitation service. WTP was investigated using double-bound questions. The typical WTP values were estimated using specialized CVM software. With double-bound questions, calculation was performed by interpreting (i) the rejection of both amounts presented : "WTP is less than the lower amount presented", (ii) the acceptance of both amounts presented : "WTP is higher than the higher amount presented ", and (iii) the acceptance of only one presented amount : "WTP is more than the low amount presented and less than the higher amount presented". The CVM2002 obtains the representative WTP values by assuming the "Weibull distribution" or other distribution function as the WTP distribution of the population, and using the most likelihood estimate method for estimating the acceptability rate curve that gives the maximum probability of the answer pattern shown by the sample data.

Tables 13 shows summary of the answers given by the 1,000 sampled general users to the two questions for confirming the WTP for water supply services. The answers to the first question about the WTP for water supply service showed acceptability rates in the range of 36.2% - 53.0% across the four districts in Iquitos City. Of the four districts, San Juan district gave the highest acceptability rate, 53.0%. Of the water supply groups, the group 1 (not connected to the water supply system) produced 49.1% acceptability, and the group 2 (connected to the water supply system), 40.2%.

As for the answer to the first and second questions about the WTP for water supply service acceptability rates of the first and / or second questions were in the range of 62.1%-86.1% across the four district, and Punchana district produced the highest acceptability. Of the water supply groups, the group1 (not connected to the water supply system) produced 79.6% acceptability rate and the group 2 (connected to the water supply), 63.3%. That is, in the group which has more room for improvement of water supply service, WTP may be higher when the water supply service is improved.

Table 13: Status Summary of the answers to the WTP questions about water services by groups

Section (1st -2nd)	*Yes-Yes*	*Yes-No*	*No-Yes*	*No-No*	*Total*
Belen					
No. of responses	39	52	65	95	251
Ratio of responses	15.5%	20.7%	25.9%	37.9%	100.0%
		36.2%		63.8%	100.0%
Iquitos					
No. of responses	61	156	97	184	498
Ratio of responses	12.2%	31.3%	19.5%	37.0%	100.0%
		43.5%		56.5%	100.0%
Punchana					
No. of responses	53	14	63	21	151
Ratio of responses	35.1%	9.3%	41.7%	13.9%	100.0%
		44.4%		55.6%	100.0%
San Juan					
No. of responses	16	37	28	19	100
Ratio of responses	16.0%	37.0%	28.0%	19.0%	100.0%
		53.0%	47.0%	47.0%	100.0%
By water service groups (1st -2nd)	*Yes-Yes*	*Yes-No*	*No-Yes*	*No-No*	*Total*
Group 1					
No. of responses	62	83	90	60	295
Ratio of responses	21.0%	28.1%	30.5%	20.4%	100.0%
		49.1%		50.9%	100.0%
Group 2					
No. of responses	107	176	163	259	705
Ratio of responses	15.2%	25.0%	23.1%	36.7%	100.0%
		40.2%		59.8%	100.0%

Source: SADEP Study Team

Tables 14 shows the summary of answers by 1,000 sample general users to the questions asked twice for confirming the WTP for sanitation service. The answers to the first question about the WTP for sanitation service showed the acceptability in the range of 32.2% - 61.0% across the four districts. San Juan district showed the highest acceptability, 61.0%. Of the sanitation groups, the group1 (not connected to the sanitation service) produced 43.5% acceptability, and the group 2 (connected to the sanitation service but with overflow), 40.9%, and the group 3 (connected to sanitation services and without overflow), 37.4%.

In terms of the answers to the first and second questions about the WTP for santation service, acceptability rates of the first and or second question were in the range of 61.5%-83.0%, and San Juan district produced the highest acceptability. Of the sanitation groups, the group1 (not connected to the sanitation service) produced acceptability of the first and / or second questions, 76.8%, and the group 2 (connected to the sanitation service but with overflow), 67.5%, and the group 3 (connected to sanitation services and without overflow), 57.3%. That is, as the water supply service, in the group which has more room for improvement of sanitation service, WTP may be higher when the sanitation service is improved.

Table 14: Summary of the answers to the WTP questions about sanitation services by groups

Section (1st -2nd)	*Yes-Yes*	*Yes-No*	*No-Yes*	*No-No*	*Total*
Belen					
No. of responses	29	49	71	93	242
Ratio of responses	12.0%	20.2%	29.3%	38.5%	100.0%
		32.2%		67.8%	100.0%
Iquitos					
No. of responses	57	145	110	186	498
Ratio of responses	11.4%	29.1%	22.1%	37.4%	100.0%
		40.5%		59.5%	100.0%
Punchana					
No. of responses	57	5	63	26	151
Ratio of responses	37.7%	3.3%	41.8%	17.2%	100.0%
		41.0%		59.0%	100.0%
San Juan					
No. of responses	22	39	22	17	100
Ratio of responses	22.0%	39.0%	22.0%	17.0%	100.0%
		61.0%		39.0%	100.0%
Answers to WTP questions(1st -2nd)	*Yes-Yes*	*Yes-No*	*No-Yes*	*No-No*	*Total*
Group 1					
No. of responses	66	97	125	87	375
Ratio of responses	17.6%	25.9%	33.3%	23.2%	100.0%
		43.5%		56.5%	100.0%
Group 2					
No. of responses	37	75	73	89	274
Ratio of responses	13.5%	27.4%	26.6%	32.5%	100.0%
		40.9%		59.1%	100.0%
Group 3					
No. of responses	62	66	68	146	342
Ratio of responses	18.1%	19.3%	19.9%	42.7%	100.0%
		37.4%		62.6%	100.0%

Source: SADEP Study Team

With combinations of answers Yes and No to the two questions about WTP as they are, WTP representative value cannot be estimated. To obtain WTP representative value, an acceptability rate curve that maximizes the probability of the answer pattern shown by the samples needs to be estimated by assuming Weibull or other distribution model. The acceptability rate with y axis, S(T), indicates “share of people who accepted the prices presented both in the first and second questions, or either of the prices”. In this case, when an extremely high WTP value is obtained, the average value may become

infinite. So, the "rounded averages" were also obtained by excluding WTP values higher than the highest price presented. The estimation equation (*) of an acceptability rate curve through Weibull regression is as follows:

$S(T) = \exp[-\exp(\ln T - \mu)/\sigma]$ (*)

T: The presented price

μ : Location parameter [the parameter which determines the shape of an acceptability rate curve with response to each person's answer pattern, $\mu = \beta$ Xi (Xi are explanation variables for individual persons' attributes, and β is the coefficient of the explanation variables.)]

σ : Scale parameter (which determines an acceptability rate curve).

Table 15 : Estimate result of WTP representative value

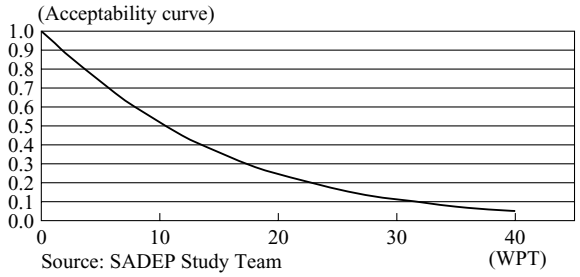
Estimate result	No. of samples	Sigma (σ)			Constant term			WTP representative value (sol)		
Section		Factor	Asymptotic t value	P value	Factor	Asymptotic t value	P value	Average	Rounded average	Median value
Model		Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull
Water	1000	0.917	28.10	0.00	2.680	81.40	0.00	**14.13	**13.54	**10.44
Group 1	295	0.369	16.20	0.00	3.310	133.00	0.00	**24.47	**24.18	**24.04
Group 2	705	0.757	22.40	0.00	2.260	69.30	0.00	**8.82	**8.81	**7.26
Sanitation	1000	0.794	28.20	0.00	2.340	81.60	0.00	**9.66	**9.36	**7.77
Group 1	383	0.426	18.50	0.00	2.760	111.10	0.00	*13.99	**13.82	**13.50
Group 2	274	0.632	14.90	0.00	2.250	51.60	0.00	**8.50	**8.47	**7.51
Group 3	343	0.722	13.80	0.00	1.680	37.10	0.00	**4.91	**4.64	**4.13
Water	1000	0.917	28.10	0.00	2.680	81.40	0.00	**14.13	**13.54	**10.44
Belen	251	0.754	10.60	0.00	3.110	40.30	0.00	**20.53	**19.06	**16.92
Iquitos	498	0.908	20.10	0.00	2.390	51.80	0.00	**10.57	**10.44	**7.86
Punchana	151	0.861	13.40	0.00	2.750	43.90	0.00	**14.77	**14.22	**11.36
San Juan	100	0.786	9.480	0.00	3.080	35.30	0,00	**20.24	**18.68	**16.36
Sanitation	1000	0.794	28.20	0.00	2.340	81.60	0.00	**9.66	**9.36	**7.77
Belen	251	0.647	10.20	0.00	2.750	40.60	0.00	**14.02	**13.16	**12.30
Iquitos	498	0.845	20.00	0.00	2.120	49.30	0.00	**7.89	**7.74	**6.13
Punchana	151	0.711	14.51	0.00	2.230	42.60	0.00	**8.45	**8.37	**7.15
San Juan	100	0.467	9.36	0.00	2.830	52.60	0.00	**15.03	**14.60	**14.30

Note: Shaded cells mean to be statistically-significant.
* $p < 0.05$ (Statistically-significant when no less than the level of 5%)
** $p < 0.01$ (Statistically-significant when no less than the level of 1%)
Source: SADEP Study Team

As a result, the optimum representative values for all groups were obtained with assuming a Weibull model. In the water supply system groups, the representative value of the group 1 (not connected to water supply system) was much greater than that of the group 2 (connected to water supply system) indicating the difference of WTP between the groups.

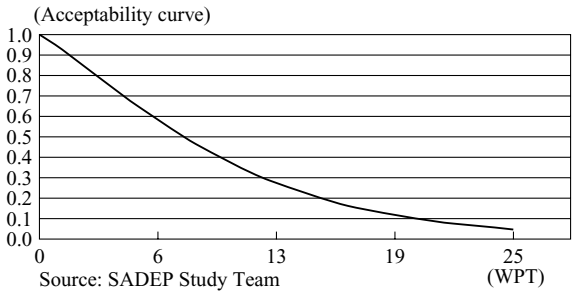
Similarly, in the sanitation groups, the group 3 (connected to the sanitation system and without overflow) showed a rounded average WTP value of 4.64 sols. As such, it was confirmed that there exists "WTP" of the group concerned about discharge of untreated sewage to the Amazon and which place environmental value on "disposal through the final treatment plant" provided in the scenario. The water supply and sanitation acceptability rate curves showing the relationship between acceptability rate and WTP were drawn from the Weibull model (Figures 3 and 4).

Figure 3: Acceptability rate curve of WTP for water services



Source: SADEP Study Team

Figure 4: Acceptability rate curve of WTP for sanitation services



Source: SADEP Study Team

The total WTP in the area to be benefited from the scenario can be estimated by multiplying the estimated monthly WTP per household by the number of beneficiary households. The total is the sum of the value of the environmental improvement project explained in the scenario prepared. The number of beneficiary households in this case is the sum of the number of households that are already connected to the water supply and sanitation systems and the number of households that are expected to enjoy benefits to be brought about by the scenario in the future. As a result, the total WTP in Iquitos City in 2003 is estimated as 16,241,900 sols (4,707,800 US dollars or approximately 494 million yen). The total WTP in 2004 and 2005 estimated, taking the increase in the number of households into consideration, is 16,388,700 sol (4,750,000 US dollars or approximately 499 million yen) and 16,545,800 thousand sols (4,796,000 US dollars, or approximately 504 million yen) respectively. (Table 16)

Table 16: Estimated WTP total in the beneficiary areas

Section	No. of samples	Estimated monthly WTP (sol)	Share (%)	Estimated No. of beneficiary households (household)			Estimated annual total of WTP (1,000 sols)		
				2003	2004	2005	2003	2004	2005
Total	1,000	-	100.0	60,023	60,566	61,146	16,241.9	16,388.7	16,545.8
Water service WTP total	1,000	13.54	100.0	60,023	60,566	61,146	9,611.5	9,698.3	9,791.3
Group 1	295	24.18	29.5	17,707	17,867	18,038	5,137.9	5,184.2	5,233.9
Group 2	705	8.81	70.5	42,316	42,699	43,108	4,473.6	4,514.1	4,557.4
Sanitation service WTP total	1,000	9.36	100.0	60,023	60,566	61,146	6,630.4	6,690.4	6,754.5
Group 1	383	13.82	38.3	22,989	23,197	23,419	3,812.5	3,847.0	3,883.8
Group 2	274	8.47	27.4	16,446	16,595	16,754	1,671.6	1,686.7	1,702.9
Group 3	343	4.64	34.3	20,588	20,774	20,973	1,146.3	1,156.7	1,167.8

Note: WTP is incremental payment when satisfactory services are provided.
Source: SADEP Study Team

Table 17 shows the current average payment, the employed estimated additional WTP, the ratios of the WTP to the current average payment, and the total WTP after adding the additional amount for water supply and sanitation services. The employed estimated additional WTP was 65.1% of the current payment for water supply service, 144.5% of current for sanitation service, and 83.9% of the current total payment for water supply and sanitation services, verifying that the WTP for sanitation service was higher than current charges.

Table 17: Comparison between WTP and current water/sanitation tariffs

Section	No. of samples	Current average payment (sols) (A)			Employed estimated additional WTP (sols) (B)			Ratio of WTP to current average payment (%) (B / A)			Total WTP after addition (sols) (A+B)		
Section	1,000	Water	Sanitation	Total	Water	Sanitation	Total	Water	Sanitation	Total	Water	Sanitation	Total
Water	1,000	20.81	6.48	27.29	13.54	9.36	22.90	65.1	144.5	83.9	34.35	15.84	50.19
Group 1	295	0.00	6.10	6.10	24.18	-	-	-	-	-	24.18	-	-
Group 2	705	20.80	6.50	27.30	8.81	-	-	42.4	-	-	29.61	-	-
Sanitation	1,000	20.81	6.48	27.29	13.54	9.36	22.90	65.1	144.5	83.9	34.35	15.84	50.19
Group 1	383	19.90	0.00	19.90	-	13.82	-	-	-	-	-	13.82	-
Group 2	274	21.10	6.50	27.60	-	8.47	-	-	130.3	-	-	14.97	-
Group 3	343	21.00	6.40	27.40	-	4.64	-	-	72.5	-	-	11.04	-
District	1,000	20.81	6.48	27.29	13.54	9.36	22.90	65.1	144.5	83.9	34.35	15.84	50.19
Belen	251	18.39	5.59	23.98	19.06	13.16	32.22	103.6	235.4	134.4	37.45	18.75	56.20
Iquitos	498	21.63	6.74	28.37	10.44	7.74	18.18	48.3	114.8	64.1	32.07	14.48	46.55
Punchana	151	20.05	6.20	26.25	14.22	8.37	22.59	70.9	135.0	86.1	34.27	14.57	48.84
San Juan	100	20.16	6.10	26.26	18.68	14.60	33.28	92.7	239.3	126.7	38.84	20.70	59.54

Source: SADEP Study Team

(3) WTP factor analysis

We used the Weibull model to perform regression analysis of various factors potentially related to WTP for water services and or sanitation services, respectively. In the analysis, the proposed prices served as dependent variables with the following independent variables selected on the expectation that they would have impact on the proposed prices. (See Tables 18 through 23.)

Water service factors analysis : independent variables

Gender, age, number of persons in household, monthly income, water usage volume, water pressure, water availability time, water charges, and satisfaction with water services.

Sanitation service factors analysis : independent variables

Gender, age, number of persons in household, monthly income, sanitation service charges, satisfaction with sanitation services, susceptibility to water-borne diseases, and presence or absence of indoor toilet

Table 18 : Factor analysis of WTP for water service (Weibull regression I-1)

Section	Group (Sample numbers are in parentheses)	Result of model estimation		Factors										
		Log likelihood	AIC	x_1	x_2	x_3	x_4	x_5	x_6	X_7	x_8	x_9	x_{10}	x_{11}
				σ	Gender	Age	Persons in household	Monthly income	Water usage volume	Water pressure	Water availability times	Water tariffs	Satisfaction	Constant term
Entire beneficiaries	Entire beneficiaries [1000]	-397.27	816.54	**0.618	-0.056	*-0.108	0.041	*0.128	0.039	-0.073	*-0.112	-0.072	-0.043	**2.370
Water service group	Group 1 [295]	-233.71	481.41	**0.461	-0.052	-0.013	*-0.102	0.024	**-0.213	-	-	-	-0.026	**2.750
	Group 2 [705]	-397.27	816.54	**0.618	-0.057	*-0.108	0.041	*0.128	0.039	-0.073	*-0.112	-0.072	-0.043	**2.370
Sanitation service group	Group 1 [383]	-72.79	167.57	**0.453	-0.138	0.098	0.075	*0.314	-0.018	0.052	-0.021	0.028	-0.135	**2.840
	Group 2 [274]	-129.82	281.64	**0.513	-0.016	-0.053	0.056	0.010	0.017	0.092	-0.052	-0.048	0.027	**2.320
	Group 3 [343]	-186.03	394.06	**0.611	*-0.129	-0.084	0.010	*0.147	-0.011	-0.054	-0.065	0.023	-0.063	**1.780

Note1 (Tables 18 and 21): Shaded cells indicate results that are mean to be statistically-significant.
* < 0.05 (Statistically-significant when no less than the level of 5%)
**< 0.01 (Statistically-significant when no less than the level of 1%)

Note2 (Tables 18 to 23): AIC is an indicator to show the degree of fitness of estimation through weibull distribution model, to the pattern of WTP answers of the 1,000 samples. The smaller figures are (i.e. the more logarithmic likelihood is), the more degree of fitness of the model is.

Source: SADEP Study Team

Table 19: Factor analysis of WTP for water service (Weibull regression I-2)

Section	Group (Sample numbers are in parentheses)	Result of model estimation		Asymptotic t value										
		Log likelihood	AIC	x_1	x_2	x_3	x_4	x_5	X_6	X_7	x_8	X_9	x_{10}	x_{11}
				σ	Gender	Age	Persons in household	Monthly income	Water usage volume	Water pressure	Water availability times	Water tariffs	Satisfaction	Constant term
Entire beneficiaries	Entire beneficiaries [1000]	-435.36	892.72	15.20	-1.34	-2.74	0.09	2.51	0.85	-1.79	-2.55	-1.68	-0.92	57.70
Water service group	Group 1 [295]	-233.71	481.41	12.20	-1.23	-0.31	-2.13	0.57	-3.98	-	-	-	-0.53	62.00
	Group 2 [705]	-397.27	816.54	15.20	-1.34	-2.74	0.09	2.51	0.85	-1.79	-2.55	-1.68	-0.92	57.70
Sanitation service group	Group 1 [383]	-72.79	167.57	6.34	-1.76	1.20	0.90	2.17	-0.17	0.58	-0.25	0.33	-1.40	38.00
	Group 2 [274]	-129.82	281.64	9.43	-0.25	-0.79	0.84	0.13	0.25	1.51	-0.78	-0.77	0.37	39.90
	Group 3 [343]	-186.03	394.06	9.29	-2.10	-1.43	0.14	2.02	-0.17	-0.87	-0.98	0.37	-0.96	29.60

Source: SADEP Study Team

Table 20: Factor analysis of WTP for water service (Weibull regression I-3)

Section	Group (Sample numbers are in parentheses)	Result of model estimation		p value										
		Log likelihood	AIC	x_1	x_2	x_3	x_4	x_5	x_6	X_7	x_8	x_9	x_{10}	x_{10}
				σ	Gender	Age	Persons in household	Monthly income	Water usage volume	Water pressure	Water availability times	Water tariffs	Satisfaction	Constant term
Entire beneficiaries	Entire beneficiaries [1000]	-435.36	892.72	0.00	0.18	0.01	0.35	0.01	0.40	0.07	0.01	0.09	0.36	0.00
Water service group	Group 1 [295]	-233.71	481.41	0.00	0.22	0.76	0.03	0.57	0.00	-	-	-	0.59	0.00
	Group 2 [705]	-397.27	816.54	0.00	0.18	0.01	0.35	0.01	0.40	0.07	0.01	0.09	0.36	0.00
Sanitation service group	Group 1 [383]	-72.79	167.57	0.00	0.08	0.23	0.37	0.03	0.87	0.56	0.80	0.74	0.18	0.00
	Group 2 [274]	-129.82	281.64	0.00	0.80	0.43	0.40	0.89	0.80	0.13	0.44	0.44	0.72	0.00
	Group 3 [343]	-186.03	394.06	0.00	0.04	0.15	0.89	0.04	0.86	0.39	0.33	0.72	0.34	0.00

Source: SADEP Study Team

Using p values, we have identified the following explanatory variables as having a significant impact on WTP.

WTP for water services:

① The younger the age of the respondent, the higher WTP.

② The higher the monthly income,[15] the higher WTP.

③ The lower the current water usage volume or the shorter the water availability time, the higher WTP. We therefore consider that water supply volume restricted by limited water availability time resulted in the higher WTP.

WTP for sanitation services :

① Lower WTP when the respondent is female.

② The younger the age of the respondent, the higher WTP.

③ The lower the satisfaction with the current sanitation service, the higher WTP. Satisfaction with the water service was not recognized as having a significant impact on WTP for water services, but this was probably because many households are satisfied with alternative sources of water (for example, wells or tank trucks). By contrast, it is difficult to use other means to reduce the degree of dissatisfaction with sanitation services, and this probably resulted in the degree of dissatisfaction being expressed directly as WTP.

④ Higher WTP, if households lack an indoor toilet. On this point, it would seem that installation of a toilet served as a direct image for reflection of the household sanitary environment that would result from connection to sanitation system.

15 It is possible to perform international comparisons of the relationship between monthly income and WTP by calculating the income elasticity of WTP (the rate of increase of WTP for a 1.0% increase of income).

Table 21: Factor analysis of WTP for sanitation service (Weibull regression II-1)

Section	Group (Sample numbers are in parentheses)	Result of model estimation		Factors									
		Log likelihood	AIC	X_1	x_2	x_3	x_4	x_5	x_6	X_7	x_8	x_9	x_{10}
				σ	Gender	Age	Persons in household	Monthly income	Sanitation tariffs	Satisfaction	Water-borne diseases	Indoor toilet	Constant Term
Entire beneficiaries	Entire beneficiaries [1000]	-376.89	771.78	**0.592	*-0.085	-0.034	-0.029	0.065	-0.007	**-0.221	-0.038	**0.167	**2.030
Water service group	Group 1 [295]	-15.74	49.48	**0.291	*-0.319	*-0.267	**-0.385	0.082	-0.140	*-0.316	-0.033	-0.029	**1.760
	Group 2 [705]	-347.42	712.85	**0.608	-0.070	*-0.088	0.050	*0.098	-0.086	-0.027	-0.025	0.006	**2.370
Sanitation service group	Group 1 [383]	-7.14	24.28	*0.262	-	-	-	-	-0.138	-0.050	0.027	-	**2.600
	Group 2 [274]	-141.57	301.14	**0.527	-0.036	-0.062	0.003	0.014	-0.045	-0.048	-0.072	0.018	**2.290
	Group 3 [343]	-221.48	460.97	**0.604	*-0.128	-0.031	-0.032	0.123	0.027	-0.122	-0.009	0.040	**1.820

Source: SADEP Study Team

Table 22: Factor analysis of WTP for sanitation service (Weibull regression II-2)

Section	Group (Sample numbers are in parentheses)	Result of model estimation		Asymptotic t value									
		Log likelihood	AIC	x_1	x_2	x_3	x_4	x_5	X_6	x_7	x_8	x_9	x_{10}
				σ	Gender	Age	Persons in household	Monthly income	Sanitation tariffs	Satisfaction	Water-borne diseases	Indoor toilet	Constant Term
Entire beneficiaries	Entire beneficiaries [1000]	-376.89	771.78	14.60	-2.11	-0.80	-0.64	1.41	-0.17	-5.01	-0.93	4.81	50.00
Water service group	Group 1 [295]	-15.74	49.48	3.10	-2.66	-2.07	-3.32	0.79	-1.22	-2.78	-0.29	-0.65	19.50
	Group 2 [705]	-347.42	712.85	14.10	-1.64	-2.02	1.10	2.02	-1.94	-0.58	-0.56	0.15	55.10
Sanitation service group	Group 1 [383]	-7.14	24.28	2.45	-	-	-	-	-0.71	-0.34	0.24	-	22.30
	Group 2 [274]	-141.57	301.14	9.73	-0.63	-0.94	0.04	0.21	-0.80	-0.77	-1.22	0.27	40.04
	Group 3 [343]	-221.48	460.97	10.01	-2.35	-0.57	-0.50	1.92	-0.48	-1.19	-0.16	0.84	32.80

Source: SADEP Study Team

Table 23: Factor analysis of WTP for sanitation service (Weibull regression II-3)

Section	Group (Sample numbers are in parentheses)	Result of model estimation		p value									
		Log likelihood	AIC	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
				σ	Gender	Age	Persons in household	Monthly income	Sanitation tariffs	Satisfaction	Water-borne diseases	Indoor toilet	Constant Term
Entire beneficiaries	Entire beneficiaries [1000]	-376.89	771.78	0.00	0.03	0.43	0.52	0.16	0.86	0.00	0.35	0.00	0.00
Water service group	Group 1 [295]	-15.74	49.48	0.00	0.01	0.04	0.00	0.43	0.22	0.01	0.77	0.51	0.00
	Group 2 [705]	-347.42	712.85	0.00	0.10	0.04	0.27	0.04	0.05	0.56	0.58	0.88	0.00
Sanitation service group	Group 1 [383]	-7.14	24.28	0.01	-	-	-	-	0.48	0.74	0.81	-	0.00
	Group 2 [274]	-141.57	301.14	0.00	0.53	0.35	0.96	0.83	0.43	0.44	0.22	0.79	0.00
	Group 3 [343]	-221.48	460.97	0.00	0.02	0.57	0.61	0.05	0.63	0.23	0.87	0.40	0.00

Source: SADEP Study Team

(4) Estimation of ATP

While WTP is a maximum amount which beneficiaries are willing to pay for certain hypothetical service, it is difficult to directly use this data as basis of setting its tariff.

Moreover, it is necessary to set water and sanitation tariff at price level that majority of beneficiaries can actually afford because the water and sanitation services is of highly public nature. For that purpose, ATP is frequently referred and used. The ATP is considered as amount, which beneficiaries can pay for certain services, calculated with reference to household income and composition of household expenditures in the service area. There are various methodologies proposed for computing ATP. For example, one is to determine ATP as a certain share of household's disposable income based on past surveys and experiences (The World Bank sets as ceiling benchmark of ATP, 4% for water service, and 1 % for sanitation service of household's disposable income – in total 5% for water and sanitation services.).[16] Another is to compute ATP for

16 JICA (2002)

a certain service by finding out the ranking of the expenditure for the service among various expenditure items, and comparing the expenditure for the service with one-rank-higher and one-rank-lower expenditure items.[17] This study estimated ATP with the following method.[18]

Since 1995 the National Institute of Statistics and Information (INEI: Instituto Nacional de Estadistica e Informatica) has conducted the National Household Survey (ENAHO: Enucuesta Nacional de Hogares) to measure living standards of the people. The 2001 ENAHO results are currently available and was used to estimate ATP. The theoretical rationale for revising tariffs requires a detailed study of beneficiary's ATP, and estimating ATP requires access to detailed breakdowns such as water and sanitation service charges in the ENAHO household data. Water and sanitation charges are included in the Item 2 (Housing) of Table 24, but the breakdonn of the Housing cost is not published. In the data published by ENAHO, that for the Department of Loreto, in which Iquitos is located, most closely approximates the current conditions in Iquitos.

It is generally believed that 5.0% is the ceiling for the ratio of water and sanitation tariffs to total household expenditures. This ratio declines as per capita GDP increases. This is because the share of expenditure on water and sanitation services as Basic Human Needs decreases due to increased income level and change of expenditure structure of households. For example, an appropriate, payable amount for water and sanitation service tariffs in Denmark is 0.8% of household expenditures, while in Pakistan it is 4.5%. Besides, detailed analysis of the nation wide household survey of Panama in this SADEP study slows that the share in Panama was 2.33%. (See Table 25.)

Table 24: Result of household survey in Peru (2001)

Expenditure breakdown	Monthly expenditure (sol)			Composition ratio (%)		
	Peru Average	Lima Average	Department of Loreto Average	Peru Average	Lima Average	Department of Loreto Average
1. Food	533.0	764.0	479.0	42.7	36.3	49.2
2. Housing	271.0	549.0	204.0	21.7	26.1	21.0
3. Transportation/Correspondence	145.0	284.0	94.0	11.6	13.5	9.7
4. Education/Amusement	113.0	238.0	52.0	9.1	11.3	5.3
5. Personal goods	36.0	62.0	35.0	2.9	2.9	3.6
6. Clothing	40.0	49.0	30.0	3.2	2.3	3.1
7. Medical/Drug	50.0	84.0	37.0	4.0	4.0	3.8
8. Household goods	29.0	22.0	17.0	2.3	1.0	1.7
9. Others	30.0	53.0	25.0	2.4	2.5	2.6
Monthly expense total	1247.0	2105.0	973.0	100.0	100.0	100.0

Source: * INEI (2001). Encuesta Nacional de Hogares – Ivtrimetre del 2001

17 JBIC encourage this methodology to be used in the case of sanitation services. This methodology, firstly, acknowledges that there is global commonality in the ranking of various household's expenditure items, regardless income levels and regions. Secondly, it grasps the structure of household's expenditures in a certain area. And, thirdly, it considers to set the expenditure for sanitation services, following: ① food expenditure indispensable in daily life; ② education and medical expenditure useful for poverty eradication in the future; and ③ utility charges (electric and water) necessary in urban life (see Infrastructure Development Institute (2002)). However, in this study, this methodology could not be used because the detailed structure of household's expenditure was not available.

18 In the case of sanitation services, there is a possibility that beneficiaries and users are not necessarily identical. Sanitation services provide benefits of improvement of river environment, not only to nearby residents, but also residents in downstream of the river. However, sanitation charges are shouldered by users connected to sewerage system. In this case, although the benefit of sanitation services can wide spread, the cost needs to be paid by users, who are part of beneficiaries. Therefore, there is a view that cost of sanitation services should be not only from user charges, but also from subsidies (this issue needs to be further elaborated in another study). It should be noted that in the case of Iquitos City the beneficiaries of sanitation services are considered mainly Iquitos citizens because there is no large cities about 50km downstream of the Amazon River. It is considered that, as potential beneficiaries, there are those who think highly of value of bio-diversity of the Amazon River in Peru and from Iquitos in the world. CVM study this time focuses only on Iquitos residents, and therefore, there is possibility that the overall project benefit is underestimated.

Table 25: International comparison of ratio of Water/Sanitation tariffs to Household Expenses

Country	Gross National Income per capita* (USD)	Ratio of Water/Sanitation Tariff to Household Expense
Denmark	31,090	0.8%**
Germany	23,700	1.0%**
Poland	4,240	1.4%**
Estonia	3,810	2.5%**
Panama	3,290	2.33%***
Pakistan	420	4.5%****

Source: *World Development Report 2003
**Report on Water Pricing/Cost Recovery in the Baltic Sea Countries (2002)
***Estimated based on figures by Censos Nationales de Poblacion y Vivienda Resultados Finales 2000 (Panama), Direccion de Estadistica y Censo.
****Pakistan Water Sector Strategy (http://www.waterinfo.net.pk/pwss/vol4j.htm

Table 24, together with World Development Report 2003 (The World Bank), suggests the following:

① Table 24 shows that the average Peruvian household expenditure in 2001 was 1,247 sols, which amounts to an average annual expenditure of 744.4 USD per capita, given that the average family consists of 5.6 persons.

② According to World Development Report 2003, Peru's gross national income per capita in 2001 was 2,000 USD.

③ The CVM survey shows that the average monthly household income in Iquitos City is 852.44 sols = 247.1USD, which amounts to an average annual income per capita of 511.2 USD, given that the average family consists of 5.8 persons.

④ From ①, ② and ③, the gross annual income per capita in Iquitos City is estimated to be 1,374.2USD.

⑤ According to World Development Report 2003, the gross national income per capita and ratio of water and sanitatim tariff to household expense for the six countries (the five countries whose ratio of water and sanitation tariff to household expenditure is already available, plus Panama whose figure is available from the SADEP survey) is as shown in Table 25.

⑥ From ④ and ⑤, it may be estimated that the ratio of water and sanitation tariff against household expenditure in Iquitos City may would fall between 4.5% (Pakistan) and 2.5% (Estonia); given its income level, it is expected to fall between 3.00% and 4.00%. (A more accurate estimate would be possible if the ratio of water and sanitation tariff as compared to household expense, and gross national income per capita of each country are available.)

From these data, we used the following four ratios in estimating ATP.

(i) Ceiling for developing country ATP estimated at 5.00%.

(ii) Estimated maximum ratio for Iquitos city (based on its income level): 4.00%

(iii) Estimated minimum ratio for Iquitos city (based on its income level): 3.00%

(iv) Figures for Panama estimated at 2.33% (based on SADEP survey)

For the total monthly expenditure, the following two figures were used:

(i) Household figures based on ENAHO (973.00 sols/m)

(ii) Estimated monthly average expense, based on a sample of 1,000 households from the CVM survey (852.44 sols/m)

As shown in Table 26, eight ATPs for water and sanitation services were estimated. Considering the city's income level, the ratio of water and sanitation tariffs against household expenses was set at 3.00% to 4.00%, and the figures from the CVM survey were employed as monthly expenses. This resulted in the ATP for water and sanitation service being 18.7 - 24.9 sols/month for water service, and 6.9 - 9.2 sols/month for sanitation service, respectively. Comparison of estimated WTPs and ATPs are shown in Table 27.

Table 26: Estimated Results of ATP

Expenditure Breakdown	*INEI2001				**Monthly spending estimates in this CVM survey			
Applied ratio for water and sanitation service charges	max	Ceiling 1	Ceiling 2	Panama	max	Ceiling 1	Ceiling 2	Panama
Applied Ratio (%)	5.00%	4.00%	3.00%	2.33%	5.00%	4.00%	3.00%	2.33%
1. Food	479.0	479.0	479.0	479.0	-	-	-	-
2. Housing	204.0	204.0	204.0	204.0	-	-	-	-
***Water					31.1	24.9	18.7	14.5
***Sanitation					11.5	9.2	6.9	5.4
Water/Sanitation Subtotal	48.7	38.9	29.2	22.7	42.6	34.1	25.6	19.9
3. Transportation/ Correspondence	94.0	94.0	94.0	94.0	-	-	-	-
4. Education/ Amusement	52.0	52.0	52.0	52.0	-	-	-	-
5. Personal Goods	35.0	35.0	35.0	35.0	-	-	-	-
6. Clothing	30.0	30.0	30.0	30.0	-	-	-	-
7. Medical/Drug	37.0	37.0	37.0	37.0	-	-	-	-
8. Household Goods	17.0	17.0	17.0	17.0	-	-	-	-
9. Others	25.0	25.0	25.0	25.0	-	-	-	-
Monthly Expense Total	973.0	973.0	973.0	973.0	852.44	852.44	852.44	852.44

Notes: * INEI (2001). Encuesta Nacional de Hogares – Ivtrimetre del 2001
**The CVM was implemented in November 2003. It was 2 years after the implementation of the INEI survey in November 2001. Therefore the consumer price in the city of Iquitos during this period was adjusted with the following value: Consumer Price Index=99.15.
***Estimated from the present tariff structure of Water and Sanitation Public Corporation (Water/Sanitation=73.1/26.9)
Source: SADEP Study Team

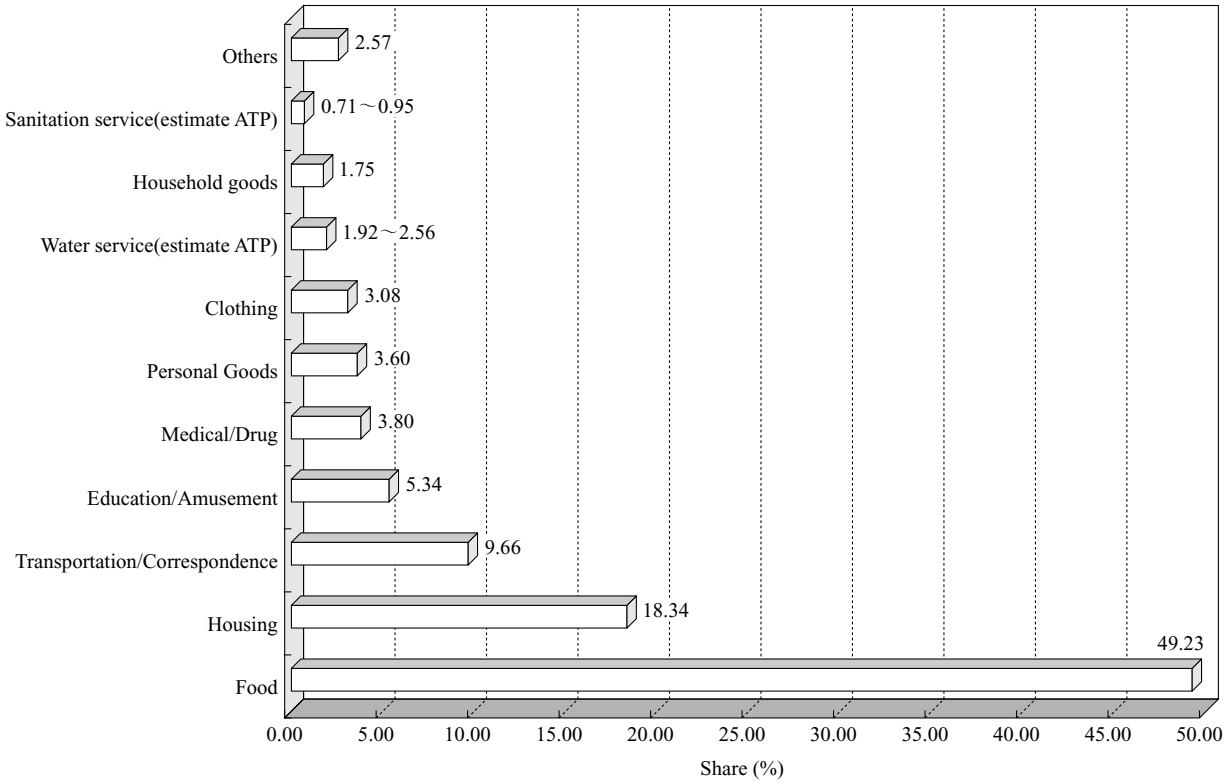
Table 27: Comparison of WTP and ATP

Section	No. of Samples	Total WTP (sols)			ATP (sols)			ATP/Total WTP (%)		
		Water	Sanitation	Total	Water	Sanitation	Total	Water	Sanitation	Total
Total	1,000									
Water	1,000	34.35	15.84	50.19	18.7-24.9	6.9-9.2	25.6-34.1	54.4%-72.5%	43.6%-58.1%	51.0%-67.9%
Group 1	295	24.18	-	-	-	-		-	-	-
Group 2	705	29.61	-	-	-	-		-	-	-
Sanitation	1,000	34.35	15.84	50.19	18.7-24.9	6.9-9.2	25.6-34.1	54.4%-72.5%	43.6%-58.1%	51.0%-67.9%
Group 1	383	-	13.82	-	-	-				
Group 2	274	-	14.97	-	-	-				
Group 3	343	-	11.04	-	-	-				
District	1,000	34.35	15.84	50.19	18.7-24.9	6.9-9.2	25.6-34.1	54.4%-72.5%	43.6%-58.1%	51.0%-67.9%
Belen	251	37.45	18.75	56.20	-	-				
Iquitos	498	32.07	14.48	46.55	-	-				
Punchana	151	34.27	14.57	48.84	-	-				
San Juan	100	38.84	20.70	59.54	-	-				

Note: "Total WTP" is the sum of the current payment and WTP derived from the questionnaire.
Source: SADEP Study Team

In order to verify appropriateness of the estimated ATP for current and potential users of water and sanitation services in Iquitos city, they were then compared with the shares of households expenditure items derived from the INEI survey. The comparison between the estimated ATPs and other household expenses is shown in Figure 5. According to the Figure, if the ATP for water and sanitation services is assumed to be 3.00%-4.00% of the household expenditure, the ATP for water is estimeted at 1.92%-2.56% of the total expenditure and the ATP for sanitation 0.71-0.95%, respectively. Thus, the estimated ATP of for the water falls between clothing expenses (3.08%) and household goods (1.75%), and that of sanitation is positioned below household goods (1.75%), which may be said to be an appropriate level in relation to the other expenditures.

Figure 5: Comparison of Estimated ATP against other Household Expenses



Source: SADEP Study Team (made from INEI 2001 and other materials)

(5) Possibility of changing tariff on the basis of WTP

Table 28 is a comparison between WTP, ATP and current payment for water and sanitation services, and may suggest the following:

① The estimated ATP (water: 18.70-24.90 sols/mouth, sanitation: 6.90-9.20 sols/month) in Iguitos city ranges from between minus 10% to plus 20% of from the current paymeut (water: 20.81 sols/mouth, sanitation: 6.48 sols/month), which may indicate that there is limited room for tariff increase.

② The estimated ATP is well below the total WTP (water: 34.35 sols/m, sanitation: 15.84 sols/m), which shows that the ATP is limted, while Iquitos residents show have relatively high WTP.

③ A tariff increase in the area would require a rise in income and subsequently a rise of the ATP. Moreover, an improvement in the tariff collection ratio could lead to an increase in the potential WTP of currently non-paying users. It should also be noted that in order to increase tariff levels, a reduction of operating costs by reviewing the business processes of the service provider is essential.

Table 28: Comparison between WTP, ATP and current payment for water and sanitation services

Item	*WTP total with price hikes by scenarios [sol/m]*	*ATP (sol/m)*	*Current average monthly payment (sol/m)*
Water charge	34.35	18.70-24.90	20.81
Sanitation charge	15.84	6.90-9.20	6.48
Total	50.19	25.60-34.10	27.29

Source: SADEP Study Team

Chart 4: Conclusion

CVM is a survey based on the consumer theory, using a questionnaire to assess, in moretary terms, “change of utilities from the present time when environment has not undergone improvement, to hypothetical future when environment will have improved”, and to estimate WTP for environment-improving services.

This means that the WTP is the amount expressed by respondents on the basis of a hypothetical scenario, so that the results cannot readily be applied to the actual tariff system of environmental improvement service; but still, the WTP estimated through CVM can provide important basic information for cost-benefit analysis and tariff setting. Governments can use this information for policy-making on water and sanitation services, thereby optimizing resource allocation among various public services.

In ensuring financial sustainability of water and sanitation sactors, it is necessary to have in place an appropriate tariff level, and to ensure a high collection ratio. In order to set appropriate tariff and user charges, sufficient justifications are needed for users and suppliers. The WTP estimated through CVM can be data of demand side (i.e., beneficiaries).

It seems that cost analysis in supply side was emphasized in public projects. But, in order to introduce private sector's management into the projects, it is necessary to set tariff and user changes in due consideration of demand side and market mechanism. CVM can be a tool to realize this approach.

Based on the above, it may be concluded that the CVM is an effective tool to ensure financial sustainability in the government/private/project levels. There is only limited number of large scale CVM surveys in developing countries, while there are many in Europe and the United States. In this study, a survey involving 1,000 samples in Iquitos City was conducted and produced useful outcome. This would be a good effort considering a concrete project, although there are several issues to be studies for actual application to set tariffs (drawing demand carve analysis of supply side and cost-benefit analysis).

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<Appendix> Analysis of results of commercial user survey

In the main part of this paper, the surveyed samples were general household users of water supply and sanitation services in Iquitos City. However, since whole users of the services included commercial users, an additional survey of commercial users was conducted. Most of the commercial users in Iquitos City are self-employed stores, restaurants and other comparatively small-scale users. Large-scale commercial facilities cannot be seen except some hotels. In the tariff of the Water Supply and Sanitation Public Corporation, general household users and commercial users are treated separately. Commercial users must therefore be sampled as a different category.

The 750 samples randomly extracted on a trial basis during the first pre-test included 60 commercial users (8%). Simple random extraction of 1,000 samples may therefore include 80 commercial users (8%). Since 80 samples were insufficient for estimating WTP, it was decided to conduct another survey targeting a minimum of 200 samples and a pre-test for commercial users as well.

(1) Summary of profile of commercial users

Below is a summary of the profile from a sample of 200 commercial users.

-The majority are self-employed in sectors like restaurants and retail. The largest number of employees of a user was 25, with average staffing of 2.9. Most commercial users are very small-scale, owner-operated businesses.

-The largest monthly water consmption volume of a user was approximately 150,000 liters, the average approximately 12,000 liters. The maximum monthly water charge payment of a user was 300 sols, the average 33.9 sols.

-Average water availability time was 11.05 hours, putting commercial users under the same restrictions as general users. Because of this, some businesses used their own wells or other sources to ensure access to water.

-The maximum monthly sanitation charge payment was 100 sols, the average 11.1 sols.

-Among other utility charges, one business reportedly paid a maximum of 2,500 sols per month for electricity.

(2) Estimation of WTP

Rather than using a "choice of two options" format for commercial users, we used a "payment card" format to survey WTP. WTP was estimated as a representative value using ordinary statistical processing. To find the representative WTP value for the sample of 200 commercial users, we calculated an the average value, median value and standard deviation for the entire sample and for the sample after excluding the top 5% of WTP. From these basic statistical values, we selected the median value for the entire sample as the representative WTP value in light of the small number of samples in the commercial user survey and the large fluctuations in the WTP range depending upon the type of business.

The results indicate a representative WTP value for commercial user water services of 20.0 sols per month for businesses in Group 1 (not connected to the water system), and 4.0 sols per month for businesses in Group 2 (already connected). (Table 29)

The representative WTP value for sanitation services was 5.0 sols per month for businesses in Group 1 (not connected to the sanitation system), 1.5 sols per month for Group 2 (connected but receiving incomplete services because of overflows etc.) and 1.5 sols per month for Group 3 (receiving full sanitation services, but willing to pay for improvements of the surrounding environment because of no final treatment for sewage and placing a value on environmental enhancement of the surrounding rivers). (Table 30)

Table 29: Representative WTP estimate for commercial user (Water service)

Item	Statistic score	Entire beneficiaries	Water service group	
			Group 1	Group 2
No. of samples		200	13	187
Entire sample	Average value	5.54	19.62	4.54
	Standard deviation	0.04	0.88	0.03
	95% confidence interval	4.54-6.54	13.39-25.84	3.73-5.35
	Median value	5.00	20.00	4.00
Sample after excluding the top 5% of WTP	Average value	4.45	19.62	3.83
	Standard deviation	0.03	0.88	0.03
	95% confidence interval	3.69 - 5.22	13.39- 25.84	3.14 - 4.63
	Median value	4.50	20.00	0.00

Source: SADEP Study Team

Table 30: Representative WTP estimate for commercial user (Sanitation service)

Item	Statistic score	Entire beneficiaries	Sanitation service group		
			Group 1	Group 2	Group 3
No. of samples		200	18	66	116
Entire sample	Average value	2.26	5.56	2.42	1.66
	Standard deviation	0.01	0.12	0.04	0.01
	95% confidence interval	1.93-2.59	4.54-6.57	1.73-3.12	1.36-1.95
	Median value	2.00	5.00	1.50	1.50
Sample after excluding the top 5% of WTP	Average value	1.91	5.56	2.03	1.51
	Standard deviation	0.01	0.12	0.03	0.01
	95% confidence interval	1.65-2.17	4.54-6.57	1.50-2.56	1.24-1.79
	Median value	2.00	5.00	1.00	1.00

Source: SADEP Study Team