Study of the Tariff Pricing and the Impact of Cross-Subsidy for Water Supply and Sewerage in Bangladesh

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Japan International Cooperation Agency

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Index

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Introduction

1 Objective of the Research

The objective of the study is to analyze the effectiveness and appropriateness of the tariff pricing based on Willingness to Pay and/or Affordability to Pay approach and method of financial management by reviewing the experiences and related information of several cities, and to consider the applicability of such tariff pricing to JICA-funded projects in developing countries including Bangladesh.

In addition, we will organize data on the water and sewerage tariff systems of local governments in Japan and their durability, and analyze data by comparing these systems and service tariff systems in countries targeted by this survey. More specifically, we will analyze the impact of the financial balance of water and sewerage services on the fiscal management of local governments in Japan, the profitability of water and sewerage services of different local governments, the possibility of cost reduction through the self-help efforts of local governments and public-private partnership (PPP), and the possibility of transferring best practices to water and sewerage services in developing countries.

2 Target Country/Region for the Research

The target country/region for this research is Bangladesh. Other than Bangladesh, research on Brazil, Chile, China, Singapore, Malaysia, Thailand, Vietnam, Indonesia, Japan, United Kingdom, France, Germany and United States is included as well to collect related information.

3 Points to be Considered

3.1 Definition of “Affordability To Pay (ATP)”

Affordability to Pay (ATP) method is a relatively new concept and a clear definition of ATP is not determined yet. When analyzing ATP, we consider not only the proportion of each item within the household expenditure, but also the order among expenditure items.

3.2 Selection of Target Cities

Target Cities are as below:

Country	City
Brazil	São Paulo
	Rio de Janeiro
Chile	Santiago
China	Shenzhen
	Xian

Singapore	Singapore
Malaysia	Kuala Lumpur
	Perak
Thailand	Bangkok
	Pattaya
Vietnam	Ho-Chi-Minh City
	Hanoi
	Hue
Indonesia	Jakarta
	Surabaya
	Yogyakarta
Japan	Yokohama
	Miura
United Kingdom	London
	Exeter
Germany	Berlin
	Bonn
France	Paris
	Île-de-France
United States	Washington DC
	Kansas City

Chapter 1 Current Status of the Japanese Water Sector

1.1 Current Situation of Local Public Finance and Water and Sewerage Public Organizations in Japan

This section reviews the current fiscal status of Japanese local governments on water and sewerage organizations. Although self sustainable finances should be the principle under public finances, most of water and sewerage accounts receive fund transfer from local governments to compensate for a part of the operating costs and budget deficits. This chapter analyzes the purpose of the fund transfer and identifies the possibility to reduce the fund transfer by improving management of water and sewerage companies with deficits and resulting in fiscal burden for the local governments.

The overall condition of the local public finance has been deteriorating since 1991. Financial debt has reached 200 trillion yen and financial deficit was 22.2% of local government budget proposals in Fiscal Year 2010.

Transfer of funds from local governments to water and sewerage public organizations has significant impacts on local governments' fiscal status and the fund transfer reached 2.1 trillion yen in FY2008. Especially simplified water and sewerage public organizations are highly dependent on the fund transfer from local governments for their operating revenues. The ratio of fund transfer from local government to operating revenue on simplified water public organizations is 25% and that on sewerage public organizations is 43.4% based on FY2008 data.

A part of the fund transfer can be utilized to fill the budget gap. According to the study results, it is estimated that about 362 billion yen out of 1,405 billion yen of fund transfer offset the budget deficit. Moreover, local governments consider to use Public Private Partnership (PPP) method not only to mitigate fiscal burden for increasing rehabilitation needs but also to ,maintain and inherit proper technology, and improve management of utilities.

1.2 Disparity among Local Governments from a Management Perspective

This section reviews the impact of the performance of water and sewerage organizations on the fiscal condition of local governments by analyzing required fund transfer from local governments. In addition, local governments are categorized by the number of population and the age of assets, in order to identify the disparity among water and sewerage organizations on dependence on fund transfer and the possibility for management improvements.

- Disparity among water public organizations

  The Study Team reviewed 2,216 organizations and analyzed dependency on fund transfer from local governments and the feature.

  - Total revenue: Smaller organizations tend to be more reliant on fund transfer from local governments.
  - Profitability: Smaller organizations tend to be more reliant on fund transfer from local governments.
  - Feature of fund transfer from local governments
    - Population size: Organizations which have a smaller population of service recipients tend to be more reliant on fund transfer from local governments.
    - Service period: Ratio of fund transfer from local governments to revenue shows a declining trend from the beginning of the service up to year 50. The ratio increases during year 51-60 for the rehabilitation investment, and declines again after year 61.
    - Tariff level: Organizations which collect higher tariff tend to be more reliant on fund transfer from local governments.

- Disparity among sewerage public organizations

  The Study Team reviewed 1,909 organizations and analyzed dependency on fund transfer from local governments and the feature.

  - Total revenue: Smaller organizations tend to be more reliant on fund transfer from local governments.
  - Profitability: Smaller organizations tend to be more reliant on fund transfer from local governments.
  - Feature of fund transfer from local governments
    - Population size: Organizations which have a smaller population of service recipients tend to more reliant on fund transfer from local governments.
    - Service period: New organizations tend to be more reliant on fund transfer from local governments.
    - Tariff level: Organizations which collect higher tariff tend to be more reliant on fund transfer from local governments.

- Impact of fund transfer to water and sewerage public organizations on local public finances

Based on the above analysis, the Study Team identified the benchmark of conditions that increases impacts of fund transfer to water and sewerage public organizations on local public finance as follows:

Table Benchmark that increases the impact of fund transfer

	Water public organizations	Sewerage public organizations
Population size	Less than 50,000	Less than 20,000
Tariff level	More than 1,500 yen (per 10 m3)	More than 2,700 yen (per 20 m3)

Source: Study Team

1.3 Possibility of Cost Reduction by Improving Operation and Maintenance (O&M)

Possibility of cost reduction in O&M is identified by defining a benchmark based on performance of Japanese utilities.

- Water public organizations

  The Study Team reviewed O&M cost and analyzed the possibility of a cost reduction by using the benchmarking system method.

  - Cost composition: O&M cost for organizations which have water treatment plants is 98.2 yen/m^3. O&M cost for organizations which do not have water treatment plants is 125.2 yen/m^3, and the main factor for the cost increase is the cost for receiving water from other organizations.
  - Overall tendency on O&M cost
    - Annual water supply amount: When the water supply amount is less than 500,000 m^3, O&M cost increased sharply.
    - Plant utilization ratio: When the plant utilization ratio is less than 50% or more than 91%, O&M cost increased relatively.
    - Water source: O&M cost is divided into three groups: receiving water from other organizations (highest), surface water stream (middle), and ground water (lowest).
    - Penetration rate: When the penetration rate is less than 95%, O&M cost increased relatively.
  - Identifying best practices

    The Study Team divided the organizations into three groups; the water receiving group, the surface water stream group, and the ground water group. The groups were then ordered by O&M cost, from lowest to highest. The Study Team identified the organizations with lowest 25% of O&M costs as better than best practice, i.e. the organization with the highest level of O&M costs among them is considered as the best practice; and the organizations with highest 25% of O&M costs as worse than worst practice, i.e. the organization with the lowest level of O&M costs among them is considered to be the worst practice.

- ✧ Water receiving group:
  Best practice: 95.6 yen/m3
  Worst practice: 134.6 yen/m3
- ✧ Surface water stream group:
  Best practice: 61.5 yen/m3
  Worst practice: 98.1 yen/m3
- ✧ Ground water group:
  Best practice: 48.6 yen/m3
  Worst practice: 78.1 yen/m3

- ➢ O&M cost reduction through self-help efforts
  The Study Team estimated possible O&M cost reductions through improving the plant utilization ratio as follows:

Table O&M cost reductions through self-help efforts

	Plant utilization ratio is less than 50% or more than 91%	Plant utilization ratio is 51-90%
Mean O&M cost	90.7 yen /m3	75.0 yen /m3

Source from Study Team

- ➢ Formulating indicators from best practices
  The Study Team formulated performance indicators based on the unit input amount of human resource and material of the organization identified as the best practice.

Table Benchmark that increases the impact of fund transfer

Input Item	Water receiving group	Surface water stream group	Ground water group:
Human resource (person/million m^3)	1.74	2.62	1.65
Power consumption (Wh/m^3)	421.15	272.63	475.19
Sodium hypochlorite (g/m^3)	20.85	3.34	3.87
Polyaluminum chloride (g/m^3)	10.26	18.65	

- Sewerage public organizations
  - ➢ Cost composition: O&M cost for the sewerage treatment plants without connection to the river basin is 35.8 yen/m^3.

- General trend on the O&M cost
  - ✧ Annual water supply amount: When the water supply amount is less than 100,000 m^3, O&M cost increased sharply.
  - ✧ Maximum operation rate (fair weather): O&M cost is divided into three groups: operating rate of less than 30% (low operation group), operating rate of 31-50% (middle operation group), operating rate of more than 51% (high operation group).
  - ✧ Penetration rate: When the penetration rate is less than 5%, the O&M cost increased sharply.
- Identifying best practices

  The Study Team divided the organizations into two groups; the middle operation group and the high operation group. The groups were then ordered from the lowest to the highest O&M cost organizations. The Study Team identified the organizations with lowest 25% of O&M costs as better than best practice, i.e. the organization with the highest level of O&M costs among them is considered as the best practice; and organizations with highest 25% of O&M costs as worse than worst practice, i.e. the organization with the lowest level of O&M costs among them is considered to be the worst practice.
  - ✧ Middle operation group:

    Best practice: 94.7 yen/m^3

    Worst practice: 177.5 yen/m^3
  - ✧ High operation group:

    Best practice: 68.2 yen/m^3

    Worst practice: 131.4 yen/m^3

- O&M cost reduction through self-help efforts

  The Study Team estimated possible O&M cost reductions through improving the plant utilization ratio as follows:

Table O&M cost reduction through self-help efforts

	Low operation group	Middle operation group	High operation group
Mean O&M cost	247.0 yen/m^3	139.5 yen/m^3	82.8 yen/m^3

Source from Study Team

- Formulating indicators from best practices

  The Study Team formulated performance indicators based on the unit input amount of human resource and material of organization identified as the best practice.
  - ✧ Middle operation group:

Human resource: 2.15 person/million m^3 for O&M

Power consumption: 0.86 Wh/m^3

Solid chlorine: 3.22 g/m^3

- ✧ High operation group:

Human resource: 7.43 person/million m^3 for the whole organization

Power consumption: 0.91 Wh/m^3

Trichloroisocyanuric acid: 0.99 g/m^3

Chapter 2: An Appropriate Level of Water and Sewerage Tariffs for Users

2.1 Case Study on Full-cost Recovery

The term “full-cost recovery” means securing funding for all project expenses by the income earned from the project with the burden of beneficiaries, without government subsidy. In the early 1990’s, it was generally understood for the power sector that setting out a tariff to recover all project costs, including maintenance, management, and operation, is appropriate. For the water sector, the same concept was introduced to relieve fiscal burden and achieve financial soundness of the water sector. For this reason, since the 1990’s, there have been many cases of loans provided by international organizations such as the IMF and the World Bank with the conditionality that water tariffs must be increased to the level at which the entire costs of the water projects can be recovered. However, a close look at the status of cost recovery in the water sector by Global Water Intelligence revealed that operational and maintenance (O&M) costs and part of capital investment were recovered in only 50% of water projects even in high-income countries. This percentage drops to between 22 to 39% in medium-income countries, which clearly indicates that it is difficult to set water tariffs at which all project costs can be recovered.

Table Percentage of Projects for which Costs can be Fully Recovered at Average Water Tariffs

	O&M costs are unrecoverable	O&M costs are recoverable	O&M costs and a part of capital investment are recoverable
High-income countries	8	42	50
Upper medium-income countries	39	22	39
Lower medium-income countries	37	41	22
Low-income countries	89	9	3
World average	39	30	30

Source: Komives et al. (2005)

2.2 Examples of Adoption of Willingness to Pay Method

As awareness increases on the limitations of setting water and sewerage tariffs that enable full cost recovery, economic costs and benefits to society as a whole regarding water and sewerage projects has been more emphasized. As a result, the method of setting water and sewerage tariffs

based on consumers' willingness to pay (WTP) has begun to be considered. The following section discusses past cases that adopted the WTP method.

2.2.1 Overview of Projects Adopting WTP

During the period when international financial institutions carried out structural adjustment lending, finances were often provided with the conditionality on the privatization of water and sewerage utilities or water and sewerage tariff increases mainly in Central and South America. We then reviewed some projects financed by the World Bank carried out in Central and South America since the late 1980's, and found that of those projects that were financed on the condition of a tariff increase, few projects (one in Venezuela to be exact) verify that the new tariffs were within the range of consumers' willingness to pay.

The WTP method was mostly used to calculate economic benefits in economic analysis after confirming the WTP amount based on the WTP survey.

2.3 Setting Appropriate Tariffs Using Cross-Subsidies and Considering Affordability to Pay

Although achieving full cost recovery is a target in the long run, it may not be easy and preferable to set tariffs at a level which all project costs can be recovered in the short run. The concept of sustainable cost recovery[1] has been introduced. In order to achieve sustainable cost recovery, it is considered necessary that the tariffs paid by users be set by taking "affordability to pay (ATP)" into consideration. If costs and future investment cannot be recovered by tariff revenues, it is necessary to consider cost recovery within the project income as much as possible using the cross-subsidy scheme. Then, if there is still a shortage of revenue, the setting of a subsidy would be necessary.

2.3.1 Overview of the Discussion Relating to Appropriate Tariff Setting by Considering Affordability to Pay

The adjustment of tariffs requires a long-term perspective, and the need for a gradual implementation of such an adjustment has begun to be recognized. In these circumstances, tariff setting taking low-income groups' affordability to pay into consideration and a subsidy policy for low-income consumers have come to be emphasized. This has shifted the focus of attention from the pursuit of efficient financing during the 1990's to more effective subsidy setting.

The setting of a social tariff for vulnerable people does not always conflict with the securing of financial continuity, and it is considered possible that cross-subsidies, taxes, or other subsidy schemes including governmental subsidies will be available.

[1] Winpenny, J., 2003. "Financing Water for All," World Panel on Financing Water Infrastructure, France

(1) The Concept of Affordability to Pay

Affordability can be estimated by comparing the consumer's ability to pay based on his/her disposable income, household expenditure, and additional spending for other indispensable services (electricity, etc.) and the amount of his/her water and sewerage tariff payments. There are two ways of estimating affordability: an affordable amount on the macro level (which is developed by relating national average household water charges to the average national household income or expenditure) and an affordable amount on the micro level (which is obtained by calculating the amount affordable to specific group members including individuals with low incomes and the socially vulnerable). In this survey, we have set ATP-based tariffs in accordance with the circumstances in target cities within the survey, by focusing not only on the proportion (percentage) of total household income and expenditure but also on the order of spending items and using the idea of what amount of spending items would be considered affordable.

2.3.2 Overview of the Discussion Relating to Appropriate Tariff Setting by Using Cross-subsidies

In the cross-subsidy scheme, different tariffs are set for each user and area and the income from each user (area) is cross-subsidized, thereby adjusting the overall profitability of the project. In general, there are many cases where minor users are subsidized by major users by way of setting a unit price that is higher than cost for major users and a unit price that is lower than cost for minor users. However, there are other complementary methods as follows.

- Industrial users, commercial users, household users, etc. (classification by purpose)
- High-income users, low-income users (classification by income level)
- Major users and minor users (classification by user scale)

2.4 Tariff Structure in Various Countries

2.4.1 Overview of Tap Water and Sewerage Tariff Structure in Various Countries

(1) Overview of Tariff Structure

The main water and sewerage tariff structures are summarized from the perspective of affordability to consumers and cost recovery in the following table.

Table Characteristics of Water and Sewerage Tariff Systems

Tariff system	Cost recovery perspective	ATP perspective
Fixed Charge	A stable cash flow can be obtained but this cannot reflect changes in demand	If an appropriate tariff is set according to consumers' ability to pay, ATP can be ensured, though the water tariff cannot be lowered if the user reduces water usage.

Uniform Volumetric Charge	Cash flow that appropriately reflects changes in demand can be obtained	If an appropriate tariff is set according to consumers' ability to pay, ATP can be ensured, and control of water-related spending can also be achieved.
Increasing Block Tariff	If an appropriate tariff block can be set, highly efficient cash flow can be obtained	The tariffs borne by large poor families or communities whose level of usage is likely to be large will be significant.
Decreasing Block Tariff	If an appropriate tariff block can be set, highly efficient cash flow can be obtained	The tariffs borne by small poor families who use a small amount of water will be significant.

Source: PPIAF “Water Tariffs & Subsidies in South Asia”(2002)

2.4.2 Water and Sewerage Tariff Structures in the Cities Surveyed, the Industry Cost Recovery Situation and the current status of cross-subsidies

(1) Outline

1) Outline of the Water and Sewerage Tariff Review

The water and sewerage tariffs of each country and city are classified into the following categories.

A: Fixed Charge (Fixed tariffs only, no metered tariffs)

B: Volumetric Charge (a - Uniform Volumetric Charge; b - Increasing Block Tariff; c - Decreasing Block Tariff)

C: Other (for example, tariffs based on real estate values)

In principle, the monthly fixed and volumetric charges (or those that conform to metered tariffs) are reviewed. Connection charges incurred when connecting were outside the scope of this review.

2) Outline of the industry cost recovery situation

When analyzing the level of cost recovery in each country, the following two cases were examined based on mostly financial statements (such as profit and loss statements) of the applicable water authorities.

a) Study into the recovery rate of OPEX (O&M fees) from tariff revenues

b) Study into the recovery rate of the total of OPEX and CAPEX (capital expenditures) from tariff revenues

The items included in the tariff revenues, OPEX and CAPEX using profit and loss statements as a base in each of the reveiw in a) and b) are listed below.

	Items included in the study of a)	Items not included in the study of a), but included in the study of b)	Items excluded from both the study of a) and b)
Items included in earnings on profit and loss statements (equivalent to tariff revenues)	Water tariff revenues		Connection charges, grants and other revenue
Items included in expenses on profit and loss statements (equivalent to OPEX/CAPEX)	(Corresponding to OPEX) Labor costs, commission fees, electricity expenses, water supply costs, medicine costs, sales administrative expenses, transportation costs	(Corresponding to CAPEX) Depreciation costs, interest rates	Other expenditures

Table Summary of items included in each study

3) Outline of the Cross-Subsidy study

Through the procedure described below, a study was conducted on cross-subsidies in water and sewerage organizations in each city.

a) Cross-subsidies by differences in scale

We determined whether cross-subsidies would function according to differences in scale for each water tariff category. In particular, cross-subsidies works from large-scale users to small-scale users under the increasing block tariff. Fundamentally, the scope of the study included volumetric charges (or those that conform to metered tariffs). Fixed charges on a pipe-diameter basis on a monthly basis were considered to the extent possible.

b) Cross-subsidies by differences in usage

Cross subsidies among each water tariff category were reviewed.

A. Comparison by billing-type-specific tariff

The Study Team reviewed how the cross-subsidy functions between categories by comparing the unit price of the average water usage in each water tariff category. To compare the countries as being in the same tier, the average water usage is based on the figures of Yokohama city in fiscal 2009. According to the statistics of Yokohama city in fiscal 2009, average household water usage is 15 ㎥/month (*[2]) and average commercial water usage is 107 ㎥/month. The unit prices with respect to these figures, including similar categories, were calculated.

As with the cross-subsidy investigation by scale, the connection charge for water equipment connection and the monthly fixed charges on a pipe-diameter basis were included in the scope of review to the extent possible.

*2 Refer to page 72 in “Overview of Water Service in Yokohama City 2010”
http://www.city.yokohama.jp/me/suidou/kyoku/suidoujigyo/pdf/5-syou.pdf

B. Comparison with consideration to sales volume and revenue

The revenue per chargeable water volume of 1 ㎥ can be calculated from the data of chargeable water volume and revenue. Where the chargeable water volume and revenue for each category are available in the public domain, the revenue per chargeable water volume of 1 ㎥ for each category was calculated and the obtained revenue with the average value was compared to see whether each category is receiving cross-subsidy. Where the chargeable water volume and revenue for each category are not available in the public domain, though it may not be a directly investigated figure, the cross-subsidy was analyzed by comparing the price in the price list with the revenue per average chargeable water volume of 1 ㎥.

(2) Japan—Yokohama City

1) Water and sewerage tariff structure

a) Overview of water tariff structure

In the water and sewerage tariff system of Yokohama city, water tariff is separated into household and commercial segments, while sewerage employs the same system for both household and commercial segments. In both water and sewerage, the progressive metered-rate structure is used except for the first block in which a base price is applied.

Although Japan's municipalities assess water tariffs on their own ways, the common practice is to refer to the multiple cost system for water price assessment.

Number of water supply categories: 2	Category	Household	Commercial
	Metered tariff	B-b (A fixed charge is charged as a base charge. The base charge is not charged on an progressive basis.)	
	Other tariff systems	An activation charge is required to begin service.	
	Charging of minimum required fee	Charged (Minimum usage charged according to the pipe diameter registered in the meter)	
Number of sewerage categories: 1	Category		
	Metered tariff	B-b (A fixed charge is charged as a base charge. The base charge is not charged on an progressive basis.)	
Industrial use water	Metered tariff	B-a (special charge)	
* Legend for metered tariff: A: Fixed charge (Fixed charge only. No metered charge) B: Volumetric Charge (a - Uniform Volumetric Charge; b - Increasing Block Tariff; c - Decreasing Block Tariff) C: Other (Tariff based on real-estate values, etc.)			

Table Overview of Yokohama City's Water Tariff Structure

b) Water Tariff

As shown in the table below, water tariff is separated into household and commercial segments. The water tariff for commercial is applied when the usage of water is 201 ㎥ or more over a two-month period. Within the 201-600 ㎥ usage range, the unit price per ㎥ for household and commercial segments are the same. Where the usage exceeds 600 ㎥, the

unit price per ㎥ for commercial water exceeds that for household water. A minimum usage level according to the pipe diameter is set so that a fixed charge can be charged even when this minimum usage is not reached.

Category		tariff
Household	(usage)	
	0-16 ㎥	1,580 yen (base tariff)
	17-20 ㎥	43 yen x Amount + 892 yen
	21-40 ㎥	158 yen x Amount - 1,408 yen
	41-60 ㎥	226 yen x Amount - 4,128 yen
	61-100 ㎥	269 yen x Amount - 6,708 yen
	101-200 ㎥	293 yen x Amount - 9,108 yen
	201 m^2 or more	320 yen x Amount - 14,508 yen
Commercial	(usage)	
	201–600 ㎥	320 yen x Amount - 7,254 yen
	601–2,000 ㎥	369 yen x Amount - 21,954 yen
	2,001 ㎥ or more	409 yen x Amount - 61,954 yen

Table Yokohama City Water Tariff (two months)

Source: Yokohama City website *[3]

c) Sewerage Tariff

In sewerage tariff, the same tariff structure is employed in both household and commercial segments. As with the case of the supply of water, the water tariff goes up on a constant progressive basis according to the increase in water usage. As with the supply of water, a minimum usage according to the pipe diameter is set, and a fixed fee is charged even when this minimum usage is not reached.

Category (household and commercial)	Tariff
0-16 ㎥	1,260 yen（base tariff）
17-20 ㎥	20 yen x Amount + 940 yen
21-40 ㎥	118 yen x Amount - 1,020 yen
41-60 ㎥	173 yen x Amount - 3,220 yen
61-100 ㎥	234 yen x Amount - 6,880 yen
101-200 ㎥	264 yen x Amount - 9,880 yen
201-400 ㎥	299 yen x Amount - 16,880 yen
401-1,000 ㎥	341 yen x Amount - 33,680 yen
1,001-2,000 ㎥	389 yen x Amount - 81,680 yen
2,001-4,000 ㎥	416 yen x Amount - 135,680 yen
4,001-㎥	472 yen x Amount - 359,680 yen

Table Yokohama City Sewerage Tariff (two-month period)

Source: Yokohama City website *[4]

2) Business cost recovery from water tariff revenue

The statistics of Yokohama City (fiscal 2008 and 2009) publicly report the account balance of household and commercial water and sewerage. According to these statistics, the revenue from water tariffs exceeds the cost required for sales and achieves the OPEX Cost-Recovery in each

*[3] http://www.city.yokohama.jp/me/suidou/os/ryokin/sikumi.html
*[4] http://www.city.yokohama.jp/me/suidou/os/ryokin/sikumi.html

segment in the water supply service. However, if the cost of depreciation, asset depletion and financing (interest payments and bond management expenses) are subtracted from the water tariff revenue, the balances of both 2008 and 2009 are in deficit, and the CAPEX Cost-Recovery is not achieved.

The sewerage business, which is managed under non-consolidated accounting, stays in surplus when the applicable OPEX cost is subtracted from the sewerage supply earnings; however, it turns into deficit when the applicable CAPEX cost is subtracted. The cost of depreciation, which comprises a particularly large portion, cannot be fully covered by the revenue from water tariffs and thereby is appropriated by the subsidy.

3) Cross-subsidy study

a) Cross-subsidy by usage size

In the water tariff for the household segment, the unit price per ㎥ is cheapest, approximately 88 yen, when the usage of water for two months is 20 ㎥. When the usage of water is greater than 20 ㎥, the unit price per ㎥ increases as the usage of water increases. As a result, the households using near to 20 ㎥ of water absorb other households' cross-subsidy. As clearly shown also in the excerpt from the Yokohama City document below, we can see the tariff revision in April 2001 was a step toward decreasing the cross-subsidy on a usage-size basis from the perspective of reducing consumer feelings of unfairness amid the overall trend of the decreasing average water usage.

> "The tariff structure employed is a so-called progressive tariff structure in which the price tariffd for a basic level of water usage is low and the prices charged for the larger usage layers are high. The proportion of water usage moves from the commercial segment to the household segment. At the same time, however, the average water usage per user becomes smaller both in the commercial and household segments.
>
> Responding to these circumstances in which the number of small-usage users are increasing, the tariff revision in April 2001 reduced the degree of progressive (the magnification obtained by dividing the excess fee's highest unit price by the base tariff's unit price per ㎥) from 5.2 times to 4.1 times to establish payment fairness between large usage and small usage users."

b) Cross-subsidy by use purpose

A. Comparison by billing-type-specific price

Water tariff in Yokohama City is divided into three segments: household, commercial and industrial types. The statistics on Yokohama City in fiscal 2009 show that the average household water usage was 15 ㎥/month (*[5]) and the average commercial water usage was 107 ㎥/month. In the investigation, these values were used as the standard water usage to calculate the unit prices of water per ㎥. The differences seen in the unit price lists also indicate that the cross-subsidy is functioning.

*[5] Refer to page 72 in "Overview of Water Service in Yokohama City 2010"
http://www.city.yokohama.jp/me/suidou/kyoku/suidoujigyo/pdf/5-syou.pdf

<Water supply>

Group	Average water usage (Unit: yen)	Unit price at Average water usage per ㎥ (Unit: yen)	Unit price of standard usage of each type when the unit price of the standard household usage is 1
Household (15 ㎥ /month)	1,666	111	1.00
Commercial (107 ㎥ /month)	26,986	126	1.14

Table　Unit Price of Yokohama City Water Supply by Use Purpose

<Sewerage>

Group	Average water usage (Unit: yen)	Unit price at average waterusage per ㎥ (Unit: yen/㎥)	Unit price of standard usage of each type when the unit price of the standard household usage is 1
Household (15 ㎥ /month)	1,260	84	1.00
Commercial (107 ㎥ /month)	23,553	220	2.62

Table　Unit Price of Yokohama City Sewerage by Use Purpose

B. Comparison with consideration to sales volume and revenue

As shown in the table below, the annual subscription amount per chargeable water volume of 1 ㎥, which is the overall average, is positioned in the middle of that of household water and that of commercial water. From this fact as well, we can see the cross-subsidy diverted from commercial to household water is working.

Group	Annual subscription (Unit: yen)	Chargeable water volume (Unit: ㎥)	Annual subscription per chargeable water volume of 1 ㎥ (Unit: yen/㎥)
Household	45,649,776,042	314,306,327	145.24
Total *Excluding industrial water	74,614,144,769	399,899,814	186.58
Commercial	28,914,817,125	84,484,789	342.25

（Note 1）　The table includes public bath water usage because it is contained in the statistics despite its minimal level

（Note 2）　Settled amount in fiscal 2008

（Note 3）　Actual usage in fiscal 2008

Table　Cross-Subsidy in Yokohama City (water supply)

From both aspects of the price list and from the study of revenue and sales volume, it has been clarified that the cross-subsidy diverted from commercial to household water is working both in water and sewerage services. From the excerpt from the Yokohama City document shown below*[6] too, we can see that cost recovery achievement was pursued also as a policy with cross-subsidy between commercial and household use water.

*6 2010 Yokohama City Water Service Overview: Chapter 5 “Water Service Tariffs in Yokohama City”

"Yokohama's current water tariff structure employs a specific tariff structure for each use, whether for household, commercial or public bath use. This structure focuses on the use purpose, taking a stance of placing importance on the users' burdens according to each use group. From this viewpoint, a disparity in burden is introduced depending on the use, and a particular consideration is paid as a policy to household water, which is water for living, so that insufficiencies caused by the low prices tariffd for household water can be recovered from commercial water. Thanks to this mechanism, the entire revenue and expenditure can be balanced."

(3) Vietnam: Ho Chi Minh

1) Summary

In Vietnam, setting separate service tariffs requires the approval of the People's Committees of the respective cities. People's Committees ask for comments on service tariffs from the People's Council, which represents the public at large.

Vietnam also adopted a nation-wide policy about water tariffs in the Circular 95/2009. The details of the policy are as follows:

1. Principles

- The price of tap water should be determined based on costs.
- If an increase (decrease) in manufacturing costs leads to an increase (decrease) of 15% or more in the retail price, related institutions must adjust the water price by reasonable measures.

2. How to set water tariffs

Water tariffs are calculated in the following way for service tariff categories shown in the table below. Progressive metered-rate structure are applied to households.

- Total costs = Material costs + Personnel costs + General manufacturing costs + General management costs + Sales costs
- Average costs = Total costs / Sales volume (Sales volume = Total amount – Non-tariffable water volume)
- Average water tariff = Average costs + Appropriate profit (determined by People's Committees in accordance with local conditions)
- Retail price = Average water tariff × Ratio

Category	Water usage	Ratio to the average service rate
General households	10 m^3 or less	0.8
	10 - 20 m^3	1.0
	20 - 30 m^3	1.2
	30 m^3 or more	2.0
Government institutions		1.2
State-run companies		1.2

Public facilities		1.0
Industrial facilities		1.5
Business/service/commercial facilities		3.0
Average		1.0

Since service tariffs are determined based on this decree in Vietnam, the structures of service tariffs are similar in many cities.

In accordance with the above principles, Ho Chi Minh City makes a distinction between four water and sewerage service tariff categories: households; industrial facilities; government institutions; and business facilities. Progressive metered-rate structure is applied to water and sewerage services for households and basic metered-rate structure to services for the other three categories. Sewerage tariffs are calculated by multiplying the amount of water supply by tariff rates and levied as environmental protection fees.

Number of water service categories: 4	Category	Households	Industrial facilities	Government institutions	Business facilities
	Metered tariff	B-b	B-a		
Number of sewerage service categories: 4	Category	Households	Industrial facilities	Government institutions	Business facilities
	Metered tariff	B-b	B-a		
Legends for metered tariffs: A: Fixed tariff (Fixed charge only. No metered tariff) B: Volumetric Charge (a - Uniform Volumetric Charge; b - Increasing Block Tariff; c - Decreasing Block Tariff) C: Other (Tariff based on real-estate values, etc.)					

Table **:** Summary of Water Tariffs in Ho Chi Minh City

a) Water tariffs

There are three water tariff categories for households. In Ho Chi Minh City, water tariffs are levied based on a progressive metered-rate structure per person rather than per houshold. Although water meters are allocated to households, the numbers of persons who live in each household is registered. We were told that calculations are easy due to these circumstances. In order to promote the efficient use of water resources and eliminate waste, Ho Chi Minh City has adopted a progressive metered-rate structure. In order to promote industries, water tariffs for industrial use are kept low. No connection charges are levied (*[7]).

Category		Unit price per cubic meter (including tax; unit: VND/ m^3)
Households	(Consumption per person)	
	0 - 4 m^3	4,000
	4 - 6 m^3	7,500
	6 m^3 or more	10,000
Industrial facilities		6,700

*[7] Based on Decree 117, 2007. We received comments from water corporations that Ho Chi Minh City is the only city that does not levy connection fees at present.

Government institutions	7,100
Business facilities	12,000

Table : Water Service Tariffs in Ho Chi Minh City (Unit Tariff per Cubic Meter by Category)

b) Sewerage tariffs

Sewerage tariffs are calculated by multiplying water tariffs by a tariff rate and levied as environmental protection fees. For each category, pre-tax water tariffs multiplied by the tariff rate (10%) are levied as environmental protection fees. In addition, a fixed amount of tariffs per cubic meter of water consumed is levied from all categories as forest protection fees.

Category		Environmental protection Unit tariff per m^3 (including tax: unit: VND/m^3)	Forest protection Unit price per m^3 (including tax: unit: VND/ m^3)
Households	(Consumption per person)		40
	0 - 4 m^3	400	
	4 - 6 m^3	750	
	6 m^3 or more	1,000	
Industrial facilities		670	
Government institutions		710	
Business facilities		1,200	

Table : Sewerage Service Tariffs in Ho Chi Minh City

2) Service cost recovery by service tariff revenue

According to interviews with the Ho Chi Minh City Water Corporation, the corporation's average revenue is 6,413 VND/m^3 (after the tariff rate revision in 2010), while its average manufacturing cost is 6,700 VND/m^3, which indicates that 96% of its costs are covered by its revenue. However, in order to make up for costs that could not be recovered during the inflation of 2007, maintenance costs for some of the large facilities are covered by government funds and the corporation has not yet achieved full recovery of its costs, including CAPEX.

3) Cross-subsidies in cities targeted by the survey

a. Cross-subsidies by size

There are three subsidy categories for water tariffs for general households, depending on the amount of consumption. The unit price per cubic meter is the lowest (4,000 VND) for households whose water consumption is 4 m^3 or less per person. Cross-subsidies occur from households with large water consumption per person to those with small water consumption. In other service tariff categories, the unit price is the same in each category, without cross-subsidies between different groups.

b. Cross-subsidies by usage

b-1 Comparison by service tariff category

In Ho Chi Minh City, there are four different service tariff categories: households, government institutions, industrial facilities and business facilities. Since water tariffs are set low for general households and industrial facilities and high for business facilities, cross-subsidies occur from the latter to the former categories. The following table shows data for fiscal 2009. Service tariffs for households and industrial facilities are 0.9 times the average unit price, and tariffs for business facilities 1.6 times the average price. Tariffs for industrial facilities are set low in order to attract industries, while tariffs for business facilities are set high. Nevertheless, we have been told that there is no dissatisfaction among business facility users. Tariffs set at relatively high levels are accepted by business facilities and hotels probably because they are able to shift these water service tariffs to tenants and customers.

(4) Indonesia: Jakarta

① Summary

1) Water and sewerage service providers

In indonesia, water and sewerage service providers differ greatly between Jakarta and areas other than Jakarta. Concessions are available in Jakarta and water supply services are provided in West Jakarta by PALYJA, which belongs to the SUEZ company group, and in East Jakarta by PAM JAYA. Sewerage services are provided by PD PAL JAYA.

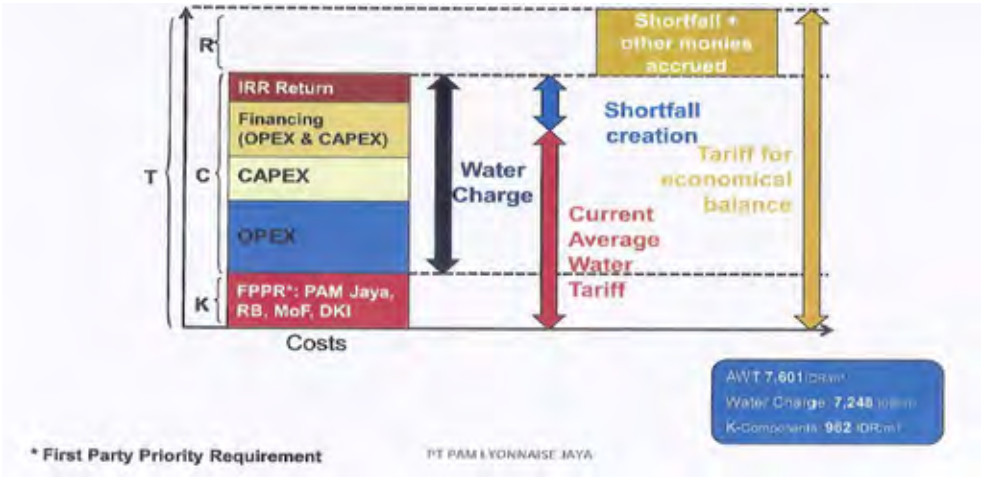
In areas other than Jakarta, all water and sewerage services are operated under the jurisdiction of municipal and prefectural public water corporations (PDAM) as a result of decentralization of power. Tariffs levied by PDAM are determined based on the Ministry of Home Affairs Decree No. 23/2006, whose Chapters 9 and 10 distinguish between the following four categories for the setting of tariffs levied by PDAM and allow setting tariffs that do not ensure full cost recovery.

Table 3. The tariff for each PDAM subscriber group.

Consumer classification	Minimum daily basic need consumption of 10 m^3/month	>10 m^3/month
Group 1	Subsidised tariff	Break-even tariff
Group 2	Break-even tariff	Full-cost tariff
Group 3	Full-cost tariff	Full-cost tariff
Special group	Based on agreement	Based on agreement

Source: Ministry of Home Affairs Decree No. 23 of 2006 Article 9 and 10.

In Jakarta, there is a regulating organization (Badan Regulator PAM DKI), which determines tariffs as shown in the following figure. Water tariffs are set at the level where CN + K (PAM + DEPKEU + PAD + BR) + R is covered, where Cn (C) represents water tariffs, K the First Party Primary Requirement (FPPR) and R the reserve account.



In Jakarta, water tariff categories are divided into detailed sub-categories depending on the nature of facilities. There are seven categories at present. Facilities included in each category will be described later. Basic or progressive metered-rate structure are imposed on different categories.

There are five major categories (households, small business facilities, large business facilities, public facilities and industrial facilities) for sewerage tariffs, and each category is further divided into sub-categories depending on usage. Metered tariffs and connection tariffs are levied, both on a basic metered-rate structure except for some connection tariffs.

The development rate of sewerage disposal facilities for households remains low in Jakarta and most of the wastewater treated in existing facilities is used for industrial facilities.

Number of water supply categories: 7	Category	Group 1	Group 2	Group 3A	Group 3B	Group 4A	Group 4B	Special Group
	Metered tariffs	B-a	B-b					B-a
Number of sewerage categories: 5 (Number. of major categories, which are divided into sub-categories)	Category	Households	Small business facilities	Large business facilities	Public facilities	Industrial facilities		
	Metered tariffs	A						
	Other charges applied	Connection charge (Fixed)	Connection charge (Area-proportional)					

Legends for usage-based tariffs:
A: Fixed charge (only fixed tariff, without usage-based tariff)
B: Volumetric Charge (a - Uniform Volumetric Charge; b - Increasing Block Tariff; c - Decreasing Block Tariff)
C: Other (real-estate price based tariff, etc.)

Table : Summary of Water and Sewerage Tariffs in Jakarta

b) Water tariffs

There are a total of seven water service categories, from Group 1 to the Special Group, as shown below. The details of individual groups and water tariffs imposed on them (unit price per cubic meter by category) are shown in the following table.

The categorization of households shown in the table below is based on household area. Households belonging to Group 2 (lowest-income households) are included in the sub-category with consumption less than 28.8 m^3, those belonging to Group 3A (low-income households) in the sub-category with consumption 28.8 m^3 or more and less than 70 m^3, those belonging to Group 3B in the sub-category with consumption 71 m^3 or more and less than 120 m^3, and those belonging to Group 4A in the sub-category with consumption 121 m^3 or more. Tariffs for Group 4B vary depending on the usage of facilities and the nature of the economic activities of companies(*8).

Category	Facilities
Group 1	Orphanages, charity accommodations, religious facilities and hydrants
Group 2	Lowest-income households and government hospitals
Group 3A	Waterworks, tanks and low-income households
Group 3B	Medium-income households, small stores and small service stations
Group 4A	High-income households, medium-size stores, private hospitals, research institutes, government offices, embassies, educational facilities, army facilities, medium-size service stations, restaurants, barber shops, hotels (no stars), industrial facilities (small)
Group 4B	Hotels (one, two or three-star hotels), cottages, offices, hotels (four or five-star hotels), high-rise buildings, food and beverage manufacturers, chemical plants, warehouses, etc.
Special group	

Table : Facilities Included in Water Tariff Categories in Jakarta

Category		Unit prices per cubic meter (Unit: Rp/m^3)
Group 1		1,050
Group 2	(Consumption)	
	0 to 20 m^3	1,050
	20 m^3 or more	1,575
Group 3A	(Consumption)	
	0 to 10 m^3	3,550
	11 to 20 m^3	4,700
	20 m^3 or more	5,500
Group 3B	(Consumption)	
	0 to 10 m^3	4,900
	11 to 20 m^3	6,000
	20 m^3 or more	7,450
Group 4A	(Consumption)	
	0 to 10 m^3	6,825
	11 to 20 m^3	8,150
	20 m^3 or more	9,800
Group 4B		11,325
Special Group		13,200

*8 Based on materials of Palyja.

Table : Water Supply Tariffs in Jakarta (Unit Price Per Cubic Meter by Category)

c) Sewerage service tariffs

There are five major categories for sewerage service tariffs, each of which are divided into sub-categories, with tariff rates set with great care depending on usage. Tariffs are double tiered, with sewerage tariffs and connection charges. Basic metered-rate structure is adopted as the basic system and unit prices per cubic meter vary depending on usage. Meanwhile, connection charges for households are levied on fixed charges based on contracts, while connection charges for other categories are levied on the basic metered-rate structure, as is the case with sewerage tariffs.

Category		Unit price per cubic meter (Unit: Rp/m^3)	Connection tariffs (Unit: Rp per connection for households; Rp/m^3 for other categories)
Households	(Sub-category)		
	Type A	72	10,000
	Type B	90	10,000
	Type C	108	10,000
	Type D	126	10,000
Small business facilities	(Sub-category)		
	Shops	108	1,000
	Offices (up to 3 stories)	108	1,000
	Beauty parlors	126	1,000
	Caterers	144	1,400
	Restaurants	180	1,500
	Small hotels	180	1,500
	Other	180	1,500
Large business facilities	(Sub-category)		
	High-rise offices	360	1,750
	High-rise offices (including restaurants and/or gymnasiums)	396	1,925
	Shopping centers/malls/supermarkets/showrooms	396	1,925
	One, two and three-star hotels	396	1,925
	Apartments/condominiums	540	2,625
	Four-star hotels	540	2,625
	Entertainment facilities/large restaurants/cafes	576	2,800
	Private hospitals	576	2,800
	Five-star hotels	576	2,800
	Other	576	2,800
Public facilities	(Sub-category)		
	Religious facilities	40	550
	Community health center	85	1,100
	Schools	108	850
	Government institutions	144	1,100
	Other institutions	144	1,100
	Schools (including dormitories)	144	1,100
	Swimming pools	180	1,100
	Public hospitals	216	1,500
	Medical clinics	216	1,500
Industrial facilities	(Sub-category)		
	Small size	144	1,000

	Medium size	432	4,200
	Large size	468	4,300

Table : Sewerage Service Tariffs in Jakarta (Unit Tariffs and Connection Fees by Category)

2) Service cost recovery by service tariff revenue

Data in the financial statements of PALYJA and PT AETRA Air Jakarta, which are the water service providers in Jakarta, indicates that these companies have both been able to achieve full cost recovery, including CAPEX, in their water supply services. Sewerage services are provided by PD PAL JAYA. Although PD PAL JAYA has achieved full cost recovery, most of the household sewerage in Jakarta is not treated by PD PAL JAYA. Therefore, it needs to be noted that the bulk of PD PAL JAYA's revenue is collected from large business facilities.

3) Examination of cross-subsidies in cities targeted by the survey

a. Cross-subsidies by size

Some categories (Groups 2, 3A, 3B, 4A and 4B) are charged for water supply services at a progressive metered rate, which involves cross-subsidies by size. Service tariffs are imposed on Other categories (Groups 1, 4B and the special group) are charged for these services at basic metered-rate structure, which does not involve cross-subsidies by size.

Sewerage tariffs are grouped into very detailed categories without clear categorization standards. However, cross-subsidies by size between sub-categories occur to a certain extent by such mechanisms as larger industrial facilities being charged at higher unit price than smaller ones within the same major category.

a. Cross-subsidies by usage

a-1 Comparison between different service tariff categories

We will make comparisons of unit prices per cubic meter for standard water consumption regarding water supply services by assuming water consumption of 15 m^3 for groups up to 3B, which includes medium-income households, and water consumption of 107 m^3 for Groups 4A and 4B. Groups 3A and 3B are charged at a unit price about five times higher than the price for Groups 1 and 2, and Groups 4A and 4B at a unit price about ten times higher than the price for Group 1, which involves cross-subsidies between these groups.

Category	Tariffs for average water usage (Unit: Rp/m^3)	Ratio of a standard unit price of the category to a standard unit household tariff
Group 1	1,050	1.00
Group 2 (15 m^3)	1,050	1.00
Group 3A (15 m^3)	4,700	4.48
Group 3B (15 m^3)	6,000	5.71

Group 4A (107 m^3)	9,800	9.33
Group 4B	11,325	10.79

Table : Cross-subsidies by Water Supply Service Category in Jakarta

As shown in the tariff rate table, sewerage tariffs vary between tariff categories depending on usage, which involves cross-subsidies.

a-2 Comparison based on the amount of water sold and revenue

The following table shows a comparison of the amounts of chargeable water volume and revenue of PALYJA, one of water supply concession corporations, by tariff category. The table indicates that there are considerable cross-subsidies from Groups 3A, 3B, 4A and 4B to Group 2, which includes lowest-income households.

Tariff category	Statistical category	Sales volume: Percentage (A)	Percentage of earnings (B)	Earnings per sales volume (B)/(A)	Ratio of earnings per sales volume
Group 2	Social Class	23%	4%	0.17	1.00
Group 3A	Medium Class	28%	21%	0.75	4.41
Group 3B	Upper Class and Commercial	49%	75%	1.53	9.00
Group 4A					
Group 4B					

Table : Cross-subsidy Conditions Based on Revenue and Sales Volume in PALYJA's Water Supply

Source: Data from Interview Results

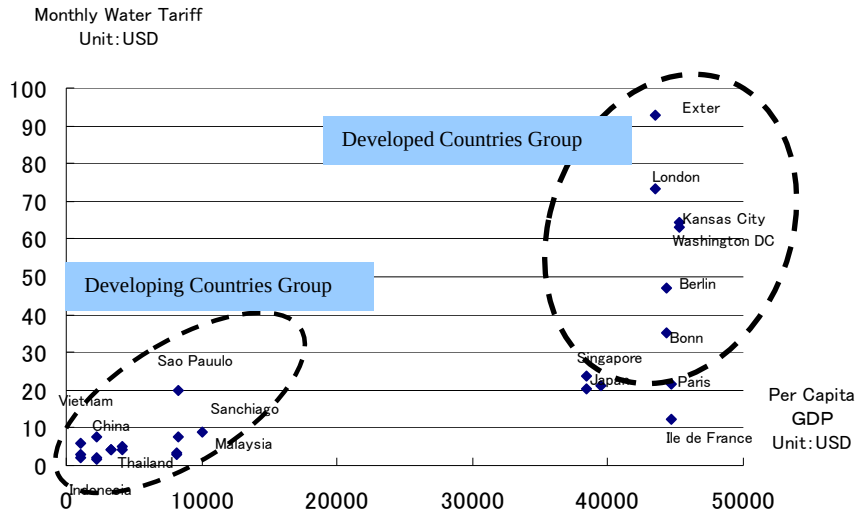
2.4.3 Water and sewerage tariff structure, situation in relation to project cost recovery, and current status of cross-subsidies in the investigated cities.

(1) Comparison of Water and Sewerage Tariffs among Cities

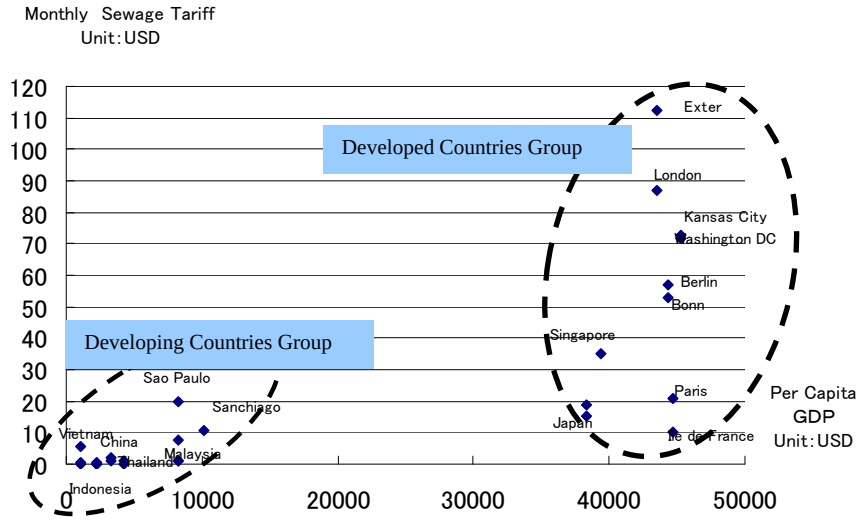
In this investigation, a total of 26 cities are covered. However, the water and sewerage tariff structure, the situation in relation to project cost recovery, and the current status of cross-subsidies differ across these investigated cities. In this paragraph, the differences between these cities will be confirmed and, at the same time, the background of these differences will be examined for each item.

Water and sewerage tariff structure will be compared among different countries in the world, for standard amounts of water for home and commercial use (home use: 15 m^3, commercial use: 107 m^3) respectively. With a view to comparing these cities accurately, the basic and metered tariffs were totaled to obtain monthly tariffs. In cases where the basic tariff was caliber-based, 13 mm and 20 mm were assumed for home and commercial uses respectively. The rate levels of water and sewerage services for home use are shown below.

＜Water tariff (home use)＞



＜Sewerage tariff (home use)＞



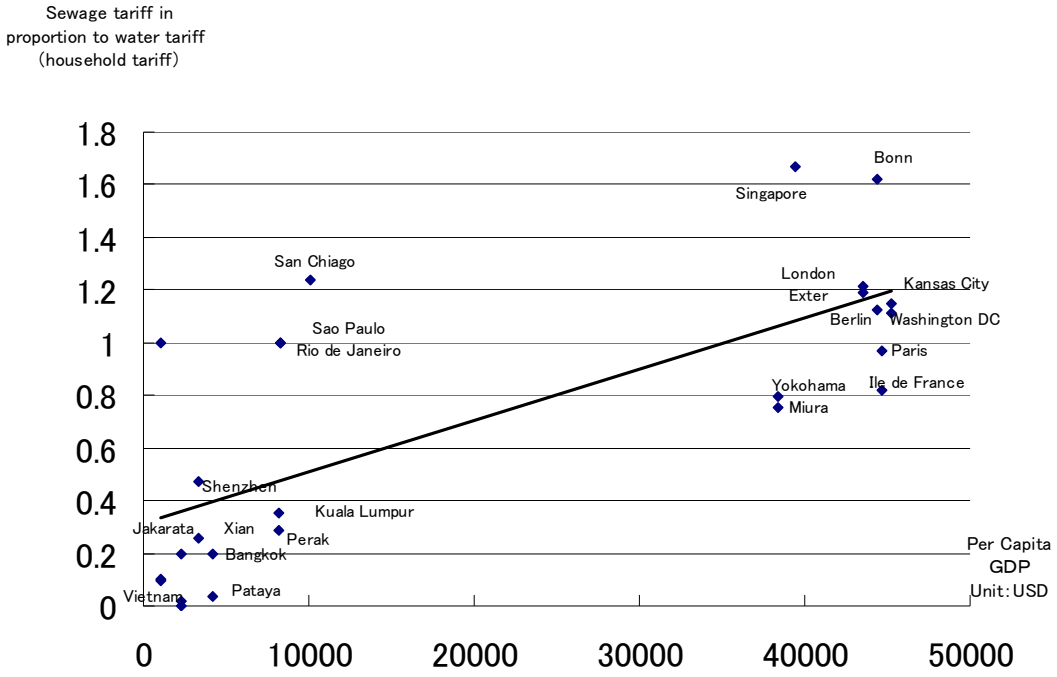
The following points should be noted from the above comparison.

(1) Water tariffs in the group of developing countries generally fall within 10 US dollars per month for home use. Regarding the group of developing countries, there is no strong correlation between the amount of GDP and the tariff level in each country.

(2) Regarding sewerage tariffs in the group of developing countries, the tariff amounts are extremely low in countries where GDP is less than a certain level (around 8000 dollars). It appears that the countries which charge substantially for sewerage treatment are those that have achieved a certain level of economic development.

(2) The ratio of Sewerage Tariff to Water Tariff

The ratio between water and sewerage tariffs (for home use) was calculated for a standard amount of water. Moreover, the ratio of water to sewerage tariff was plotted against GDP per capita, as shown below.



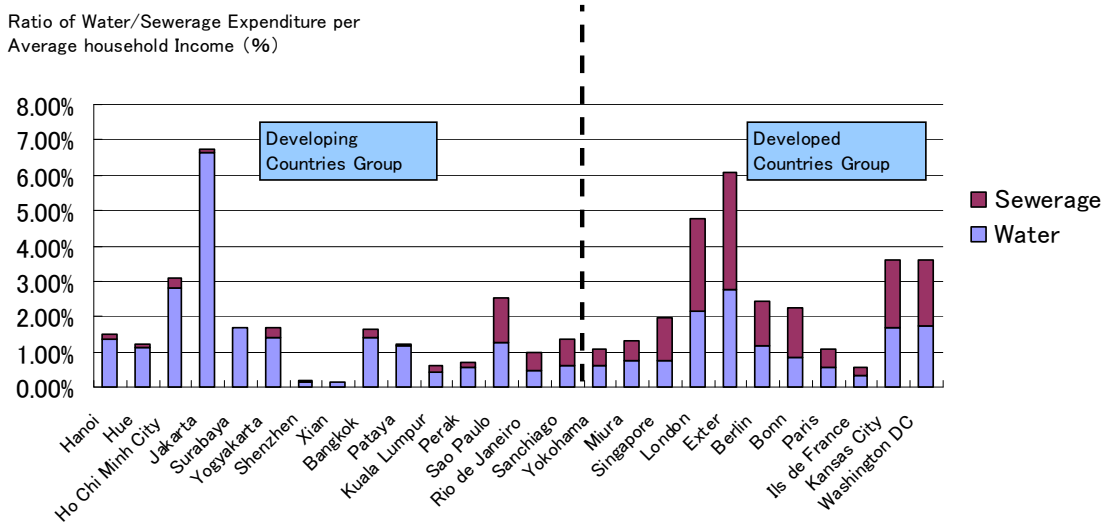
The following points can be noted from the above figure.

- The average of developed country group shows higher ratio of sewerage tariff to water tariff than the average of developing country group.
- In quite a few countries where GDP per capita is below about 8,000 dollars, sewerage rates amount to around half of water rates.
- On the other hand, although the level of GDP per capita is similar, in South American countries (such as Chile and Brazil) water and sewerage tariffs are approximately equal.

- In advanced countries, water and sewerage tariffs are approximately equal.

(3) The Ratio of Water and Sewerage Tariff Expenditure to Household Expenditure

The graph shows the ratio of water and sewerage tariff expenditure to household expenditure of each city.



(4) Cost Recovery of Water and Sewerage

The situation relating to project cost recovery and the current status of cross-subsidies in the investigated cities will be confirmed. The following points will be clarified: regarding project costs, which of the following criteria the water and sewerage tariffs in each country correspond to; and regarding cross-subsidies, which category receives (gives) cross-subsidies and to what extent they are inclined.

1: Tariff revenues recover the costs including Capex (Total recovery including depreciation, interest, etc. is assumed)
2: Tariff revenues recover a portion of Capex (Partial recovery of depreciation, interest, etc. is assumed)
3: Tariff revenues and O&M expenses are almost comparable
4: Tariff revenues cannot recover O&M expenses

The following points can be noted from the following study.

③Factors identified from the comparison table

1) Developed Countries (Japan, United Kingdom, the United States, Germany, France, Singapore)

- **Cross-Subsidy based on purpose of use is not functioning in many cases.**

The same tariff structure is applied for differing purposes of use in many of the developed countries. For instance, the same tariff structure is applied for both household and business segments for the sewerage service, and also for the water service where the amount of consumption is 200 ㎥ or less. The completely same tariff structure is applied in France and Germany, except in Ile-de-France where a tax exemption may be applied to administrative organs.

In contrast, tariffs based on the purpose of use are applied with individual unit prices in some cases in Singapore and Miura City in Japan. Nevertheless, tariffs for non-households and for households (40 ㎥ or less) are the same in Singapore, and unit prices for different purposes of use are almost consistent in Miura City. As can be observed, Cross-Subsidy between different purposes of use is not functioning strongly in many cases, even where different tariff structures are set based on the purposes of use.

The reason why Cross-Subsidy is not functioning in developed countries is to reduce complications in the billing process. Another possible reason is that although the poor exist even in developed countries, they are not necessarily considered in the framework of the water service industry but are considered within the entire social security system.

- **Volumetric Cross-Subsidy is not functioning in many cases.**

The same unit price for different volume of usage is applied in many cases in most of the developed countries. Linear volumetric tariff structure is applied for both the water and sewerage services in France, Germany, and the U.S. (Washington D.C.) and volumetric Cross-Subsidy is not functioning.

In the U.K and Singapore, unit price partly varies according to the volume of usage, and volumetric Cross-Subsidy is applied in some cases. However, different volumetric tariffs are applied only for particular large-scaled users in the U.K, and tariff for households are only divided into two sub-categories in Singapore.

Cross-Subsidy is applied for both Yokohama City and Miura City in Japan by setting detailed unit prices based on the volume of usage. Politically, the utilization of an increasing-block tariff structure has been promoted. However, it should be noted that in Yokohama City, the volumetric Cross-Subsidy is being reduced as seen in the latest revision in tariffs. This is because the unit price for small-scaled usage has been pulled up from the point of management of the water business operators, due to the reduction in water consumption by households after the spread of water-saving equipments.

- **Status on cost recovery depends on variable factors; whether the operator is the public or private sector, and whether tariffs are politically established to a certain extent.**

The status on cost recovery varies by country. For example, Japan and the U.S are able to cover their OPEX but not CAPEX for both their water and sewerage services. In contrast, France and Germany have been able to recover the cost, including both the CAPEX and OPEX.

Firstly, the nature of the operator should be considered as a factor in recovering the cost. If the operator is a private sector, there will be an incentive to raise profit for a fiscal year, inclusive of depreciation costs. The tariff structure in the UK is flexible to some extent (only monitoring by Ofwat is required), so that tariffs can be raised to a level where profit can be produced. s. s

Secondly, focus is placed on whether cost recovery is politically raised as a clear objective. Especially in France and U.K., the object to achieve cost recovery in the water service is specified clearly and tariffs can be revised flexibly to some extent. Also in Washington D.C., tariffs have been revised depending on business conditions and the financial plan for each fiscal year. The process of revising the tariff structure is not simple and requires a large number of public hearings, but awareness towards cost recovery is considered to be strong. In contrast, Japan applies the comprehensive cost calculation method but the objective to achieve cost recovery is not working as strongly.

2) Developing Countries (Malaysia, Thailand, China, Vietnam, Indonesia, Chile, Brazil)

- **Cross-Subsidy based on purpose of use is applied**

Cross-Subsidy based on purpose of use is not largely seen in the developed countries, but in contrast, tariffs based on the purpose of use, such as for commercial or industrial use, are applied in the developing countries and Cross-Subsidy from such categories are functioning on household use in many cases.

Nevertheless, the level of Cross-Subsidy varies by country. Cross-Subsidy from non-household use to household use is relatively strong in Indonesia and Brazil, while this is relatively weak in Thailand, China, and Vietnam.

Different ranks are established on tariffs for households in Indonesia and Brazil and Cross-Subsidy toward the household segment is stipulated under laws and regulations on water services. It is assumed that a Cross-Subsidy based on the purpose of use is accepted in these countries as it is important to improve the insufficient diffusion rate for water services toward households and, especially, to consider for the poor.

- **Volumetric Cross-Subsidy varies by country and by city.**

Volumetric Cross-Subsidy is not much functioning in the developed countries as described above, but it is functioning in some countries and cities of the developing countries, and can be

categorized as follows:

A: Cases where volumetric Cross-Subsidy is functioning by purpose of use

Volumetric Cross-Subsidy is applied for all purposes of use in Brazil, Indonesia, Malaysia (Perak), and Thailand. Consumption of around up 30 to 50 ㎥ per a month are classified under categories 3 to 4 where different unit prices are established for each category. The same unit price is applied to consumption exceeding this volume regardless of the amount used.

When focusing on the level of increase which is the ratio between the lowest and the highest unit price for each purposes of use, the level for households is the largest among all usage categories in many cases. This trend is notable in Sao Paulo and Rio de Janeiro. In these cities, the first block within the tariff structure for households is set extremely low in particular, and there is a strong incentive to regulate the usage amount as can be seen in some cases where the unit price nears that for other purposes of use when the amount of consumption increase.

B: Cases where volumetric Cross-Subsidy is applied only for households

In Malaysia (Kuala Lumpur), Vietnam (Hanoi, Ho-Chi-Minh City) and China (Shenzhen), volumetric Cross-Subsidy is applied only for households. Especially, in Vietnam, Cross-Subsidy functions only for households taking the form of an increasing-block tariff structure for its basic tariff structure which is stipulated under the law.

Same as for Case A above, it is assumed that the volumetric Cross-Subsidy is applied to regulate the water consumption of households and to establish cheaper tariffs for small-scaled users.

At the same time, it can be considered that the tariff structure under Case B promotes the demand by industrial users, through the application of a linear volumetric tariff system. Especially in Ho Chi Minh City and Shenzhen, water tariff for industrial use is established at a relatively low level for attracting industries and businesses.

C: Cases where volumetric Cross-Subsidy is not applied for any purposes of use

In Vietnam (Hue), China (Xian) and Chile, volumetric tariff is not applied and a linear volumetric tariff structure is instead being applied. The reason is assumed to be to lower administrative costs in the case of Chile, and to promote the demand for its rich water supply in the case of Hue.

- **There are cases in sewerage water where tariff is established regardless of the costs**

A special tariff structure is set for sewerage services in developing countries, for reasons such as the water meters failing to function. For example, the tariff is set by the size of the residential area in Indonesia, and by the number of residents and residential area for household use and by the

number of employees for industrial use in Malaysia. It is possible that these tariff structures do not necessarily reflect the volume of sewerage disposed.

Furthermore, there are cases as can be seen in China and Vietnam where an addition to water tariff.is collected at an extremely cheaper unit price compared to water. About 10% of the water tariff is set as sewerage tariff (environment protection fee) since sewerage services are not provided in Vietnam.

- **It is assumed that the recovery of costs depends on the existence of an effective mechanism for revising tariffs that is based on costs.**

Cost recovery through tariff revenue largely differs by country and city, but a strong factor is whether or not the service provider can reflect a certain amount of the revenue on the water rate.

For example, SABEP (Brazil) and water service providers in Chile or Jakarta, Indonesia have been able to revise their tariffs by taking account of the costs and appropriate profit (the ATA mechanism is currently not functioning in Indonesia), and succeeded in improving the income and expenditure of the operator.

In contrast, the hike in tariff is regulated in other countries and it is difficult to revise the tariff as needed. For example, although a process exists for revising the tariff in Vietnam, this requires the approval of the People's Committee; the tariff has not been raised for 10 years in Thailand for political reasons. OPEX is being collected almost entirely, but it is difficult to realize a further improvement in cost recovery.

2.5 Relief measures for the poor in foreign countries

2.5.1 Outline of systems established in relation to relief measures for the poor

The systems established in relation to relief measures for the poor in the target cities can be roughly divided into the following categories: (1) reduction of and exemption from part (mainly fixed tariff) of the water tariff, (2) setting of a tariff level specifically for the poor based on certain criteria, (3) subsidies and financial support, (4) other systems, and (5) no particular measures.

The qualifications in order to become a beneficiary of the systems established under relief measures for the poor in the target cities can be roughly divided into the following categories: (1) relating to amount of income, (2) relating to welfare benefits and other subsidies, and (3) relating to living environment and other conditions.

Type of poverty measures	City	Outline of poverty measures	Definition of beneficiary
(1) Reduction of and exemption from part of water tariff	(2)-(1) Yokohama	Amounts equivalent to the basic rate of water tariffs and sewerage tariffs are reduced or exempted (1,580 yen for water and 1,260 yen for sewerage)	For example, single-parent families (such as single-mother families on welfare) and other households receiving subsidies for medical expenses and single-parent families
	(2)-(2) Miura		For example, households on welfare, households receiving childcare allowance, and social welfare facilities (Class 1 or 2 residential facilities or facilities providing bathing services)
	(8)-(1) Bangkok	All utilities are free of tariff. (The target amount of water is 20 m^3)	
	(9)-(2) Shenzhen <Sewerage>	Sewerage tariff is partially (or entirely) reduced or exempted	
	(10)-(2)Hue	The tariff for the first 2 m^3 is exempted	
	(12)Santiago	More than 50% of the tariff for the first 15 m^3 is subsidized. (100% is subsidized for the poorest class)	People whose income level is within the bottom 20% of the whole country
	(13)-(2) Rio De Janeiro	Slightly more than one third of the tariff is reduced or exempted for the first 6 m^3	People whose income level is within the bottom 5% and who live in favelas
(2) Setting of tariff specifically for the poor	(11)-(1) Jakarta <Tap water>	Tariffs are set for each class and there is a tariff for the poor	People whose house has a floor space within a certain level
	(11)-(4) Jogjakarta <Tap water>	Tariffs are set for each class and there is a tariff for the poor	People whose house has a floor space within a certain level
	(13)-(1) Sao Paulo	A tariff for the poor (A) and a tariff for slums (favelas) (B) are set A tariff for the poor is also set for utilities for commercial use	A: Households that have up to three family members working for the lowest wages, live in a house with a floor space of 60 m^2 or smaller, and use electricity up to 170 kwh/month B: People who have been out of work for 12 months or less C: People who live in slums
(3) Subsidies and financial support	(4)-(2) Washington DC	22.44 dollars are deducted from water and sewerage tariffs (or services equivalent to this amount are available for free) or the amount for 400f3 per month is deducted under the Customer Assistance Program	
	(4)-(3) Kansas City	Up to 500 dollars support per year under the Customer Assistance Program	People whose income level is within 185% of the income specified in the U.S. Poverty Guidelines
	(6)-(3) Perak	An amount equivalent to 20 m^3 is subsidized	People who receive existing subsidies
	(7)-(1) Singapore	Water tariffs are is returned during recessions	People who live in flats with one or two rooms
(4) Other systems	(3)-(2) London (3)-(3) Exeter	Watersure program is applied and the water tariff is capped at a certain amount	People who receive benefits, households with many children (more than two children who are 19 years old or younger, go to school and are qualified for child allowance), or people who use a large amount of water due to medical reasons
	(5)-(1) Paris (5)-(2) Ile-de-France	There is no exemption, different tariff, or subsidy. Social security services are provided. Counseling services are available	
(5) No particular measures	(6)-(1) Kuala Lumpur	There are no measures	
	(10)-(3) Ho Chi Minh	There are no measures	

Table : Summary of relief measures for the poor in water and sewerage services in various countries

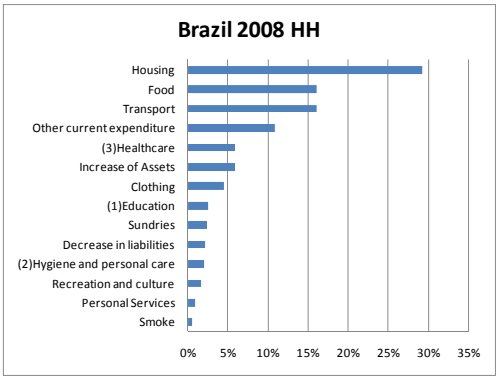
Chapter 3 Simulation of water and sewerage services in developing countries

3.1 Setting tariff levels according to the concept of affordability

This section describes in detail surveys conducted about the affordability to pay (ATP) tariff level. The concept of ATP is relatively new and there is no established definition. To study ATP tariffs we have performed trial calculations by using household expenditure charts for individual countries to focus on the order of household expenditure items and their percentages in relation to household income and expenditure, and then determining which expenditure item is equivalent to the affordable tariff.

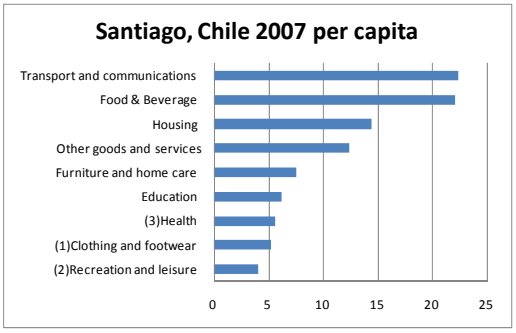
3.1.1 Outline of household expenditure data in subject countries

The following are outlines of household expenditure data in four countries where we conducted field surveys.



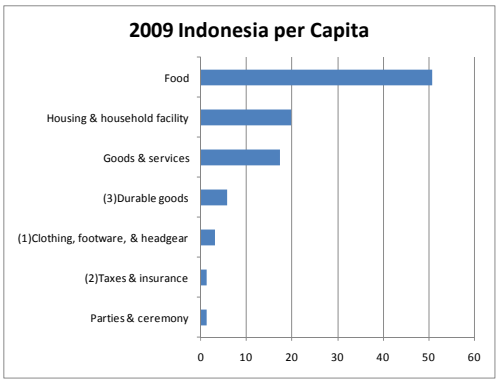
Source: Instituto Brasileiro de Geografiae Estatística, Consumer Expenditure Survey 2008, http://www.sidra.ibge.gov.br/bda/orcfam/default.asp?t=4&z=t&o=22&u1=1&u2=1&u3=1&u4=1&u5=1&u6=1(originally in Portuguese)

Figure :1 Household expenditure chart referenced in the survey in Brazil



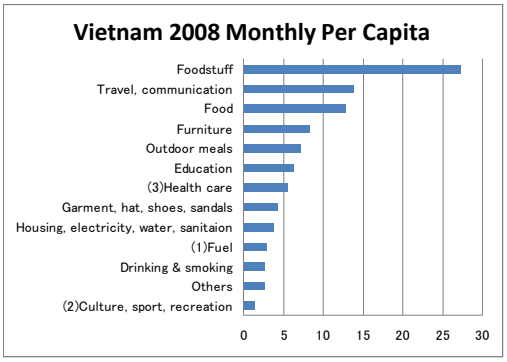
Source: National Statistic Institute Chilean Statistics, Family Budget Survey, Composition of Average Household Expenditure by Per Capita Income Quintile, 2007, by products http://www.ine.cl/canales/chile_estadistico/encuestas_presupuestos_familiares/2008/Presentacion%20EPF%202006-2007.pdf (originally in Spanish)

Figure : Household expenditure chart referenced in the survey in Chile



Source: Badan Pusat Statistic(Statistic Indonesia), Percentage of Average Expenditure per Capita Monthly by Group of Commodities, Indonesia, 1999, 2002-2009, http://www.bps.go.id/tab_sub/view.php?tabel=1&daftar=1&id_subyek=05&notab=7

Figure : Household expenditure chart referenced in the survey in Indonesia



Source: General Statistics of Vietnam, household living standards 2008, http://www.gso.gov.vn/default_en.aspx?tabid=515&idmid=5&ItemID=9647

Figure : Household expenditure chart referenced in the survey in Vietnam

3.1.2 Trial calculations of ATP tariffs in the subject countries

We have performed trial calculations of ATP tariffs in the field survey subject countries and in Bangladesh (Khulna) by using the following method and based on the following concept of analysis.

1） Outline of surveys

To perform trial calculations of ATP tariffs in the subject countries, we interviewed staff of water and sewerage public organizations who had collected information in the four subject countries.

① Subjects of surveys

The subjects of the surveys were the staff (specialist staff) belonging to interview departments of water and sewerage public organizations and also secretaries or general office workers in the departments, PwC local staff and JICA local staff who acted as substitutes for the general public. The number of people who gave answers is listed below. The number of subjects in these surveys was not of a level sufficient to make the surveys statistically significant and it was estimated that the survey results would have considerable variation depending on income levels, living environments, personal preferences and other factors. Therefore, we added a qualitative analysis to these surveys, estimated reference values of ATP tariffs, and pointed out important matters to keep in mind in further surveys in the future.

Country/City	Total
Brazil	8
Chile	7
Vietnam	10
Indonesia	10

Table : Number of interviewed people

② Survey methods

We applied the anchoring technique to interviews. We showed the subjects some items selected from the household expenditure chart for each country, and interviewed them by using a questionnaire to study their intentions about paying water and sewerage tariffs.

The questions about water and sewerage services consist of two stages; (i) primary questions regarding the current service level and (ii) secondary questions regarding satisfactory service levels (for example, the 24-hour supply of drinking water for the water service and the improvement of hygienic environments for the sewerage service). In each stage, we took steps to check whether they recognized the importance of the water and sewerage services, which item for willingness to pay in the household expenditure chart they considered to be equivalent to the water and sewerage tariffs, and to check the willingness to pay whether they considered water and sewerage tariffs on the same level as the above-mentioned anchoring items.

We asked these two-stage questions about anchoring items selected for (1) only the water tariff, (2) only the sewerage tariff and (3) the total of water and sewerage tariffs to check their willingness to pay. We selected the anchoring items for each country, based on the household expenditure of each country as confirmed in 3.1.1 (Table xx).

Country	(1) Water tariff		(2) Sewerage tariff		(3) Water and sewerage tariffs	
Brazil	Education	(2.5%)	Hygiene & personnel Care	(1.9%)	Health care	(5.9%)
Chile	Clothing & footwear	(5.2%)	Recreation & leisure	(4.1%)	Health	(5.6%)
Vietnam	Fuel	(2.9%)	Culture, sports, & recreation	(1.5%)	Health care	(6.4%)
Indonesia	Clothing, footwear & Headgear	(3.3%)	Tax and Insurance	(1.4%)	Durable goods	(5.9%)

Table : Expenditure items used in the questionnaire in each country and their percentages

2） ATP-value trial calculation method and results

① ATP-value trial calculation method

We performed a trial calculation of an ATP value by multiplying the percentage of an item the interviewee selected or the percentage of expenditure the interviewee indicated, by the total amount of household expenditure in the country.

Data regarding household expenditure in each class were available for Brazil, Chile and Vietnam (*9), so we calculated ATP values for not only the average income level but also the low-income class by multiplying the above-mentioned percentage by the total amount of household expenditure(*10). Our interviews did not cover Bangladesh, so we used the results of the survey in Vietnam, which has a GDP level relatively close to that of Bangladesh, and made assumptions for the percentages of water and sewerage tariffs to the total amount of household expenditure to perform trial calculations of ATP values. We used statistical data relating to household expenditure in urban areas for Khulna in Bangladesh.

Household expenditure in the low-income class is classified differently from country to country, and we used the total amount of expenditure in the statistically lowest class.

Country	Average household expenditure	Low-income class	Expenditure of low-income class	Percentage of class
Brazil	BRL 2,419.77	BRL 830 or less	BRL 722.20	22%
Chile	CLP 740,706	Quintile 1 (5 levels)	CLP 327,228	20%
Vietnam	VND 2,819,200	Quintile 1 (5 levels)	VND 1,318,800	20%
Indonesia	IRP 5,124,804	N/A	N/A	N/A
Bangladesh	BDT 8,315	Decile 1 (10 levels)	BDT 2,130	10%

Table : Household expenditure used for trial calculations of ATP in each country

Source: Data for Brazil, Chile and Bangladesh were obtained from statistics from each country.
Data for Indonesia were obtained from the World Bank Database.

Note: We calculated household expenditure based on data relating to household expenditure per person in Vietnam (average and low-income classes) and in Indonesia, and on the assumption that the average number of household members is 4.12, 4.41 and 4.2 persons respectively (based on censuses, statistics and other data).

② Survey results

Table xx outlines the results of the survey in each country regarding recognition of the importance of services and the affordability of tariffs equivalent to the anchoring items.

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*9 We did not make calculations of ATP for the low-income class in Indonesia because statistics in each class was unavailable.

*10 The ATP values for the low-income classes are for reference only, because interviewees are not always in low-income classes.

Table: Anchoring Items of Individual Countries and Items Agreed on for Payment and Percentages

Country (Number of samples)	Overview of Water and Sewerage Services		(1) Water tariff	(2) Sewerage tariff	(3) Water and sewerage tariff	Remarks
Brazil (8)	- Tap water is drinkable. Since water is supplied 24 hours a day in Sao Paulo, primary and secondary questions received the same reply. (Rio de Janeiro does not have 24-hour access and the service is bad.) - Although most of them do not purchase drinking water, they filter tap water for drinking. - Because water and sewerage are charged together, we received only one type of reply.	Anchoring Items	Education (2.5%)	Hygiene & personnel Care (1.9%)	Health care (5.9%)	- Although water tariffs are inexpensive in Brazil, water service enterprises have already recovered the costs. Moreover, it is widely believed that water and sewerage tariffs should be free for low income group. - Because the national average household budget chart is applied to the residents of big cities, such as Sao Paulo and Rio de Janeiro, many respondents expressed a feeling of oddness. Therefore, more detailed hearing became necessary. - As for the comparison with "Education," because the proportion of its expense in household budgets varied greatly depending on income groups, its appropriateness as an anchoring item required further consideration.
		Primary and secondary questions	n.a.	n.a.	Sao Paulo: One person (comparatively lower income group) showed the equivalent level of intention to pay to Education. On the other hand, four people (comparatively higher income group) did not show the equivalent level of intention to pay to Education because, in their cases, the proportion of Education expense in household budgets is high. But they agreed to pay the equivalent level to Health Care and Hygiene. Rio de Janeiro: People did not show the equivalent level of intention to pay to either Education or Healthcare. The importance was the equivalent level to Health care, Hygiene and Education.	
Chile (7)	- Water is supplied 24 hours a day, and tap water is drinkable.	Anchoring Items	Clothing & footwear (5.2%)	Recreation & leisure (4.1%)	Health (5.6%)	- As for the importance of water and sewerage tariffs, many of the replies specified them among the top household expenditure items. - The reply stated that drinkable water had already been supplied 24 hours a day.
		Primary question	Only one person replied Yes. Importance: Food, Beverage and Health, etc.	Only one person replied Yes.	Two people replied Yes.	

		Secondary question	Three people replied Yes.	Three people replied Yes. One of them replied Clothing (5.2%). The recognition of importance varies greatly.	Two people replied Yes.	
Vietnam (10)	- Respondents annual incomes are average to high. - Tap water is undrinkable, and there is no 24-hour water supply. - They boil tap water for drinking. - Two households use well water.	Anchoring Items	Fuel (2.9%)	Culture, sports, & recreation (1.1%)	Health care (5.6%)	- Because most of them considered water tariffs inexpensive, many of them hesitated to select it as a high ranking item. - Fuel, which was one of the anchoring items, has been increasing greatly in recent years, so it seemed to be an inappropriate selection.
		Primary question	No one replied Yes. More than one person replied the importance as equivalent to Electricity; one person replied the importance as equivalent to Culture.	No one replied Yes. One person replied the importance as equivalent to Culture.	No one replied Yes. Everyone replied that Health Care was expensive.	
		Secondary question	Two people replied Yes. However, most of the respondents affirmed the possibility of paying more than the current level (from 1.5 to 3 times as much). Many of them replied that 1-3% of household expenditure was appropriate.	Four people replied Yes. In addition, they reply that 0.2-0.4% was appropriate.	No one replied Yes. However, most of the respondents affirmed the possibility of paying more than the current level. One reply stated that 5% of household expenditure was appropriate.	
Indonesia (7)	- Except for two respondents, they answered that they had 24-hour access to water, but none is drinkable. - They use bottled water for drinking.	Anchoring Items	Clothing, footwear & Headgear (3.3%)	Tax and Insurance (1.4%)	Durable goods (5.9%)	- As for sewerage, all except two replied they had no service. Therefore, replies solely for sewerage could not be obtained.
		Primary question	Six people replied Yes. As for the importance, many of them specified major household expenditure items, such as Food and Goods and Services.	n.a.	Seven replied Yes. As for the importance, many of them specified major household expenditure items, such as Food and Goods and Services.	
		Secondary question	Similarly, six people replied Yes.	n.a.	Similarly, seven people replied Yes.	

(3) General overview of ATP trial calculation results

The following table shows the ATP values of individual countries as a result of trial calculation by using the above-mentioned method. As for Bangladesh, the equivalent level of the willingness to pay to that of Vietnam is assumed as mentioned above.

	Currency	Water Tariff		Sewage Tariff		Total	
		Average	Low Income	Average	Low Income	Average	Low Income
Brazil	BRL	3.2	1.0	3.2	1.0	6.5	1.9
Chili	CLP	590	260	645	285	1,235	545
Vietnam	VND	5,808	2,908	1,936	969	7,743	3,877
Indonesia	IDR	11,377	n.a.	8,712	n.a.	20,089	n.a.
Bangladesh	BDT	16.6	4.3	5.5	1.4	22.2	5.7

Table: ATP Values of Individual Countries

	Water Tariff		Sewage Tariff		Total	
	Average	Low Income	Average	Low Income	Average	Low Income
Brazil	2.00%	2.00%	2.00%	2.00%	4.00%	4.00%
Chili	1.19%	1.19%	1.31%	1.31%	2.50%	2.50%
Vietnam	3.00%	3.00%	1.00%	1.00%	4.00%	4.00%
Indonesia	3.33%	3.33%	2.55%	2.55%	5.88%	5.88%
Bangladesh	3.00%	3.00%	1.00%	1.00%	4.00%	4.00%

Table: Percentages of Water and Sewerage Tariffs in Household Expenditures People's Affordability to Pay

(4) Points to keep in mind concerning the study results

Points to keep in mind about the study method obtained from this study include the following.

- **The number of items in the household expenditure chart and anchoring items:** The above results were obtained from hearing. However, in some cases, appropriate items could not be chosen because (1) itemization of household expenditure was not detailed enough, and (2) the household expenditure chart did not include items under some anchoring items. Moreover, in some other cases, the proportion of expenses in household budgets has changed due to price fluctuation in recent years (for example, fuel price in Vietnam). Therefore, we obtained replies in terms of comparison with other utilities (electricity and gas) or of proportions in expenditure. Furthermore, by selecting an anchoring item of which the structure of expenditure in household expenditure varies greatly depending on income groups and personal preferences (for example, education), variation of results may increase greatly.
- **Current inexpensive water tariffs:** Many replies seemed to be influenced by the inexpensiveness of current water tariffs. Moreover, when cost recovery has been achieved already, respondents questioned the need for paying more for water services.
- **Data of the household expenditure chart:** This study used the chart of the national average household expenditure, but depending on differences in regionalities, such as urban areas and rural areas, and in income groups, the structure of household expenditure

varies greatly. Especially when the number of samples is small, use of the national average household expenditure chart must be reviewed.

3.1.3 Comparison of Current Tariffs and Tariffs Obtained by ATP Trial Calculation

(1) Comparison of current tariffs and tariffs obtained by ATP trial calculation

The following is the result of comparison between the current tariffs and the tariffs obtained by ATP trial calculation.

	Item	Unit	Water Tariff		Sewage Tariff		Total	
			Average	Low Income	Average	Low Income	Average	Low Income
Brazil	Current Tariff (a)	BRL/m3	2.22	0.83	2.22	0.83	4.44	1.66
	ATP Tariff (b)		3.23	0.96	3.23	0.96	6.45	1.93
	(b)/(a) (times)		1.45	1.16	1.45	1.16	1.45	1.16
Chili	Current Tariff (a)	CLP/m3	314.97	157.49	344.58	172.29	659.6	329.8
	ATP Tariff (b)		590	260	645	285	1,235	545
	(b)/(a) (times)		1.87	1.65	1.87	1.65	1.87	1.65
Vietnam	Current Tariff (a)	VND/m3	3,652	3,652	348	348	4,000	4,000
	ATP Tariff (b)		5,808	2,908	1,936	969	7,743	3,877
	(b)/(a) (times)		1.59	0.80	5.56	2.79	1.94	0.97
Indonesia	Current Tariff (a)	IDR/m3	4,700	n.a.	505	n.a.	5,205	n.a.
	ATP Tariff (b)		11,377	n.a.	8,712	n.a.	20,089	n.a.
	(b)/(a) (times)		2.42	n.a.	17.25	n.a.	3.86	n.a.
Bangladesh	Current Tariff (a)	BDT/m3	1.2	n.a.	n.a.	n.a.	n.a.	n.a.
	ATP Tariff (b)		16.6	4.3	5.5	1.4	22.2	5.7
	(b)/(a) (times)		13.86	n.a.	n.a.	n.a.	n.a.	n.a.

3.2 Simulation of Project Sustainability by the Introduction of ATP Tariffs and Cross-Subsidy

After setting certain preconditions on water and sewerage projects in Vietnam (Hanoi) and Indonesia (Jakarta), we did a trial calculation and analyzed the income from the tariff and the improvement in the recovery rate of project costs when ATP tariffs and cross-subsidy according to the tariffs were introduced.

3.2.1 Preconditions of Simulation

The preconditions of the simulation were set according to the information found from this study. Other conditions were set accordingly in reference to such materials as FS reports compiled previously by JICAor other domestic and foreign organizations.

The trial calculation and analysis were conducted for the following three cases: when the conditions are set based on the current tariffs (a. Base case); when ATP tariffs are applied (b. With ATP tariff application); and when cross-subsidy is adjusted (c. With cross-subsidy adjustment).

Previous Reports and Other Materials Referenced in Implementing Simulation

City	Project	Report
Hanoi (Vietnam)	Water	- Study on Private-Initiative Infrastructure Projects in Developing Countries in FY2008, "Study on the PPP Project Formation for Hanoi Water Supply System in the Socialist Republic of Viet Nam," March 2009, Tokyo Engineering Consultants Co., Ltd. and Ebara Corporation
	Sewerage	- FEASIBILITY STUDY FOR THE CONSTRUCTION PROJECT OF CENTRAL LARGE-SCALED WASTEWATER TREATMENT PLANTS FOR HANOI ENVIRONMENTAL IMPROVEMENT March 2009 NIPPON KOEI CO., LTD in association with VIWASE
Jakarta (Indonesia)	Water	- Proposed Loan Republic of Indonesia: West Jakarta Water Supply Development Project August 2007 Asia Development Bank
	Sewerage	- Study on Transfer of Know-how Concerning Maintenance and Management of Sewage Facilities in Republic of Kazakhstan, June 2009, Nippon Koei Co., Ltd. and Nihon Hels Industry Corporation - CENTRALIZED WASTEWATER TREATMENT PLANTS IN INDONESIA SEPTEMBER 2006 USAID

3.2.2 Simulation Result and Examination

The following table shows the simulation result for Hanoi and Jakarta.

Recovery Rate of Costs of Water and Sewerage Projects in Hanoi and Jakarta

City	Project	Project cost	Base case	b. With ATP tariff application	c. With cross-subsidy adjustment
Hanoi	Water	O&M cost	354%	449%	462%
		Capital investment cost	142%	195%	203%
	Sewerage	O&M cost	102%	132%	157%
		Capital investment cost	1%	12%	21%
Jakarta	Water	O&M cost	188%	261%	278%
		Capital investment cost	1002%	1838%	2028%
	Sewerage	O&M cost	53%	171%	243%
		Capital investment cost	0%	1000%	2031%

* 100% or higher recovery rate of project costs means the said project costs have been recovered in full; otherwise, some of the project costs have not been recovered.

(Recovery rate of O&M cost) = (Cumulative profit during the trial calculation period) / (Cumulative O&M cost during the trial calculation period)

(Recovery rate of capital investment cost) = {(Cumulative profit and loss during the trial calculation period) - (Cumulative O&M cost during the trial calculation period)} / {(Cumulative depreciation during the trial calculation period) + (Cumulative interest paid during the trial calculation period)}

(1) Hanoi, Water

Full recovery of project costs is expected even in the base case. By introducing ATP tariffs, which will increase the current water tariffs by about 1.6 times, will further increase the profitability of the project.

As a result, full recovery of project costs can be achieved without introducing cross-subsidy.

(2) Hanoi, Sewerage

In the base case, only O&M cost can be recovered, and capital investment cost cannot be recovered. Even with application of ATP tariff, which is about 1.3 times as much as the household tariff of the base case, and with implementation of cross-subsidy, which charges non-household use twice as much as the household use, only part of capital investment cost can be recovered. Moreover, even if cross-subsidy is increased to three times as much as the household use, full recovery of project costs cannot be achieved.

Therefore, in order to achieve full recovery of project costs, the conditions of this trial calculation require either price setting exceeding ATP tariff or obtainment of funds from sources where part of capital investment cost needs not to be recovered (government subsidy, or grant aid from an international aid agency or other organizations).

(3) Jakarta, Water

Full recovery of project costs is expected even in the base case. The result shows the basic tendency similar to that of water in Hanoi, but it’s more profitable.

(4) Jakarta, Sewerage

In the base case, capital investment cost cannot be recovered at all, and only part of O&M cost can be recovered. With ATP tariff application, since a very high ATP tariff is applied (about 17 times as much as the household tariff of the base case), O&M cost and capital investment cost can be fully recovered without introducing cross-subsidy.

3.3 Simplified Simulation for Bangladesh

A simplified simulation was conducted for waterworks projects in Bangladesh (Chittagong and Khulna) based on the similar ideas and method used for Hanoi and Jakarta in 3.2, for the

purpose of standardizing the method of simplified simulation for future examination of waterworks development.

3.3.1 Preconditions of Simulation

The preconditions, trial calculation and considered cases in implementing the simulation are set in the same way as in 3.2.

Previous Reports and Other Materials Referenced in Implementing Simulation

City	Project	Report
Chittagong	Water	SPECIAL ASSISTANCE FOR PROJECT FORMATION(SAPROF) FOR KARNAPHULI WATER SUPPLY PROJECT NOVEMBER 2005 SAPROF TEAM FOR JAPAN BANK FOR INTERNATIONAL COOPERATION
Khulna	Water	FEASIBILITY STUDY FOR KHULNA WATER SUPPLY IMPROVEMENT PROJECT IN THE PEOPLE'S REPUBLIC OF BANGLADESH Draft Final Report OCTOBER 2010 STUDY TEAM FOR JAPAN INTERNATIONAL COOPERATION AGENCY

3.3.2 Simulation Result and Examination

The following table shows the simulation result for Chittagong and Khulna.

Recovery Rate of Costs of Water and Sewerage Projects in Chittagong and Khulna

City	Project	Project cost	Base case	b. With ATP tariff application	c. With cross-subsidy adjustment
Chittagong	Water	O&M cost	265%	496%	513%
		Capital investment cost	54%	128%	135%
Khulna	Water	O&M cost	16%	177%	316%
		Capital investment cost	0%	36%	102%

(1) Chittagong, Water

In the base case, O&M cost can be fully recovered, but only part of capital investment cost can be recovered. With application of ATP tariff, which is about 3.4 times as much as the household tariff of the base case, and with implementation of cross-subsidy, which charges non-household use as same as the household use, full recovery of project costs can be achieved.

(2) Khulna, Water

In the base case, capital investment cost cannot be recovered, and only part of O&M cost can be recovered. With application of ATP tariff, which is about 14 times as much as the household tariff of the base case, O&M cost can be fully recovered.

With application of ATP tariff and, in addition, with implementation of cross-subsidy, which charges non-household use three times as much as the household use, not all capital investment cost can be recovered.

3.3.3 Examination of O&M Indices Application of Best Practice in Japan

(1) Calculation of anticipated O&M costs using the best practice in Japan

For water and sewerage projects in developing countries, based on recognition that improvement and increased efficiency of O&M are important challenges, we examined the room for improvement when the O&M best practice of municipalities in Japan discussed in Chapter 1 is applied to developing countries.

(i) Comparison of O&M costs with the best practice in Japan

When we compared the O&M costs per 1 m^3 of water required by the best practice in Japan and in Bangladesh (Chittagong), we found that the former cost about 16 times as much as the latter, resulted in a huge difference in two cost levels. Moreover, when we looked at the breakdown of costs, nearly 60% of the costs were accounted for labor cost and expenses for commission for the former, whereas nearly 80% of the costs were accounted for power cost for the latter, which exhibits characteristic differences.

(ii) Examination of the room for O&M cost reduction by increased efficiency

When we did a trial calculation of O&M cost in Bangladesh based on the human resource input, electric power input, chemicals input, etc., per 1 m^3 of water required by the best practice in Japan, the level of the O&M cost was estimated to be reduced by about 11.5% from the current level.

Note that, in Chapter 1, we estimated that the cost could be reduced about 17% by self-help efforts.

(2) Application of anticipated O&M costs using the best practice in Japan

The simulation has shown that when O&M cost is reduced by increased efficiency by using the best practice in Japan described as above, project sustainability can be improved through the improved recovery rate of project costs, in particular, the improved recovery rate of O&M cost.