Ex-Post Evaluation Report of Japan's ODA Loan Project

Brazil

Tiete River Basin Depollution Project

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Field Survey: April and July 2009

1. Project Profile and Japan's ODA Loan

Map of the Project Area

The Tietê River after River Improvement

1.1 Background

The São Paulo metropolitan area[1] is located in southeastern Brazil. It is the economic and industrial center of the São Paulo State, which has a population of approximately 20 million people. Before the project implementation, the Tietê River, which runs through the middle of the metropolitan area, flooded every year, blocking the principal highway along the riverside and causing major human and economic harm in residential and commercial areas. Flood damage was also severe during times of heavy rain in areas around the Cabuçu de Cima River, a tributary of the Tietê, so this increased the necessity for a flood prevention project for both rivers. At the same time, the concentration of population and industrial development in the metropolitan area meant there was a greater than ever need to secure new water resources and further advance a clean, stable water supply.

1.2 Project Objective

The objective of this project is to mitigate flood damage and promote a stable water supply by implementing river improvement in the Tietê River − which flows in the middle of the São Paulo metropolitan area − and the Cabuçu de Cima River, a tributary of the Tietê River and constructing dam facilities in the upper Tietê River area; thereby contributing to the improvement of life environment for the residents and the development of the regional economy.

[1] The area is located at an altitude of approximately 715−900 meters above sea level. The annual average temperature is around 20 C, and the annual precipitation is 1,400−1,500mm. There are rainy and dry seasons, and half the precipitation concentrates in the rainy season (normally December to March).

1.3 Borrower / Executing Agency

The Water and Electric Energy Department in the State of São Paulo (Departamento De Águas E Energia Elétrica: DAEE), guaranteed by the São Paulo State Government / The Water and Electric Energy Department (DAEE).

1.4 Outline of Loan Agreement

Loan Amount / Loan Disbursed Amount	49,427 million yen / 49,386 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 1993 / July 1995
Terms and Conditions	
-Interest Rate	5.0% (Consultant portion: 3.25%)
-Repayment Period (Grace Period)	25 years（7 years）
-Procurement	General untied
Final Disbursement Date	July, 2006
Main Contractors (Over 1 billion yen)	Camargo Correa・Constran S/A(JV) / Carioca Christiani-Nielsen Engenharia S/A / Constran S/A Construcoes E Comercio / Construcoes E Comercio Camargo Correa S.A.・Enterpa Engenharia Ltda.・Serveng-Civilsan S.A. Empresas Associadas De Engenharia(JV) / Constructora Andrade Gutierrez S.A.・Companhia Brasileira De Projetos E Obras (JV) / Constructora Andrade Gutierrez S.A.・Mape S/A-Construcoes E Comercio (JV) / Construtora Oas Ltda.・Carioca Chistiani-Nielsen Engenharia S/A・Mendes Junior Trading E Engenharia S.A. (JV) / Construtora Oas Ltda.・Enterpa Engenharia Ltda.(JV) / Construtora Queiroz Galvao S.A.・CBPO Engenharia Ltda.・Construcap Ccps-Engenharia E Comercio S.A. （JV）/ Primav Construcoes E Comercio / Construtora　Triunfo S/A *All companies are from Brazil.
Main Consultants (Over 100 million yen)	Enger Engenharia S/C Ltda.・Promon Engenharia Ltda.・Chuo Kaihatsu Corporation, Co. Ltd (JV) / Enger Engenharia S/C Ltda.・Chuo Kaihatsu Corporation, Co. Ltd (JV) / Maubertec-Engenharia E Projetos Ltda. / Projectus Consultoria S.A.・Bureau De Projetos E Consultoria Ltda. (JV) / Themag Engenharia E Gerenciamento Ltda.・Vetec Engenharia S/C Ltda.(JV) *All companies are from Brazil, except Chuo Kaihatsu Corporation, Co. Ltd (Japan).

Feasibility Study (F/S)	In 1992 / Phase 1: F/S prepared by the Bureau of Energy and Sanitary in the São Paulo State Government In 1998 / Phase 2: F/S prepared by DAEE

2. Evaluation Result (Rating: B)

2.1 Relevance (rating: a)

2.1.1. Relevance at Time of Appraisal

Beginning in 1991, the federal government of Brazil spent approximately five years establishing the National Water Resources Management System (SINGREH), a framework for policies related to water resources. SINGREH emphasizes the need to develop legal systems related to environmental issues, the importance of water resources, and so on. Meanwhile, in 1968, the São Paulo State government established the HIBRACE Plan, a multi-use water resources development plan. The objective of HIBRACE was to ensure a stable supply of water and to control flooding. In 1990, The São Paulo State established the State Plan for Water Resources to deal with the implementation of water resources policies and water resources management. As a result of population growth and industrial development in the metropolitan area, Brazil began recognizing the importance of policies related to securing water resources and water use, flood control policies, and so on.

The Tietê River running through the São Paulo metropolitan area, and the Cabuçu de Cima River had a low river discharge capacity. Therefore, when there was heavy rain, flood damage occurred on average two or three times a year. The decade of the 1990s experienced rapid urbanization, and flood damage became more severe, partly because the impervious surface of commercial and paved road expanded, and rainwater could not drain into the ground. Three water flow adjustment dams had already been constructed between 1972 and 1989 in the upper river basin of the Tietê River, which is located in the eastern part of the metropolitan area. These dams did help secure water resources and implement flood adjustment; however, as population growth and urbanization continued, there was growing awareness that future projects for a stable, clean water supply and flood control were necessary.

2.1.2. Relevance at Time of Evaluation

In 2006, the federal government of Brazil established the National Water Resources Plan (PNRH), which was built upon the aforementioned National Water Resources Management System (SINGREH). The PNRH regulates government plans related to environmental issues and water resources management until 2020. In 2004, the São Paulo State established the São Paulo Metropolitan Area Water Supply Master Plan (PDAA 2004), which focused on future water demand. In 2008, the São Paulo Metropolitan Area Water Program (PMA 2008−2014) was set up, which took the form of an upgraded Master Plan. Furthermore, at the end of 2008, the Tietê Upper River Basin Comprehensive Effluent Master Plan was established, stipulating

guidelines and plans for flood control policies for the next 10 years. Due to the concentration of the population and the industry development in São Paulo's metropolitan area, policies related to flood control and a clean water supply continue to be recognized as important.

As a result of the hydraulic improvement of the river resulting from this project, there is no flood damage from the Tietê River or the Cabuçu de Cima River at present. Furthermore, there were three dams in the upper river basin of the Tietê River prior to project; two new dams were constructed as part of this project, and they are contributing to flood adjustment functions and a clean, stable water supply[2].

Nonetheless, there are still regions around the tributary rivers of the Tietê River in the São Paulo metropolitan area (regions out of the project scope) where floods partially occur at times of heavy rain. Based on the above Master Plan, the São Paulo State government and the Executing Agency (DAEE) is preventing and mitigating flood damage by proceeding with the construction of rainwater runoff reduction facilities (flood control reservoirs) along the side of tributaries. The entities are continuing to develop anti-flood projects. Furthermore, it is forecasted that water demand in the metropolitan area will grow[3] due to further population growth[4] and urbanization, so it will be necessary to guarantee additional water resources in the future.

Regarding the above situation, this project has been highly relevant with Brazil's national policies and development needs at the times of both appraisal and ex-post evaluation.

2.2 Efficiency (rating: b)

2.2.1. Outputs

During the project implementation in June 2000, the project scope was changed[5] to incorporate a new river improvement zone into the original project. The original scope is called as "Phase 1", and the added scope is called as "Phase 2". The following table explains the comparison of planned and actual major outputs.

[2] The details are described at 2.3.1.4 Effectiveness in this report.
[3] The annual average population growth from 2000−2015 is anticipated 1.03% according to the data of the United Nations' "World Urbanization Prospects: The 2003 Revision."
[4] According to the Master Plan, the daily average amount of water supply is anticipated to rise around 43,200 m3 annually.
[5] The project period and cost were also changed. Unused budget allocations from Phase 1 implementation were transferred to the cost of Phase 2. The unused project budgets are from: 1） São Paulo State government bearing the construction cost of interconnection water canal (Phase 1) in the upper Tietê River with its own budgets (around 12 billion yen), and 2) a relatively high unit price of the construction (around 13 billion yen) was set, anticipating hyperinflation that annually exceeds 1,000% at time of the appraisal of the Phase 1.

Table 1: Comparison of Planned and Actual Major Outputs

<table>
<tr><th>Outputs</th><th>Planned
(At the Appraisal)</th><th>Actual
(At the Ex-Post Evaluation)</th></tr>
<tr><td colspan="3">Phase 1</td></tr>
<tr><td>1. Hydraulic Improvement of the Tietê River (Phase 1)</td><td>(a) From Edgard de Souza Dam to Coffer Dam (at the meeting point with Pinheiros River): 16.5km
(b) Design safety degree against flood: 1/100
(c) Design section base width: 60-100m（Design section type: Trapezoidal 1V: 2H）</td><td>=>Almost as planned
(a) and (b) are as planned
(c) Design section base width: 54-61m
(In addition, one bridge for an arch-style pedestrian passageway was constructed by local funds.)</td></tr>
<tr><td>2. Hydraulic Improvement of the Cabuçu de Cima River</td><td>(a) From the meeting point between Cabuçu de Cima River and Tietê River to Três Cruzes Bridge: 10.5km
(b) Design safety degree against flood: 1/100
(c) Design section base width: Design section type is Trapezoidal (Trapezoidal section 10-20m) and Rectangular (Rectangular section 15-30m)</td><td>=>Almost as planned
(a) 10.3km
(b) As planned
(c) As planned（But the portion of the Trapezoidal section increased）
(In addition, 7 bridges were reconstructed with local funds.）</td></tr>
<tr><td>3. Upper Tietê Water Resource Development</td><td>(a) Construction of Bitritiba Dam and Paraitinga Dam
Comparison of the planned and actual is shown below.
<table>
<tr><th colspan="2">Item</th><th>Biritiba Dam</th><th>Paraitinga Dam</th></tr>
<tr><td rowspan="2">Crest length</td><td>Planned</td><td>520m</td><td>415m</td></tr>
<tr><td>Actual</td><td>535m</td><td>425m</td></tr>
<tr><td rowspan="2">Maximum height</td><td>Planned</td><td>27m</td><td>31m</td></tr>
<tr><td>Actual</td><td>26m</td><td>28m</td></tr>
<tr><td rowspan="2">Effective storage capacity</td><td>Planned</td><td>50.0 million m^3</td><td>78.0 million m^3</td></tr>
<tr><td>Actual</td><td>34.4 million m^3</td><td>35.0 million m^3</td></tr>
<tr><td rowspan="2">Planned flood flow</td><td>Planned</td><td>400 m^3/sec.</td><td>625 m^3/sec.</td></tr>
<tr><td>Actual</td><td>190 m^3/sec.</td><td>382 m^3/sec.</td></tr>
<tr><td rowspan="2">Size of drainage basin</td><td>Planned</td><td>75k m^2</td><td>182k m^2</td></tr>
<tr><td>Actual</td><td>75k m^2</td><td>184k m^2</td></tr>
<tr><td rowspan="2">Size of submerged basin</td><td>Planned</td><td>11.0k m^2</td><td>6.9k m^2</td></tr>
<tr><td>Actual</td><td>11.4k m^2</td><td>6.6k m^2</td></tr>
</table>
=>Some designs were changed.
(b) Construction of Interconnection water canal
[Interconnection water canal</td><td>=>As planned（but construction was implemented with funds</td></tr>
</table>

	between Biritiba Dam and Tietê River] * Interconnection water canal: 3,200m, Water supply pumping station: 1 place [Interconnection water canal between Biritiba Dam and Jundiaí Dam] * Interconnection water canal: 2,900m, Water supply tunnel: 750m	from the São Paulo State government）
4.Consulting Service（Phase 1）	(a) Support for the whole management: 30M/M (b) Detail design of Tietê River/Cabuçu de Cima River: 22M/M (c) Detail design of Biritiba Dam: 33M/M (d) Detail design of Paraitinga Dam: 33M/M	=>M/M increased (a) 67M/M (b) 38M/M (c) 48M/M (d) 53M/M
Phase 2		
1. Hydraulic Improvement of the Tietê River (Phase 2)	(a) From the meeting point of Pinheiros River to Peña Dam: 24.5km (b) Design safety degree against flood: 1/100 (c) Design section base width: 50m (Design section type: Trapezoidal)	=>As planned
2. Civil Works in the Lower Tietê River Basin	(a) Heightening and improvement works of Porunduva Dike (Near the Pirapora reservoir) (b) Strengthening of Pirapora Dam (c) Improvement of connecting road (Romeiros Road): 2.9km	(a) and (c) as planned (b) Cancelled
3. Consulting Service（Phase 2）	(a) Support for the whole management: 60M/M (b) Detail design: 68M/M	=>Almost as planned (a) 66 M/M (b) 56 M/M

Source: JICA documents, Project Completion Report (PCR), Answers on questionnaires

The followings are the brief explanations of the main points of difference between the planned and actual.

Phase 1

Hydraulic Improvement of the Tietê River (Phase 1)

There is a difference in the section base width between the planned and actual. At the time of

appraisal, the section base width was planned with 100m around Edgard de Souza Dam, and the major parts of the section base width were planned mostly at 60m in other areas. As a result, there is no great difference between the planned and actual.

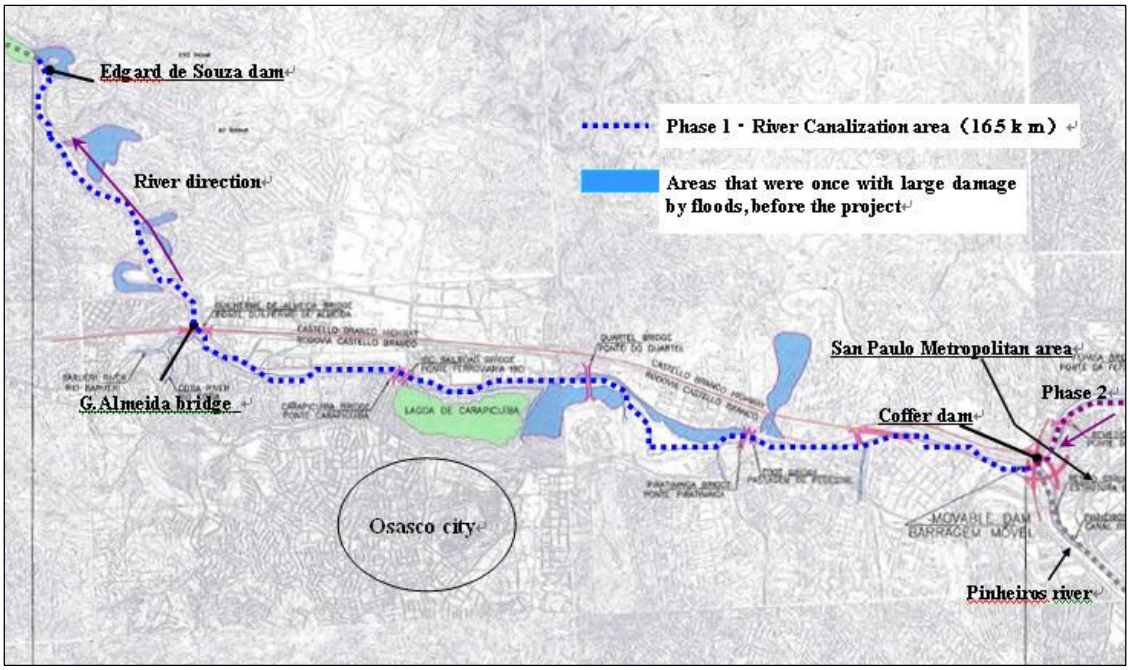
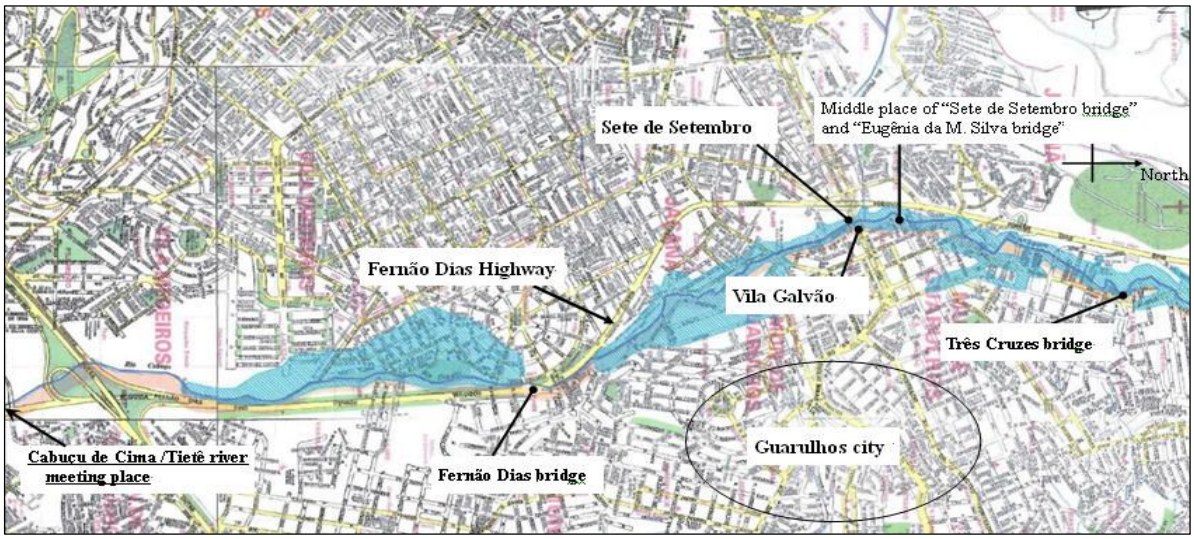


Figure 1: Project Site: Hydraulic Improvement of the Tietê River (Phase 1)

Hydraulic Improvement of the Cabuçu de Cima River

The proportion of the trapezoidal section (a design section type) increased compared to the original plan due to the design modification[6] that was deemed appropriate for project cost reasons.



[6] The detail is shown at 2.4.4 Impact "Resettlement of residents and land acquisition".

Figure 2: Project Site: Hydraulic Improvement of the Cabuçu de Cima River (the blue markings indicate actual flood damage in the past)

Upper Tietê Water Resource Development

a) Dam Construction

According to the explanation by the Executing Agency, the difference in effective storage capacity at the time of the appraisal and at the time of the ex-post evaluation was due to "the difference of the maximum height between the plan and actual,[7] leading to a disparity in the effective storage capacity." The disparities in the maximum heights and the crest lengths of the dams were due to the results of the detailed design in the project implementation stage[8].

Furthermore, the designed flood flow was different between the time of the appraisal and the time of the ex-post evaluation, because at the time of the appraisal, a discharge from a once-in-10,000-years flood was assumed; later, the design was revised to the discharge value for a once-in-a-1,000-years flood.

b) Construction of Interconnection Water Canal

The interconnection water canal and the pumping station and tunnels for water supply were constructed with funds from the São Paulo State government (the implementing agency was the Sanitation Company of the State of São Paulo [SABESP]). The reason that Japan's ODA loan funds were not used is that after the signing of the original loan agreement, water shortages became an urgent problem and water demand was tight; therefore, with JICA's approval, the construction of the interconnection water canals was commenced[9] using state government funds to act quickly to remedy the situation. At present, SABESP is operating and maintaining the facilities related to these interconnection water canals.

[7] It is about disparity in the maximum heights of the dams, of which the actual value is 28m and the planned value is 31m (3m disparity) regarding Paraitinga Dam, and which the actual value is 26m and the planned value is 27m (1m disparity) regarding Biritiba Dam.

[8] The appraisal of the dams was conducted based on the basic design of 1977 and the detailed design was planned to be conducted at the project implementation stage.

[9] Commenced in November 1997.

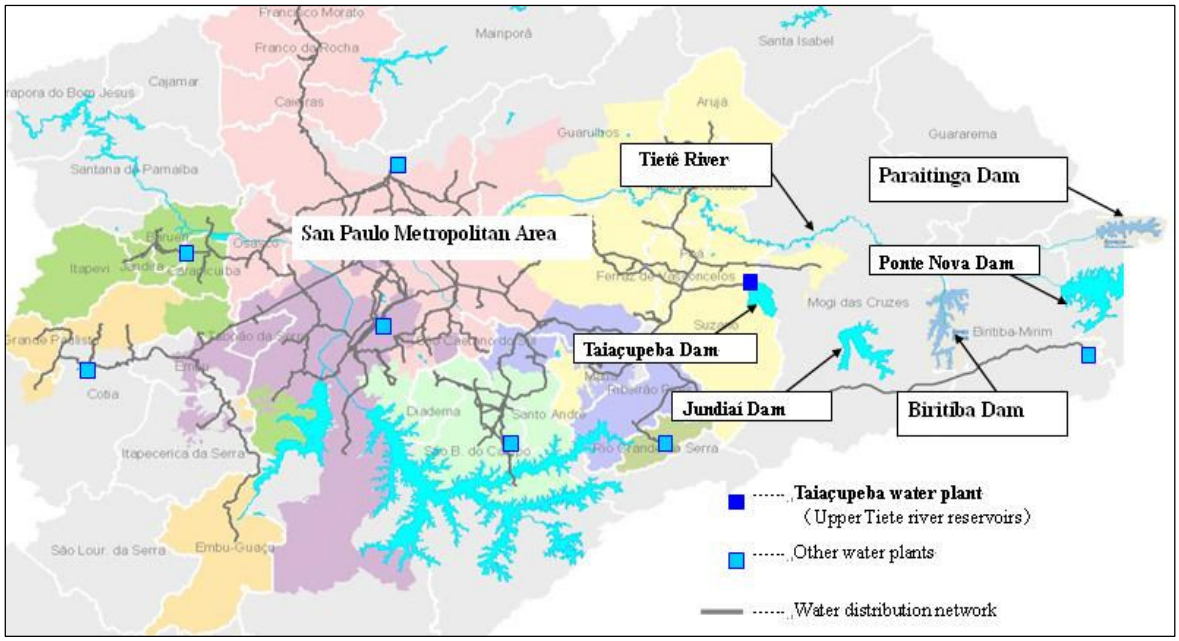


Figure 3: Project Site: Upper Tietê Water Resource Development

Consulting Service （Phase 1）

The reason the M/M increased compared to the time of appraisal was due to the extension of the project implementation period.

Phase 2

Civil Works in the Lower Tietê River Basin

In terms of the civil work of strengthening of Pirapora Dam, after the project initiation, the technical inspection about lifetime sustainability was conducted by a consultant. As a result, it was concluded that the security and lifetime sustainability were secured; therefore, with JICA's concurrence, the civil work was canceled.

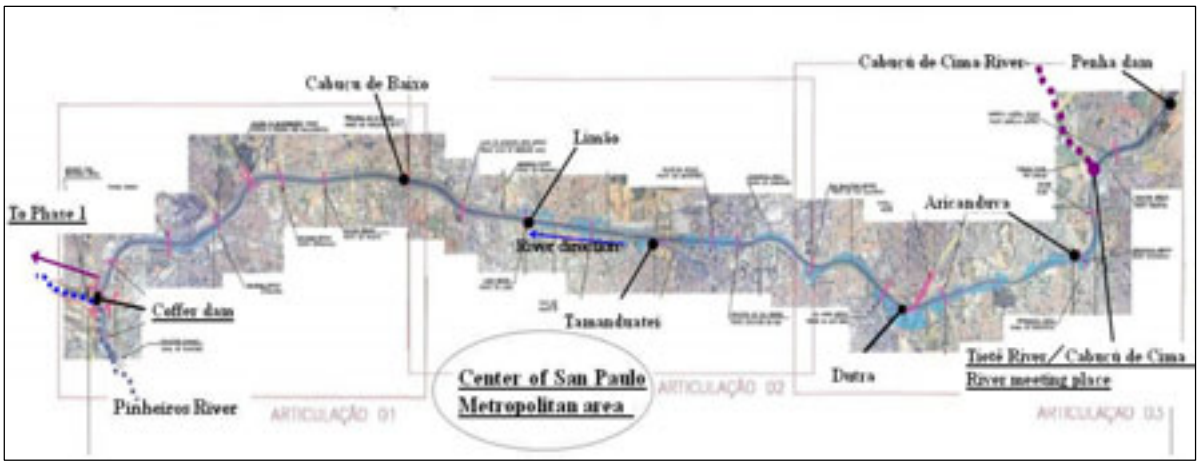


Figure 4: Project Site: Hydraulic Improvement of the Tietê River (Phase 2)

Figure 5: Pre- and Post-Views of Hydraulic Improvement of the Tietê River (Phase 2)

2.2.2 Project Period

As stated in 2.2.1, in the ex-post evaluation, the original scope is called “Phase 1” and the additional scope is called “Phase 2”. The planned project period of Phase 1 was 4 years and 11 months from July 1995 to May 2000, and the planned project period of Phase 2 was 5 years and 9 months from June 2000 to February 2006. As shown in Table 2, Phase 1 actually took eight years, from July 1995 to June 2003, 63% longer than planned. The project period of Phase 2 was the same as the plan (100% of the plan).

The delay in Phase 1 was due mainly to the delay in the Paraitinga Dam construction work, and the reasons for this delay were that the detailed design and the land acquisition procedures required substantial time and that geologically fragile areas were discovered, so it was necessary to inject cement into the soil to strengthen it. Furthermore, the delay in river improvement of the Tietê River (Phase 1) and construction of the Biritiba Dam were due to long time required for detailed designing, and the delay in the hydraulic improvement of the Cabuçu de Cima River was due to time required for land acquisition and resettlement of residents. The delay in the Civil Works in the Lower Tietê River Basin (Phase 2) was due to time required for coordination

among relevant local institutions such as the Pirapora City government as well as obtaining permission for forest clearing in the area of the connecting road to the Porunduva Dike.

Table 2: Comparison of Planned and Actual Period

Outputs	Planned	Actual
The Whole Project: Phase 1	July 1995 to May 2000 (4 years and 11 months)	July 1995 to June 2003 (8 years)
1) Hydraulic Improvement of the Tietê River (Phase 1)	February 1998 to January 2000	January 1998 to December 2000
2) Hydraulic Improvement of the Cabuçu de Cima River	July 1995 to April 1999	July 1995 to October 2001
3) Construction of Biritiba Dam	April 1998 to March 2000	December 1998 to December 2001
4) Construction of Paraitinga Dam	April 1998 to March 2000	December 1998 to June 2003
5) Consulting Service (Phase 1)	July 1997 to May 2000	July 1997 to June 2003
The Whole Project: Phase 2	June 2000 to February 2006 (5 years and 9 months)	June 2000 to February 2006 (5 years and 9 months)
1) Hydraulic Improvement of the Tietê River (Phase 2)	March 2001 to February 2006	April 2001 to February 2006
2) Civil Works in the Lower Tietê River Basin	September 2001 to February 2004	July 2003 to January 2006
3) Consulting Service (Phase 2)	June 2000 to February 2006	June 2000 to December 2005

Source: JICA documents, Project Completion Report (PCR), Answers on questionnaires

2.2.3 Project Cost

The actual project cost was below the planned cost. The planned cost was 82,379 million yen (Japan's ODA loan amount was 49,427 million), and the actual cost was 70,452 million yen (Japan's ODA loan amount was 49,386 million), which was below the planned cost (about 86% of the plan). The main reasons for cost reduction throughout both Phases 1 and 2 were the cancellation of strengthening the Pirapora Dam, the fulfillment of competitive bidding in other outputs, and the affect of fluctuations in foreign currency (Japanese yen appreciated against Brazilian Real).

The project cost was within the planned amount, but the project period exceeded the planned period; therefore the evaluation for efficiency is moderate.

2.3 Effectiveness (rating: a)

2.3.1 Effectiveness Evaluation by Operation and Effect Indicators

2.3.1.1 Discharge Capacity in the Observation Points

The following table shows the discharge capacity (flow amount maximums) in each observation point at the hydraulic river improvement zone. The "actual" at the time of ex-post evaluation, below, shows the secured capacity after the river improvement. The work of the river improvement was implemented along with the original plan, and the outputs − such as the design section base width and height of the embankment − were secured. As a result, the discharge capacity was also secured[10].

Table 3: Discharge Capacity in the Observation Points of the Hydraulic River Improvement Zone

1) Hydraulic Improvement of the Tietê River (Phase 1)

Observation Points[11]	At Time of Appraisal		Actual: At Time of Ex-Post Evaluation (Flow Amount Maximums)
	Actual Discharge Capacity	Targeted Discharge Capacity	
The meeting point of the Tietê River and the Pinheiros River	681 m^3/sec.	1,048 m^3/ sec.	1,048 m^3/ sec.
G.Almeida Bridge	717 m^3/ sec.	1,188 m^3/ sec.	1,188 m^3/ sec.
Edgard de Souza Dam	791 m^3/ sec.	1,434 m^3/ sec.	1,434 m^3/ sec.

Source: JICA documents (At the appraisal), Executing Agency documents (Actual)

2) Hydraulic Improvement of the Cabuçu de Cima River

Observation Points	At Time of Appraisal		Actual: At Time of Ex-Post Evaluation (Flow Amount Maximums)
	Actual Discharge Capacity	Targeted Discharge Capacity	
The meeting point of the Cabuçu de Cima River and the Tietê River	200 m^3/ sec.	320 m^3/ sec.	320 m^3/ sec.
Fernão Dias Bridge	100 m^3/ sec.	320 m^3/sec.	320 m^3/ sec.
Sete de Setembro Bridge	130 m^3/ sec.	297 m^3/ sec.	297 m^3/ sec.
Middle point of Sete de Setembro Bridge /Eugênia M. Silva Bridge	45 m^3/ sec.	195 m^3/ sec.	195 m^3/ sec.
Três Cruzes Bridge	25 m^3/ sec.	186 m^3/ sec.	186 m^3/ sec.

Source: JICA documents (At the appraisal), Executing Agency documents (Actual)

[10] The targeted discharge capacity value at the time of appraisal and the actual value at the time of ex-post evaluation are the same. According to the Executing Agency, as a result of securing the discharge capacity as implementing the hydraulic river improvement as planned, the capacity was secured as the targeted value.

[11] The observation points can be referenced in Figure 1 for the hydraulic river improvement of the Tietê River (Phase 1), in Figure 2 for the Cabuçu de Cima River, and in Figure 4 for the Tietê River (Phase 2).

3）Hydraulic Improvement of the Tietê River (Phase 2)

Observation Points	At Time of Appraisal		Actual: At Time of Ex-Post Evaluation（Flow Amount Maximums）
	Actual Discharge Capacity	Targeted Discharge Capacity	
Peña Dam to the End of the Cabuçu de Cima River	150 m^3/ sec.	498 m^3/ sec.	498 m^3/ sec.
End of the Cabuçu de Cima River to Aricanduva	210 m^3/ sec.	561 m^3/ sec.	561 m^3/ sec.
Aricanduva - Tamanduateí	270 m^3/ sec.	640 m^3/ sec.	640 m^3/ sec.
Tamanduateí – Cabuçu de Baixo	480 m^3/ sec.	997 m^3/ sec.	997 m^3/ sec.
Cabuçu de Baixo – Coffer Dam （around the meeting point of the Tietê River and the Pinheiros River）	640 m^3/ sec.	1,048 m^3/ sec.	1,048 m^3/ sec.

Source: Executing Agency documents (Actual)

2.3.1.2 The Highest Water Level in the Observation Points (Annual Highest Water Level)

In the hydraulic river improvement zones (Phase 1 and 2) before the project implementation, floods used to occur and cause damage in the area exceeding the Flood Danger Water Level, two or three times a year on average. Table 4 shows the recorded highest water level in each observation point of the Phase 1 and 2 zones. In the observation points after the project completion, there was only one time at which the river water level exceeded the Flood Danger Water Level in 2005 (Phase 1 zone). Although the following data cannot be concluded to be effective indicators for measuring the project effect, looking at the data of the water level, the number of exceeding the Flood Danger Water Level has diminished throughout the project implementation. Therefore, it can be assumed that flood control is working effectively. Additionally, there is no data of water level until 2006 in the Cabuçu de Cima River but, according to the Executing Agency, no flood has occurred since 2000.

Table 4: The Highest Water Level in the Observation Points（Unit: m）

Year	Observation Points (Date Shows Recorded Date)			
	Coffer Dam	Vila Galvão	Limão	Dutra
	Phase 1 (Tietê River)	Phase 1 (Cabuçu de Cima River)	Phase 2 (Tietê River: two points)	
1995	717.70 (February 2)	N/A	720.88 (February 2)	N/A
1997	719.21 (December 22)	N/A	721.22 (January 27)	N/A
2000	718.19	N/A	720.86	N/A

	(January 26)		(January 26)	
2001	716.89 (December 9)	N/A	720.75 (December 9)	N/A
2002	716.48 (November 28)	N/A	719.82 (November 28)	N/A
2003	717.14 (January 28)	N/A	720.30 (January 28)	N/A
2004	717.26 (November 29)	N/A	719.53 (April 19)	N/A
2005	719.78 (May 25)	N/A	719.76 (January 11)	N/A
2006	718.54 (March 29)	N/A	720.00 (January 4)	720.32 (November 25)
2007	718.88 (December 19)	730.34 (November 3)	720.27 (February 8)	721.11 (December 7)
2008	717.81 (January 29)	730.88 (March 13)	719.23 (January 29)	719.56 (February 22)

Source: Executing Agency Documents

Note: The double line shows the completion year of the hydraulic river improvement. The purple color shows the excess of Flood Danger Water Level (719m), and the purple color with thick frame shows the excess of the Flood Danger Water Level after the river improvement.

Reference 1: *The Water Level Standard in Each Observation Point*

Flood Danger Water Level	Flood damage can be occurred with high probability. Places where the flood may occur are prohibited to enter, and fire organizations, military, and police start their activities. Detours for cars are also prepared.
Extra Emergency Water Level	Fire organizations, military, and police are in standby. The movement of cars in the main roads is shut down by barricade. Removal of the cars is requested at the place where the flood damage was severe in the past.
Emergency Water Level	The water level rises higher than the Attention Level, and emergency notice is announced to public service entities (e.g., electric and sanitary companies), fire organizations, military, and police.
Attention Water Level	Water level becomes higher than the normal river stream, and the water level starts to be observed on a real-time base. Attention notice is announced.

Reference 2: Accumulated Precipitation at the Highest Water Level: Precipitation from the Beginning of the Rainfall to the End of the Rainfall

It cannot be said that there is a correlation between the precipitation data in Table 5 and data in Table 4 because the rainfall zone varies in the river basin and the condition of the outflow also differs. However, it can be assumed that the accumulated precipitation in the observation point was recorded high to some extent when the river water level exceeded the Flood Danger Water Level.

Table 5. Accumulated Precipitation at the Highest Water Level (Table 4) （Unit: mm）

Year	Accumulated Precipitation at the Observation Points (*date below shows its recorded date)			
	Coffer Dam	**Vila Galvão**	**Limão**	**Dutra**
	Phase 1 (Tietê River)	**Phase 1 (Cabuçu de Cima River)**	**Phase 2 (Tietê River: Two Points)**	
1995	79.30 (February 2)	N/A	**70.30** (February 2)	N/A
1997	**150.40** (December 21 to 23)	N/A	N/A	N/A
2000	13.70 (January 26)	N/A	**65.00** (January 26)	N/A
2001	54.60 (December 9)	N/A	80.80 (December 9)	N/A
2002	6.80 (November 28)	N/A	0 (November 28)	N/A
2003	63.90 (January 28)	N/A	32.40 (January 28)	N/A
2004	117.30 (November 29)	N/A	21.80 (April 19)	N/A
2005	**105.20** (May 25)	N/A	44.20 （January 11）	N/A
2006	100.40 (March 29)	N/A	N/A	N/A
2007	47.30 (December 19)	83.00 (November 3)	51.00 (February 8)	N/A
2008	45.00 (January 29)	72.40 (March 13)	45.00 (January 29)	N/A

Source: Executing Agency Documents

Note: The purple color shows the excess of Flood Danger Water Level (719m), and the purple color with thick frame shows the excess of the Flood Danger Water Level after the river improvement.

2.3.1.3 Flood Frequency, Inundated Area, and Number of Inundated Buildings (Damaged Buildings)

The following table shows the data recorded by the Executing Agency before the project implementation on the anticipated flood damage[12] and actual maximum flood damage. According to the Executing Agency, before the project implementation in the Tietê River Phases 1 and 2 zones, floods actually occurred two or three times a year on average, and on the Cabuçu de Cima River they occurred six to ten times a year on average. However, the data compiled in the Executing Agency about actual flood damage – such as the inundated area and the number of inundated buildings, etc. – was deficient, so data on flood damage was created using estimates

[12] It is not the actual value but the anticipated value of flood damage that can be occurred periodically before the project implementation.

such as the following, with reference to the various conditions, statistical data, and so on, related to flood damage. In this way, indicators and data on project effectiveness and flood damage were not managed thoroughly in the Executing Agency, which resulted in the difficulty to measure project effectiveness (quantitative effects) in the ex-post evaluation. However, according to the Executing Agency and the local interview surveys, it has been confirmed that since the project completion, no flood damage has occurred in the hydraulic improvement zones of the Tietê River and the Cabuçu de Cima River.

Table 6: Data of Anticipated Damage and Actual Maximum Damage before Project Implementation

Indicators (Anticipated Damage)	Tietê River (Phase 1 Zone)		Tietê River (Phase 2 Zone)		Cabuçu de Cima River (Phase 1 Zone)	
	Periodic Flood	Flood February 1, 1983[a]	Periodic Flood	Flood February 1, 1983[a]	Periodic Flood	Flood January 15, 1991[a]
Inundated Area	53,150 m^2	6,341,000 m^2	505,000 m^2	10,568,000 m^2	N/A[b]	350,000 m^2
Number of Inundated Houses	324	2,432	624	11,463		3,000
Number of Inundated Office Buildings	29	219	88	1,662		N/A
Total Inundated Commercial Areas	5,294 m^2	63,160 m^2	129,331 m^2	878,201 m^2		N/A
Total Inundated Industrial Areas	31,093 m^2	342,097 m^2	116,857 m^2	930,512 m^2		N/A

Source: Executing Agency documents

[a] "Flood occurred February 1, 1983" and "Flood occurred January 15, 1991" are the data of maximum damage in the last 30 years.

[b] The periodic flood damage data was not recorded.

As shown in Table 4, in one of the Phase 1 zones, a water level in excess of the Flood Danger Water Level was recorded on May 25, 2005. According to the Executing Agency, the elevation of the land surrounding the river is higher than the Coffer Dam's observation point (measurement point), so that even when the discharge from the river reached the Flood Danger Water Level at a time of heavy rain, the water did not go as far as the surrounding land areas, so no damage occurred. At other observation points in Table 4, based on the measured data, the Flood Danger Water Level did not exceed after the hydraulic river improvement. Therefore,

flood damage from the improvement zone of this project was reduced to zero, so we can judge that the initial objective (the reduction of flood damage) was achieved.

On the other hand, around the tributaries of the Tietê River and the Cabuçu de Cima River, there are locations in which floods occur at times of heavy rain, causing damage to surrounding areas. The major reason for this is that effluent treatment is not being fully carried out due to rapid urbanization from the expansion of commercial and residential areas. The Executing Agency is cooperating with local governments in an attempt to alleviate flood damage by constructing rainwater runoff reduction facilities (flood control reservoirs) along the banks of the rivers (tributaries); however, at the current time, they have not been able to prevent all flood damage in the tributaries. Nonetheless, it is expected that future flood damage will be reduced further with the addition[13] of more facilities.

Figure 6 : Flood Damage in February 1983

Figure 7: Rainwater Runoff Reduction Facilities (Flood Control Reservoirs)

Reference: *Flood Damage for Residents in the São Paulo Metropolitan Area*

The following table shows the data on residents suffering from floods in the rainy season (in normal years the four-month period from December to March). The figures show the number of victims in the São Paulo metropolitan area overall until 2003−2004 and in each municipality from 2004−2005 onwards (examples: São Paulo City → the Tietê River Phase 2 area, Guarulhos City → the Cabuçu de Cima River area, Osasco City → the Tietê River Phase 1 area). When referring to this data, it is important to note that data indicates “flood damage that occurred in the areas including all of the tributaries”. Therefore, there was no flood damage at all from the main Tietê River and the Cabuçu de Cima River.

No major changes can be seen in the number of injuries or fatalities; however, over the last few years, the number of people who have lost their homes has been lower than previously. Since the hydraulic river improvement has been completed and the aforementioned construction of rainwater runoff reduction facilities along the banks of the rivers (tributaries) is continuing, it

[13] As of December 2008, there are 42 flood control reservoirs in the São Paulo metropolitan area, and four new facilities are under construction. The largest of the flood control reservoirs has a maximum capacity of 800,000m^3 (approximately two-thirds of the size of Tokyo Dome).

is assumed that in the future flood damage will be reduced even further in the São Paulo metropolitan area.

Table 7: Flood Damage for Residents in the São Paulo Metropolitan Area

Year	Areas	Injuries	Fatalities	People who Lost their Homes
2001−02	The whole São Paulo metropolitan area	28	7	365
2002−03	The whole São Paulo metropolitan area	33	11	714
2003−04	The whole São Paulo metropolitan area	16	1	482
2004−05	São Paulo City	7	5	30
	Guarulhos City	8	2	40
	Osasco City	0	0	120
2005−06	São Paulo City	12	4	261
	Guarulhos City	1	6	46
	Osasco City	12	1	235
2006−07	São Paulo City	4	1	14
	Guarulhos City	1	2	11
	Osasco City	0	1	0
2007−08	São Paulo City	11	6	0
	Guarulhos City	4	1	44
	Osasco City	6	0	67
2008−09	São Paulo City	20	4	0
	Guarulhos City	1	1	18
	Osasco City	0	2	0

Source: Defesa Civil S.P.

2.3.1.4 Population Served, Percentage of Population Served and Amount of Water Supply （Project Effects by Upper Tietê Water Resource Development）

The Water Supply System in the Upper Tietê River Basin (water amount adjustment using storage dams) has functions not only for flood control but also for supplying clean water. In short, this adjustment system has a function that enables it to control water amount, to some extent, to prevent flood damage at times of heavy rain in the São Paulo metropolitan area while at the same time being used as a valuable source of clean water. The Biritiba Dam and the Paraitinga Dam constructed in this project, in combination with the existing three storage dams (Ponte Nova, Taiaçupeba and Jundiaí for a total of five dams), constitute the Water Supply System in the Upper Tietê River Basin. Water is delivered to the Taiaspeba Dam via the interconnection water canals and pumping stations, and then it is purified and treated at the

adjacent water treatment plant and supplied to the São Paulo metropolitan area. The water is largely used for drinking. Currently, the total amount of purified and treated water delivered from these five storage dams is approximately 10m^3/second (of this, a total of about 2.5m^3/second is the amount of purified and treated water from the Biritiba Dam and Paraitinga Dam). In the near future, it is planned to enhance the facilities and equipment functions of the Taiaspeba water treatment plant to supply water at approximately 15m^3/second.

As shown in Table 8 below, the population served and the amount of average daily water supply in the São Paulo metropolitan area are increasing year by year. The reason that the amount of average daily water supply declined slightly in 2007−2008 is that SABESP implemented a program related to the appropriate use and loss control of water. The amount of purified and treated water within the São Paulo metropolitan area overall is currently approximately 68m^3/second. As stated above, the amount of purified and treated water from the Biritiba Dam and the Paraitinga Dam is not large, but both dams are considered valuable water resources for a stable water supply to the metropolitan area.

Table 8: Population Served, Percentage of Population Served and Amount of Water Supply in the São Paulo Metropolitan Area

Item	Estimated Value before Project Implementation			Actual Value				
	1990	1995	2000	2004	2005	2006	2007	2008
Population Served (Unit: thousand people)	14,613	16,283	18,150	18,280	18,316	18,465	18,637	18,910
Supply Rate (Percentage of Population Served) (Unit: %)	91	92	94	96	96	96	96	96
Amount of the Average Daily Water Supply (Unit: thousand m^3/day)	3,818	4,361	5,044	5,565	5,685	5,810	5,763	5,754

Source: JICA documents, SABESP

2.3.2 Recalculation of Economic Internal Rate of Return (EIRR)

In this ex-post evaluation study, it was not possible to recalculate the Internal Rate of Return with the same condition as time of the appraisal, because the calculation base at time of the appraisal was unclear and the value itself was only for the Phase 1 project. The Executing Agency prepared a report regarding the economic evaluation of this project in May 2001, including a portion of Phase 2. Then, the Economic Internal Rate of Return (EIRR) was calculated as 10.97 % in the report. In this ex-post evaluation study, when EIRR was

recalculated applying the same condition,[14] the rate was 8.49%. The reason the rate was lower than the estimation is that the actual maintenance cost (actual amount of 2006−2009) increased compared to the estimated maintenance cost[15], which was calculated in May 2001.

2.3.3 Implementation of Beneficiary Survey (Qualitative Effects)

In this ex-post evaluation study, a beneficiary survey (questionnaire survey) targeted residents and those who are engaged in commercial activities was conducted[16], choosing three points which were once with large damage by flood before the project implementation. The following figures show the results.

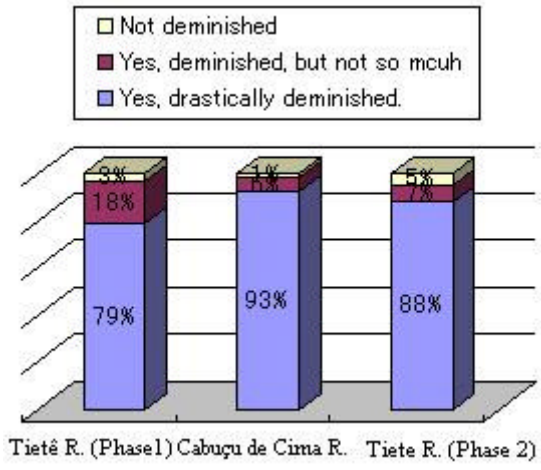


Figure 8: Whether the flood frequency has decreased compared to before the river improvement

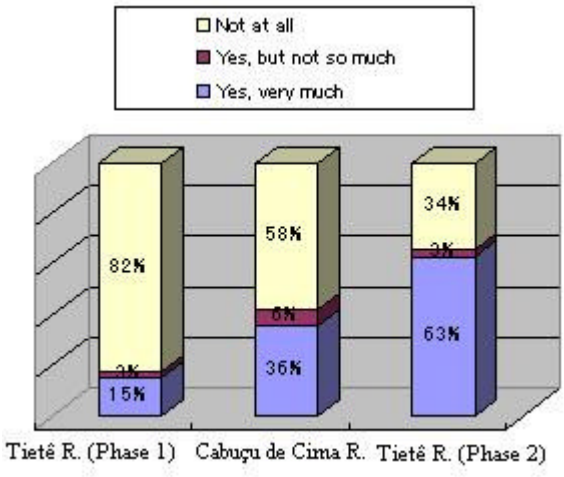


Figure 9: Whether there was flood damage (human/economic) before the river improvement

[14] In calculation of EIRR, construction costs and operation & maintenance costs were included in costs, and decrease of flood damage on buildings in surrounding residential, commerce, and industrial areas, and decrease in transport cost were included in benefits.
[15] Sufficient amount of operation & maintenance costs were not estimated, when calculating before the project.
[16] The total sample is 200, which consist of 62 samples from Tietê River Phase 1 (Osasco City), 70 samples from Cabuçu de Cima River (Guarulhos City), and 68 samples from Tietê River Phase 2 (São Paulo City).

Table 9: Transition of Damage Degree in the Pre- and Post-Hydraulic River Improvement

Type of Damage	Before the River Improvement	After the River Improvement
Flowing Dirt to Buildings	Yes 99% No 1%	Yes 9% No 91%
Damage to Furniture and Equipment	Yes 86% No 14%	Yes 5% No 95%
Damage to Buildings	Yes 48% No 52%	Yes 4% No 96%
Injuries by Flood	Yes 16% No 84%	Yes 1% No 99%
Damage to Lifelines (e.g., electricity and water supply)	Yes 35% No 65%	Yes 4% No 96%
Damage to Roads and Transports	Yes 62% No 38%	Yes 8% No 92%

Source: Beneficiary survey result: Question for those who answered "Yes" in Figure 9, three areas total

As shown in Figure 8, most residents realize that there are no longer floods in the hydraulic river improvement zone of this project. The reason that there are some respondents who answered "not diminished" seems to be due to the fact that flood still occurs（Referring to 2.3.1.3）in the tributaries of the Tietê River and the Cabuçu de Cima River.

As shown in Figure 9, flood damage was especially severe in the Phase 2 zones before the hydraulic river improvement. The residential and commercial areas in the Phase 2 zones are more crowded than the Phase 1 zones, and it seems that the damage was relatively large when floods occurred. It is evident that there has been a drastic change between the pre- and post-river improvement, looking at both the situation of human / economic damage and the transition of the damage degree.

Therefore, this project has largely achieved its objectives, and its effectiveness is high.

2.4 Impact

2.4.1 Improvement of Life Environment in the São Paulo Metropolitan Area

The result of beneficiary survey[17] regarding improvement of life environment of the residents by the flood mitigation was as follows. Judging the overall tendency, it is inferred that this project has contributed highly to the improvement of life environment for those living and working in São Paulo metropolitan area. The number of the beneficiaries of this project is assumed to be around 20 million people.

[17] A questionnaire survey was conducted in the same way as the beneficiary survey of 2.3.3 Effectiveness (3 areas and 200 samples).

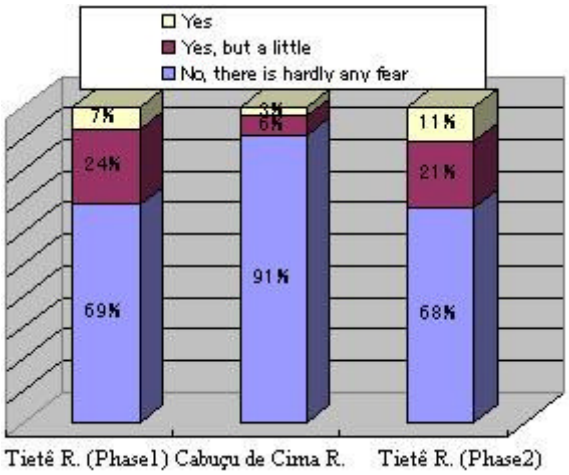


Figure 10: Whether there is fear of flood after the river improvement

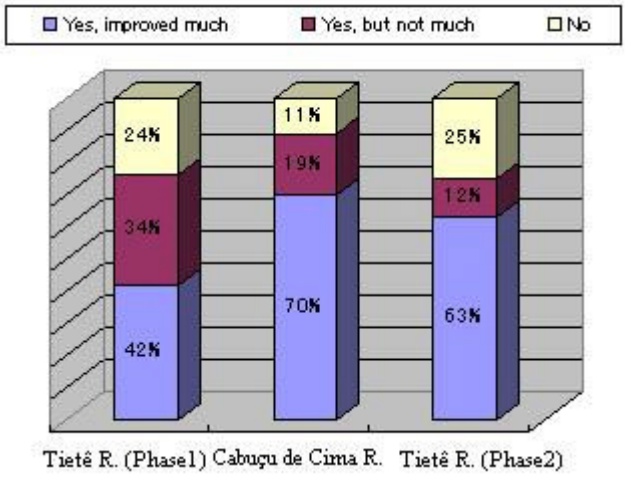


Figure 11: Whether unsanitary conditions were improved after the river improvement

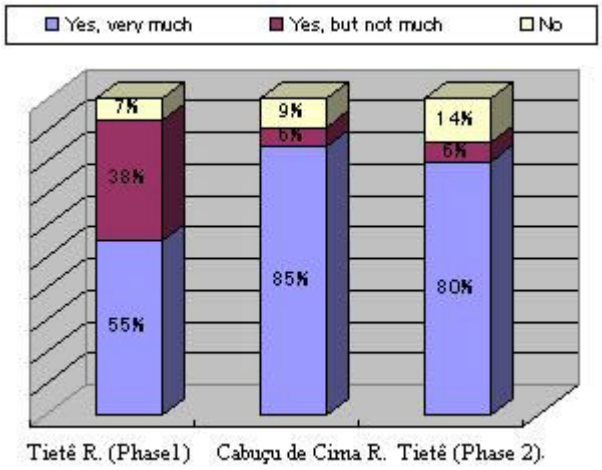


Figure 12: Do you think the sanitary improvement (Figure 11) is due to the river improvement and flood control?

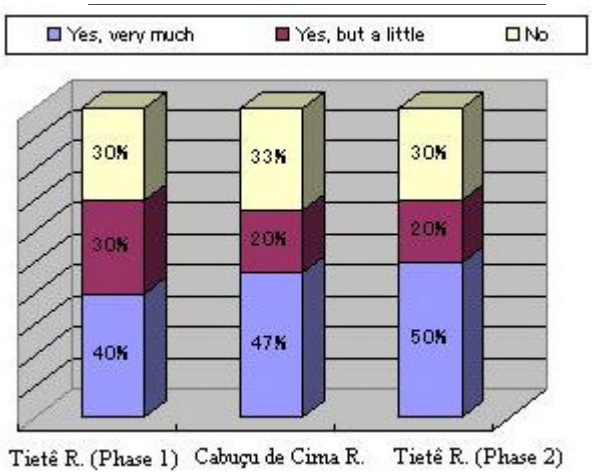


Figure 13: Do you think there has been a positive influence on commercial activities after the river improvement?

The ex-post evaluation study also surveyed whether any changes have occurred regarding diseases in pre- and post-river improvement, and the answers are shown in Table 10 (including multiple answers). The percentage of those who answered “None” increased greatly after the hydraulic river improvement. In addition, regarding leptospirosis and diarrhea, the number of answers in the Table 10 after the hydraulic river improvement has decreased. Therefore, it is assumed that this project has contributed to the improvement of health aspect of the residents as flood damage was alleviated.

Table 10: Improvement of Infectious Diseases, etc. (Unit: people)

Disease	Before the Hydraulic River Improvement	After the Hydraulic River Improvement
Infectious Disease (Leptospirosis[18])	68	8
Diarrhea	56	20
Parasitic or Worm Diseases	30	6
Hepatitis	14	2
Dengue Fever	12	10
Respiratory Disease	4	4
Others	10	8
Uncertain (No Answer)	8	12
None (Not Infected)	70	**140**

Source: Beneficiary survey results（3 areas total, sample size: 200）

2.4.2 Impact on Industrial Development (Regional Economic Development)

Table 11 shows the Gross Regional Domestic Product (GRDP) over the past few years in São Paulo City, which has been generally increasing. It cannot be concluded that the effects of this project have directly contributed to the economic growth, but it can be inferred that economic and social activities have expanded due to the alleviation of flood damage. In particular, along the hydraulic river improvement of the Tietê River Phase 2 zone, there is a trunk road called the Marginal Tietê with a traffic volume of approximately 900,000 to 1 million vehicles a day along large commercial and industrial areas, and it is assumed that the river improvement had an economic impact. Furthermore, the Marginal Tietê is also the access road to the Guarulhos International Airport (São Paulo International Airport). In interview surveys, some respondents answered they no longer need to worry about being late to catch a flight, because there was no danger of flooding. Furthermore, the Tietê Bus Terminal, the largest bus terminal in South America, is also located along the Tietê River Phase 2 zone, and it has been acknowledged that there is no longer any danger of floods disrupting the operation of the terminal or the buses, which has had a positive social and economic impact. Therefore, it can be concluded that this project, which had the objective of flood control, is supporting the economic and industrial activities of São Paulo.

[18] Leptospirosis infects from a wild rat, etc. to the human. It is an acute febrile illness with symptoms such as chills, fever, headache, worthless feeling throughout the whole body, and bulbar conjunctivas. It is assumed that the danger of infection rises after the flood. There is no human-to-human infection.

Table 11: Gross Regional Domestic Product in São Paulo City (Unit: Million real)

Year	GRDP	Year	GRDP
2002	178,953	2005	261,456
2003	209,555	2006	282,852
2004	225,170	2007	N/A

Source: Bureau of Statistics and Data (SEADE)

2.4.3 Impact on Natural Environment

2.4.3.1 The Upper Tietê River Basin（Biritiba Dam and Paraitinga Dam）

No problem was seen with respect to influence on the natural environment by implementation of this project. Apart from that, the Executing Agency conducts activities such as forestation for soil protection around reservoir dams in the Upper Tietê River Basin.

The following is the data on water quality of the both dams. According to the Executing Agency and SABESP, which collects the data, the water quality of the Upper Tietê River Basin including the dams is acceptable[19].

Table 12: Water Quality of Biritiba Dam and Paraitinga Dam

Item	Biritiba Dam	Paraitinga Dam
pH	5.81～6.47	5.94～6.26
COD (mg/l)	0.77～1.70	1.85～3.13
Temperature（℃）	19.60～23.80	22.20～22.70
Cloudiness (NTU)	3.15～6.26	6.34～9.34

Source: Executing Agency documents（2006）

Note: The above data shows both the minimum and the maximum value, because data on these items is collected at several observation points.

The Environmental Impact Assessment (EIA) regarding this project was conducted in Oct. 1997 for Phase 1 and in September 1998 for Phase 2.

Figure 14: Environmental Awareness Activity by Navigating a Workshop Boat

2.4.3.2 Environmental Activities of the Executing Agency

The water quality of the Tietê River and the Cabuçu de Cima River is poor, due to the fact that untreated sewage and waste flow into the rivers. The Executing

[19] As mentioned, the water from Biritiba Dam and Paraitinga Dam is transferred to the water treatment plant adjacent to Taiaçupeba reservoir. The water is purified and treated, and then supplied to São Paulo metropolitan area. Although the water quality standard before the purification and treatment is unknown, the standard after the purification and treatment is set at 6.5−9.0 as of pH and less than 5.0 of cloudiness, according to water quality standard of SABESP. As comments of SABESP, the pH and cloudiness in the table is near or less disparity to the water quality after the purification and treatment, which has no problem.

Agency conducts education activities on environmental issues by navigating a workshop boat in the Tietê River Phase 2 zone.

As part of the activity, elementary and secondary school students and the residents participate in seminars on sanitary awareness and issues of waste disposal into rivers on the workshop boat. These activities are recognized to be a good opportunity to raise environmental consciousness among residents in a large city such as São Paulo.

2.4.4 Resettlement of Residents and Land Acquisition

a) The Cabuçu de Cima River[20]

The construction work for river improvement of the Cabuçu de Cima River was originally planned with resettlement of residents (legal residents: 750, illegal residents: 5,170) and land acquisition (about 25 ha). In practice, 183 legal residents were subject to the resettlement, and compensation was paid to them by the State government through legal procedures. In addition, public housing was provided as resettlement compensation for 342 illegal households. Apart from that, the area subject to land acquisition was around 50 ha. Resettlement and land acquisition were implemented based on the Resettlement Program by the Habitat Bureau of the São Paulo State Government and by the City Government. No problems occurred from the implementation.

Table 13: Resettlement of Residents and Land Acquisition along the Cabuçu de Cima River

		Planned	Actual
Resettlement of Residents	Legal Residents	750 people	183 people
	Illegal Residents	5,170 people	342 households [a]
Land Acquisition	Acquired Areas	About 25ha	About 50ha

Source: JICA documents, Answers from the Executing Agency

[a] The accurate number of the people is unknown.

The reason that there was a huge difference between the plan for the resettlement of residents and the actual outcome is that the road development plan in the vicinity of the Cabuçu de Cima River (Fernão Dias Road Construction Plan[21]) was implemented in 1995−1997 with the budget of the federal government and, as a part of this, the large portion of resettlement was implemented.

In other words, many of the residents who needed to be resettled in this project were the same as those who were subject to resettlement under the road development plan that

[20] The hydraulic river improvement of Tietê River Phase 2 zone was not subject to the resettlement and land acquisition.

[21] Road expansion was implemented.

proceeded before this project, and as a result, fewer residents needed to be resettled under this project than initially planned. The public housing (apartments) provided to the households of illegal residents generally had a good reputation.

The initial plan was to acquire approximately 25ha of land, but in practice approximately 50ha of land was acquired. According to the Executing Agency, the area subject to land acquisition increased because the initial plan was to carry out river improvement using rectangular concrete (high cost), but in 1995, the plan was revised and under the new plan, rectangular concrete was adopted only in areas with a high population density, with trapezoid concrete (low cost) being adopted in many zones instead.

Figure 15: Cross-sections of the Cabuçu de Cima River. The near side is rectangular concrete, and the

b) Biritiba Dam and Paraitinga Dam

The 147 legal residents living around Biritiba Dam and the 94 legal residents living around Paraitinga Dam were subject to resettlement. Although the negotiation and compensation process with the former is almost finishing, there are still legal residents[22] in the process of negotiation with respect to the latter. The reason it takes a long time for the negotiation and procedure is that it requires time to coordinate among the stakeholders, as courts intervene in the process regarding land acquisition and the compensation process. According to the Executing Agency, the negotiation and procedure about the resettlement of Paraitinga Dam are advancing gradually and currently there are no major problems.

2.5 Sustainability (rating: b)

2.5.1 Executing Agencies

2.5.1.1 Institutional Structure for Operation and Maintenance

The Executing Agency（DAEE）is the public organization under the São Paulo State government. There are three bureaus under the superintendency: the Bureau of Water Resources Management and Assistance to Municipalities, the Bureau of Metropolitan Area Works and Technical Support, and the Bureau of Operation Support. They implement the river improvement and the management in the São Paulo State. Total number of employees was 1,252[23] in December 2008. Though the employees numbered 3,432 before the project implementation in 1995, the number decreased after the project initiation through introduction of early retirement program and new employment restraints. According to the Executing Agency,

[22] The negotiation is with respect to the compensation amount.

[23] However, the official number of employees is now 4,885, including vacant posts, as which is the way of indicating the number of employees in the public organization. The official number of the employees before the project implementation including the vacant posts was 6,646.

there was no obstacle to organizational management along with reduction of personnel.

The followings are the descriptions of the sections in charge of operation and maintenance (O&M) and its system, regarding each output.

1）Operation and maintenance system of the hydraulic river improvement zone of the Tietê River (the zones of Phase 1 and 2)

The Project Office of the Tietê River（Unidade de Gerenciamento do Projeto Tietê: UGP）is in charge of the O&M. The UGP is under the above mentioned Bureau of Metropolitan Area Works and Technical Support. The employees are 32, of which 5 are administration staff and the other 27 are technical staff.

2）Operation and maintenance system of the hydraulic river improvement zone (the Cabuçu de Cima River)

The Engineering and Construction Department（Directoria de Engenharia e Obras: DEO）is in charge of the O&M. The DEO is also under the Bureau of Metropolitan Area Works and Technical Support. There are 64 employees, 10 of which are administration staff and the other 54 are technical staff.

3）Operation and maintenance system of Biritiba Dam and Paraitinga Dam

The Upper Tietê Basin Office（Directoria da Bacia do Alto Tietê: BAT）is in charge of the O&M. The BAT is under the above mentioned Bureau of Water Resources Management and Assistance to Municipalities. The employees are 203, of which 31 are administration staff and the other 172 are technical staff. The staff of local administration offices located near the Paraitinga Dam are engaged in the management of local facilities and the periodical inspection.

As of April 2009, the BAT is in charge of the O&M of Biritiba Dam and Paraitinga Dam, but the Executing Agency started a process transferring the responsibility of O&M to SABESP[24], because the dams have functions of water supply. As the result of an interview with the SABESP, the O&M system can be judged as sufficient. Therefore, there is no problem for the O&M of the dam facilities[25].

As above, no problems are detected for securing the number of employees in the Executing agency, and it can be judged that there is no problem about operation and maintenance system of this project.

[24] SABESP consists of five departments; General Administration Department, Financial Department, Technical and Planning Department, Metropolitan Area Department, and Regional Department under the president. The organization is implementing water supply and sewage projects for 367 municipalities in the São Paulo State. The number of employees at the end of 2007 was 17,300.

[25] At present, SABESP is implementing a JICA loan project “Sanitation Improvement Project of Baixada Santista Metropolitan Region”, whose objective is to improve water quality in the coast area of the São Paulo State by development of sewage facilities and environmental monitoring system; thereby contribute to the improvement of life environment of the residents. The project started in August 2004. In addition, the organization is also implementing a JICA technical cooperation project “Control Project of Unaccounted-For Water”, whose objective is to decrease the unaccounted-for-water in the State. The project started in March 2007.

2.5.1.2 Technical Capacity for Operation and Maintenance

The Organizational Development Department（Diretoria de Desenvolvimento Organizational: DDO） under the Bureau of Operation Support is in charge of the training courses and programs for the employees, and the work training program for executive and technical staff is being planned and conducted. In 2007, 35 training programs were conducted, and 107 employees participated in these programs. In addition, there are a number of experienced employees in each section, and On-the-Job Training (OJT) is also being conducted on necessary bases.

Regarding the above, the technical level of operation and maintenance in the Executing Agency is being secured.

2.5.1.3 Financial Status for Operation and Maintenance

The following table shows data of O&M costs of each output (the hydraulic river improvement zones of the Tietê River and the Cabuçu de Cima River, Biritiba Dam, Paraitinga Dam) in the last three years. The upper column shows the actual disbursed O&M costs from the State Government to the Executing Agency, and the lower column shows the requested budget from the Executing Agency to the State Government. Prior to 2008, the São Paulo State government did not allocate enough amount of budget against the Executing Agency's request, which seems to have been some obstacles for O&M works, but the budget of O&M of each output tend to increase year by year.

Table 14: O&M Costs of Each Output (Unit: Real)

Outputs	2006	2007	2008
Tietê River	(Actual) 4,291,174	(Actual) 9,112,445	(Actual) 18,134,508
	(Requested) 25,581,127	(Requested) 15,323,500	(Requested) 25,581,127
Cabuçu de Cima River	(Actual) 0	(Actual) 1,660,000	(Actual) 5,456,583
	(Requested) 6,000,000	(Requested) 6,000,000	(Requested) 6,000,000
Biritiba Dam	(Actual) 0	(Actual) 0	(Actual) 65,505
	(Requested) 0	(Requested) 0	(Requested) 65,505
Paraitinga Dam	(Actual) 0	(Actual) 0	(Actual) 63,488
	(Requested) 0	(Requested) 0	(Requested) 63,488

Source: Executing Agency Documents

The O&M costs for the Tietê River (the actual amounts) are increasing every year. Regarding the O&M costs for the Cabuçu de Cima River, a budget close to the requested amount were finally allocated in 2008. No maintenance has been carried out for the Biritiba Dam and the Paraitinga Dam since their completion; however, in 2008, a budget was allocated for monitoring personnel's labor costs as requested. As stated above, O&M of these dams in the future is transferred to SABESP; and SABESP claims to carry out O&M with a secured budget after transfer of the facilities.

The Executing Agency is aware of the fact that O&M budget is hardly allocated as requested from the state government, and thus it tends to request smaller amount.

2.5.2 Conditions of Operation and Maintenance

The following are the descriptions of the condition of O&M of each output.

1）O&M of the hydraulic river improvement zone of the Tietê River（Phase 1 and 2)

River maintenance is being implemented regularly. Cleaning and weeding of the base of the dikes and riverbeds in the improvement zone, O&M of the river discharge control dams (the Peña Dam and so on) and the discharge gates are being implemented based on the maintenance plan of the Executing Agency. The actual maintenance is being carried out by a subcontracted private company under the supervision of the Executing Agency. Furthermore, there are several radar posts set up along the main Tietê River to measure the amount of rainfall and floodwater levels, and hence real time monitoring of the river is being implemented, and there is no problem with the operational status of the equipment. Dredging boats and berths (maintenance stations are in 3 locations) are in place.

Meanwhile, over time, silt builds up on the riverbed of the Tietê River, and in some places, this is causing corrosion and sediment contamination (buildup of sludge, etc.). According to the results of a research survey that was commissioned to a local research institution by the Executing Agency, it is expected that approximately 400,000m^3 of silt builds up in each of the Tietê River Phase 1 and 2 zones every year. As a result, there is a possibility that the silt will result in waterweed and algae growth in the river, resulting in a decline in its discharge capacity. According to the Executing Agency, the O&M budget is insufficient, so adequate removal work and disposal has not been possible; as a result, there are now approximately 2,500,000m^3 of silt that has built up throughout the river improvement zone. Given this situation, the Executing Agency is carrying out silt removal by outsourcing the work to a private company within the O&M budget[26].

[26] In this fiscal year, the work of removing approximately 400,000m^3 of silt has been commissioned to a private company, and the work is currently underway.

Figure 16: Work of Periodical Maintenance

Figure 17: Work of Silt Removal

2）O&M of the hydraulic river improvement zone of the Cabuçu de Cima River

Regular maintenance is not being carried out. The O&M budget is insufficient, so only remedial maintenance is carried out when a problem occurs. As same as the Tietê River, silt builds up on the riverbed of the Cabuçu de Cima River over time, and in some places, corrosion and sediment contamination is occurring. In some areas, the buildup of silt is already hindering water flow. It is considered that every year, approximately 100,000m^3 of silt builds up in this river overall. The Executing Agency stated that since the completion of the river improvement work, approximately 600,000m^3 of silt has built up. According to the Executing Agency, in 2008, it removed approximately 100,000m^3 of silt from the riverbed. Furthermore, it plans to remove a like volume of silt during 2009. The silt in this river overall builds up by approximately 100,000m^3 each year, so the Executing Agency plans to remove as much as possible while taking into consideration of its O&M budget.

There is also a radar post set up and operating on the Cabuçu de Cima River to measure the amount of rainfall and floodwater levels. However, the Cabuçu de Cima River is smaller than the Tietê River, so there is only one radar post on the river.

3）O&M of Biritiba Dam and Paraitinga Dam

Regular maintenance is not carried out on either dam, apart from the O&M budget allocated in 2008 as a labor cost for monitoring personnel. At present, there is no major problem due to lack of maintenance work, including the banking sand in the dams. As stated previously, the responsibility of the O&M of both dams will be transferred to SABESP. SABESP claims to carry out proper maintenance with diligence.

There is one radar post for each dam to measure the amount of rainfall and floodwater levels, and there have been no problems about their O&M conditions.

Figure 18: Paraitinga Dam

Figure 19: Biritiba Dam

No major problems have been observed in the capacity of the Executing Agency nor its operation and maintenance system; however, considering there is not sufficient O&M budget and some maintenance works are not able to be conducted, sustainability of this project is fair.

3 Conclusion, Lessons Learned, and Recommendations

3.1 Conclusion

In light of the above, this project is evaluated to be satisfactory.

3.2 Lessons Learned

Indicators and data regarding the project effect and flood damage are not always managed thoroughly, partly because the effect measurement of flood mitigation projects is not easy. To measure the project effect, it is necessary to obtain data, especially quantitative indicators including that of flood damage before the project implementation. The Executing Agency should consistently manage the indicators and data regarding project effects from the project planning stage to the evaluation/monitoring stage, with support from aid agencies.

3.3 Recommendations

As stated above, the budgets for the operation and maintenance are insufficient for removal and disposal of the silt buildup in the Tietê River and the Cabuçu de Cima River. After the project completion, there were no more floods from either of the two rivers; however, if progress is not made on the removal of the silt building up in the rivers every year, at times of heavy rain when the amount of the rivers increases, the silt could be a factor in causing a flood. The Executing Agency should make an appropriate plan for the removal of the silt and put in place a structure for removal and disposal efforts. Further, the government of the State of São Paulo should allocate sufficient budget to the Executing Agency for the operation and maintenance costs of the river facilities and endeavor to reduce the risk of floods.

Comparison of Original and Actual Scope

Items	Planned	Actual
(1) Outputs	Hydraulic Improvement of the Tietê River (Phase 1) 1) From Edgard de Souza Dam to Coffer Dam (at the meeting point with Pinheiros River): 16.5km 2) Design safety degree against flood: 1/100 3) Design section base width: 60-100m (Design section type: Trapezoidal 1V: 2H)	=>Almost as planned 1) and 2) is as planned 3) Design section base width: 54-61m (In addition, one arch-style bridge for pedestrian passageway was constructed by local funds.)
	Hydraulic Improvement of the Cabuçu de Cima River 1) From the meeting point between Cabuçu de Cima River and Tietê River to Três Cruzes Bridge: 10.5km 2) Design safety degree against flood: 1/100 3) Design section base width: Design section type is trapezoidal (trapezoidal section 10-20m) and rectangular (rectangular section 15-30m)	=>Almost as planned 1) 10.3km 2) As planned 3) As planned（But the portion of the Trapezoidal section increased） （In addition, 7 bridges were reconstructed from local funds.）
	Upper Tietê Water Resource Development Construction of Dams (Paraitinga Dam and Biritiba Dam) and Interconnection water canals	=>（Dam） Partly modified =>（Interconnection water canals） As planned（But the construction was implemented by the State government funds.）
	Hydraulic Improvement of the Tietê River (Phase 2) 1) From the meeting point of Pinheiros River to Peña Dam: 24.5km 2) Design safety degree against flood: 1/100 3) Design section average width: 50m (Design section type: Trapezoidal)	=>1), 2) and 3) as planned
	Civil Works in the Lower Tietê River Basin 1) Heightening and improvement works of Porunduva Dike (Near the Pirapora reservoir) 2) Strengthening of Pirapora Dam 3) Improvement of connecting road (Romeiros Road): 2.9km	=>1) and 3) As planned =>2) Cancelled

	Consulting Service（Phase 1 and 2） 1)Phase 1 =>Total 118M/M 2)Phase 2 =>Total 128M/M	=>1）M/M increased（Total 206 M/M） =>2）Almost as planned（Total 122M/M）
(2) Project Period	Phase 1: July 1995 to May 2000 （4 years and 11 months）	Phase 1: July 1995 to June 2003 （8 years）
	Phase 2: June 2000 to February 2006 （5 years and 9 months）	Phase 2: June 2000 to February 2006（5 years and 9 months）
(3) Project Cost Foreign Currency Local Currency Total ODA Loan Portion Exchange Rate	39,149 million yen 43,230 million yen （325,038 thousand U.S. dollars） 82,379 million yen 49,427 million yen 1U.S. dollar =133 JPY (June 1995)	49,386 million yen 21,066 million yen （181,057 thousand U.S. dollars） 70,452 million yen 49,386 million yen 1 U.S. dollar=116.35JPY (average between January 1996 and December 2005)