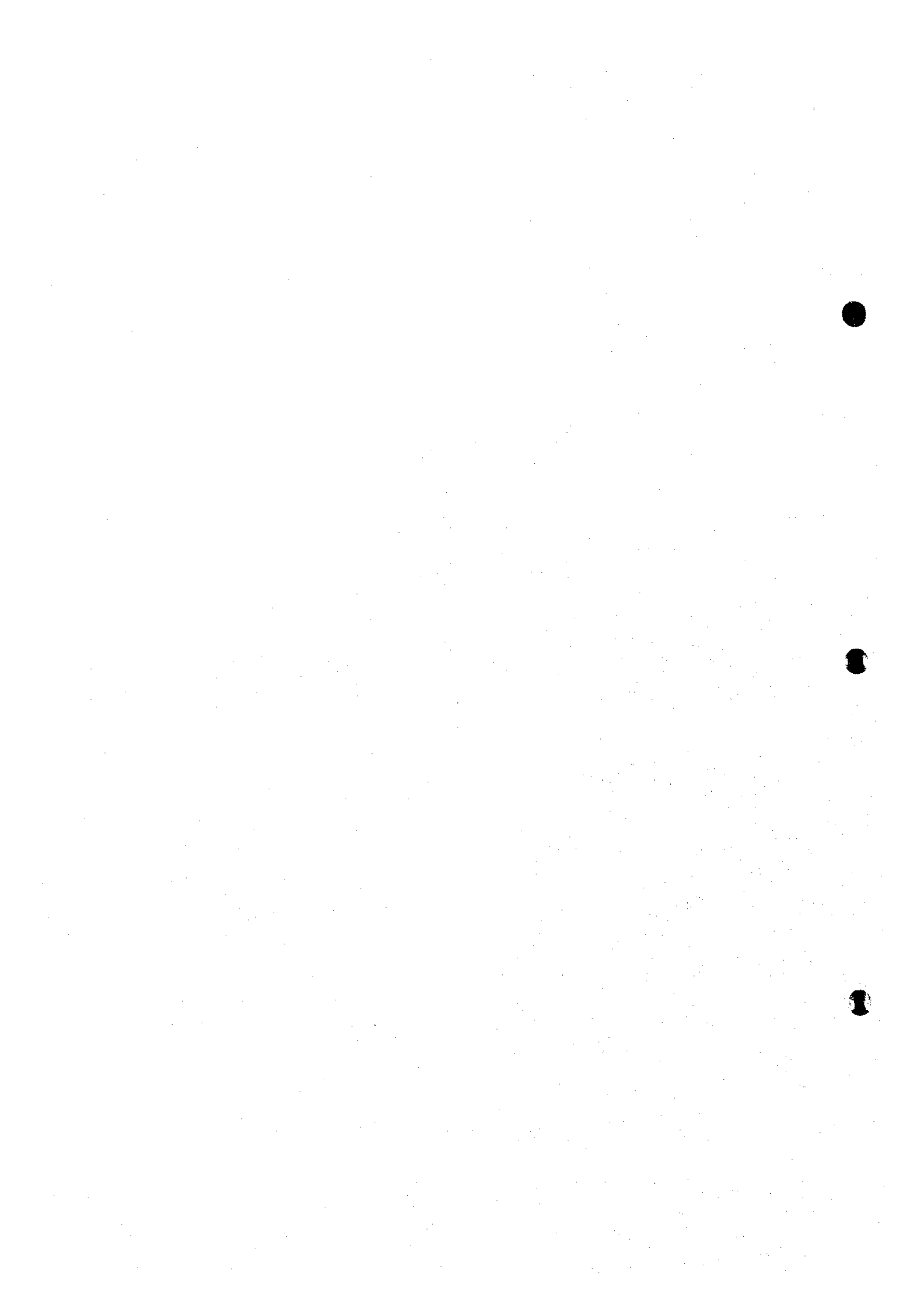


**VII WATER RESOURCES MANAGEMENT  
MASTER PLAN**



## **VII.1 Outline of Water Resources Management Master Plan**

The implementation program of the water resources management master plan covering the year 1999 to 2020 is presented in Figure VII.1. Figure VII.1 shows the projects incorporated in the master plan and related programs with those implementation schedule and annual investment requirement.

The total investment amount for the master plan between 1999 and 2020 is about 2,800 billion Rupiah including VAT(US\$1.14 billion equivalent), while about 4,200 billion Rupiah including VAT(US\$1.72 billion equivalent) for related projects.

The projects incorporated in the water resources management master plan are mainly of improvement plans of the water resources management facilities. In order to undertake smooth implementation of those improvement plans, it is recommended that a Pre-consolidation 3-year Program between 1999 and 2001 aiming at consolidation of PKB, PGKS and PJT shall be implemented as a part of the action plan towards the transformation to Persero in 2005. Implementation schedule of the Pre-consolidation 3-year Program and action plan are recommended as shown in Figure VII.2.

## **VII.2 Project Implementation Program and Action Plan**

### **VII.2.1 Pre-consolidation 3-year Program for Establishing Water Resources Management System in the Brantas River Basin**

#### **(1) Basic Strategy**

The new PJT is assumed to be established in 2002 with consolidation of PKB, PGKS, and PJT. It is strongly recommended that the Pre-consolidation 3-year Program as presented hereunder be implemented for preparatory works including technical and managerial aspects for realizing New PJT establishment.

Conceived scope of preparatory works under this program is as follows:

- (a) Managerial aspect
  - (i) Detailed examination on existing organization of PKB, PGKS, and PJT
  - (ii) Review and final confirmation on scope of works of Water Resources Management(W.R.M.)
  - (iii) Clarification of tasks and duties of respective agencies related to W.R.M.
  - (iv) Clarification of tasks and duties of Basin Water Resources Management Committee(BWRMC) including coordination with all related agencies

- (v) Formulating a business prospectus of New PJT
  - Scope of business
  - Internal organization
  - Staffing schedule
  - Facility plan
  - Profit and loss program
- (vi) Preparation of necessary institution and regulation, and its official declaration
- (vii) Training of New PJT's staff
  - Education and training of technical staff
  - Education and training of managerial staff and office workers

(b) Technical aspect

- (i) Preparation of ledgers of the rivers including river facilities and water right as well as establishment of O/M work demarcation
- (ii) Formulation of system introducing plans of the inter-agency information system and management information system.

**(2) Implementation Schedule**

Preparatory works will be started in 1999, and finished in 2001. To implement this program, outside professionals and consultants will be employed. Scope of works of the professionals and consultants are as follows:

- (a) Preparation of Implementation plan of 3-year program
- (b) Detailed examination of the existing organizations, PKB, PGKS, and PJT
- (c) Guidance for preparing New PJT's business Prospectus
- (d) Guidance for preparing work specifications and standards on technical matters
- (e) Guidance for preparing internal operation and management rules
- (f) Technical guidance and training
- (g) Development of water charge system
- (h) Implementation of Inter-agency Information System and Management Information System within the New PJT
- (i) Implementation of 3-year training program

The specific subjects to be executed in both managerial and technical aspects are as follows:

- (a) Establishment of water resources management system
  - (i) Establishment of MPW line
  - (ii) Clarification of sector responsibility

- (iii) Establishment of Basin Water Resources Management Committee(BWRMC)
- (b) Development of corporate management
  - (i) Water charge system
  - (ii) Assets management
  - (iii) MIS improvement
  - (iv) Reform of organization
- (c) Human resources development
  - (i) Preparation of human resources development program
  - (ii) Implementation of training program
  - (iii) Staff selection and placement for establishment of New PJT
- (d) Water quality control program
  - (i) Establishment of new laboratory in Malang
- (e) Water resources development
  - (i) Preliminary survey for Beng dam construction
- (f) Maintenance of existing river facilities
  - (i) Ledgers of the rivers(including river facilities and water right) and O/M work demarcation
- (g) Establishment of Inter-agency Information System
  - (i) Preparation of system introduction.

#### **VII.2.2 Action Plan in Managerial Aspect**

For transformation of the New PJT to PJT(Persero), execution of the action plan between 1999 and 2004 is recommended as well as managerial and institutional arrangement.

##### **(1) Management Development Unit**

The "Management Development Unit" (MDU) is recommended to be built attached to the Board of Directors. The Unit has major three purposes: (i) to prepare for the establishment of W.R.M. system, (ii) to prepare for the establishment of managerial development of PJT and (iii) to monitor the achievement of the Comprehensive Plan for W.R.M. in the Brantas. The component of the Unit is as shown hereunder.

Items	Component of Management Development Unit						
	B. of Corp. Plan	B. of Tech. Plan	Div. of O&M	S. of Legal	B. of HRD	S. of MIS	S. of Finance
A. Establishment of WRM system							
A.1 Establishment of MPW line		⊙		○			
A.2 Clarification of sector responsibility		⊙	○	○			
A.3 Establishment of BWRMC		○	⊙	○			
A.4 Preparatory for Consolidation	○	⊙		○	○		
B. Development of corporate management							
B.1 Preparatory for Persero	⊙			⊙			○
B.2 Internal managerial reform							
B.2.1 HRD strengthening		○			⊙		
B.2.2 Water charge system						○	⊙
B.2.3 Assets management						○	⊙
B.2.4 MIS improvement						⊙	○
B.2.5 Reform of organization					⊙		

Note: ○ : Division/Bureau/Section member of the Management Development Unit  
 ⊙ : Primary responsible member of the MDU for the corresponding item

As shown above, seven management units of PJT will consist of the Unit. Preparatory works for each item will be carried out under the task force of these management units. For example, staffs of the Bureau of Technical Planning and the Section for Legal Affairs will be jointly responsible for the preparatory works of the establishment of MPW administrative line. In this case, the Bureau of Technical Planning will be primary responsible for the work.

(2) **Preparation for establishment of W.R.M. system**

(a) **Establishment of MPW administrative line**

The major preparatory works will include the following:

- 1) To scrutinize all the W.R.M. related tasks being done by agencies related to W.R.M. in the Brantas
- 2) To scrutinize all the W.R.M. related Decrees/Regulations to find which agency should do what tasks
- 3) To prepare a matrix of current W.R.M. tasks vs. related agencies
- 4) To prepare a matrix of desirable W.R.M. tasks vs. related agencies in which the administrative line of MPW-PJT is clearly established
- 5) To have discussion meetings among the related agencies including MPW, Provincial Government Offices and PJT
- 6) To prepare draft Decrees/Regulations required for implementing the W.R.M. under the administrative line of MPW-PJT

Major elements will be as follows:

- MPW should be finally responsible for W.R.M. in the Brantas.
- This authority is delegated to PJT in daily operations of W.R.M..
- Based on this delegation, PJT can further delegate its responsibility of

implementing daily operation to other related agencies with the approval of MPW.

- Water usage rights should be clearly defined and its licensing authority should be endowed to Director of DWRUC.

**(b) Clarification of sector responsibility through delegation**

Following work item (1), the major preparatory works shown below will be needed:

- 1) Delegation of responsibility for implementation will be made from PJT to BRLKT sub-division Brantas and DPKT Dati II for watershed management sector and to BAPEDALDA for water quality management sector.
- 2) For other sectors than the above two, PJT will be directly responsible.
- 3) The demarcation of tasks in the above two sectors between PJT and the two responsibility-delegated agencies has to be clearly defined. The draft agreements should be prepared by MDU and be discussed to reach the mutual consent.
- 4) Finally, inter-ministerial agreement among MPW, Ministry of Forestry and Ministry of Environment would be necessary.

**(c) Establishment of BWRMC**

The major preparatory works of building the Basin Water Resources Management Committee will include the following:

- 1) The establishment of BW.R.M.C should be discussed and recommended at the meeting of PWMC.
- 2) The Decree on the establishment of BW.R.M.C including its scope of tasks should be drafted by MDU and be approved by MPW.
- 3) The member agencies of the BW.R.M.C should be selected. They should include watershed-related agencies and related offices of Dati II in addition to the member agencies of PWMC.

**(d) Consolidation of PKB, PGKS and PJT**

The major preparatory works for the consolidation of PKB, PGKS and PJT will include the following:

- 1) The major requirements for the development, rehabilitation and land rehabilitation and prevention works in the Brantas should be projected for the long term up to 2020.
- 2) Based on the projection, the manpower requirement for both PKB and PGKS is to be projected.
- 3) Taking this opportunity, a task survey which aims to decide the appropriate number of staffs for each task of PJT is recommended to be conducted.

- 4) A proposal of the number of manpower transferring to PKB and PGKS to PJT is to be prepared to submit to MPW for approval.
- 5) At the same time, another proposal for transferring the manpower to other government/private organizations is to be prepared for their re-employment.
- 6) The necessity of moving offices of PKB and PGKS should be studied for decision.
- 7) The necessary procedures and resulted influences for the change of employment status between the government officials and non-government officials should be investigated.

**(3) Development of Corporate Management**

**(a) Transformation from Perum to Persero**

The major preparatory works for the transformation from Perum to Persero will include the following:

- 1) To increase the number of staff of the Directorate for Business Development, including those of Bureau of Corporate Management and Bureau of Marketing. Strengthening these staffs is also required.
- 2) In the Bureau of Corporate Planning, the identification of private sector projects and their feasibility study are required to be done. The design thereof is also required with cooperation of Bureau of Design. To search for the fund source of projects is another job of the Bureau.
- 3) In the Bureau of Corporate Management, the operation and management of the completed projects are required to be done. The Bureau will be also responsible for sub-contract arrangement of management to outside companies.
- 4) In the Bureau of Marketing, identification of new projects and exploitation of new market are required.
- 5) Accompanied by the change of the company status, some accounting principles may be changed. The current managed assets will be changed into owned assets of PJT. Some changes in preparation of financial statements like P/L and B/S may be required. (refer to the Action Plan in "Finance and Budget Planning")

**(b) Organizational reform of PJT**

The following four work items in the internal managerial reform of PJT are not explained herein but will be explained in Action Plan of each sector.

- Strengthening of human resources development
- Establishment of water charge system
- Establishment of assets management system
- Improvement of MIS



The organizational reform of PJT is proposed in Figure VI.1 in this report. The major objectives thereof are the following:

- 1) Environmental conservation will be strengthened by the new establishment of Division of Environment. In this division, three sub-divisions will be established: Sub-division of Water Quality, Sub-division of Watershed Management and Sub-division of River Environment. Accompanied by this strengthening of environmental area, some increase in the number of environment experts will be required, which is accounted for in the future manpower requirement in HRD sector in this report.
- 2) Legal matters and PR sector will be strengthened by the new establishment of Section of Legal Affairs and Section of Public Relations in the Bureau of Administration. The Section of Legal Affairs will play an utmost important role in every aspects of establishing W.R.M. system as well as development of corporate management. The Section of Public Relations will be responsible for new areas of community and beneficiaries' participation and the communication between water service clients and PJT.
- 3) The Section of MIS will be newly established in the Bureau of Finance. The management finance has been so far nominal in the PJT organization. This new section of MIS will cover not only the area of management finance but also that of personnel data base and information.
- 4) The preparation for the transformation from Perum to Persero will be done in time for the start of Persero Jasa Tirta in 2005. The Directorate for Business Development will be established in conformity with the internal managerial reform which is scheduled in the initial stage of the Action Plan. However, the number of the staff will not be required so many before 2002. The preparation for Persero shifting will be start essentially after 2002.

### **VII.2.3 Action Plan in Technical Aspect**

Outline of the action plan is shown hereunder. Detailed action plan of each sector are described in the preceding chapters respectively.

#### **(1) Feasibility Study**

Besides the aforementioned Pre-consolidation 3-year Program, it is recommended to conduct the following studies separately in accordance with medium and long term development plans:

- (a) Preparation of master plan for watershed management and water quality control
- (b) Feasibility study on water resources development plan for selected priority projects among the projects incorporated in the Master Plan.

**(2) Watershed Conservation, Sabo and Flood Control**

- (a) Continuous investigation on actual conditions of illegal sand mining on riverbed.
- (b) Investigation on actual conditions of flood damage (grasp of major damage area).
- (c) Preparation of proposed flood control manual.
- (d) Preparation and announcement of flood risk area map in the whole basin.

**(3) Water Quality Control**

- (a) Establishment of continuous water quality management system
- (b) Strengthening of legislation and institutions
- (c) Preparation of waste water treatment map
- (d) Implementation of a model project of Gappei Johkaso

**(4) Water Resources Development**

- (a) Hydrological investigation in the project area
- (b) Investigation of land use and resettlement requirement in the project area
- (c) Selection of the consultants, detailed design services and procurement of the contractor(s) for the Beng dam project

**(5) River Facilities**

- (a) Stipulation of the operation rules for all river facilities in the Brantas river basin by mutual consent with related agencies, to avoid the conflicts and disputes on the water resources management.
- (b) Establishment of authorized method of the budget estimates for OMR activities.
- (c) Making of a consensus among beneficiaries about allocation of OMR cost.

**(6) Effective Operation of Water Resources**

- (a) Set up of tentative rule for water allocation and operation of the Wonorejo dam system including the Tulungagung pump station by mutual consent with related agencies.
- (b) Establishment of the proper low flow forecast in the Brantas river basin including the Ngrowo river basin.

**(7) Monitoring and Information System**

- (a) Introduction of Inter-agency Information System.
  - Installation of equipment for the system and test of operation.
  - Training of the system manager of New PJT and end users.

### VII.3 Project Investment Program and Economic Evaluation

#### VII.3.1 Investment Program and Required OM Costs

An investment program of the proposed water resources management plan is shown in Figure VII.1. The total investment between 1999 and 2020 is about 2,800 billion Rupiah including VAT (US\$1.14 billion equivalent), or 127 billion Rupiah per year on average. Table VII.1 shows annual operation and maintenance cost of the water resources management plan excluding those for the existing facilities. At the full development stage at 2021, the annual operation and maintenance cost is estimated to reach 42 billion Rupiah per year.

Table VII.2 and the following table compares the past expenditures of PJT, PKB and PGKS and the proposed investment and operation and maintenance costs.

Item	Past Expenditure*	Proposed by 2020	Rate of change
Investment <sup>(1)</sup>	123,856	126,909	4%
OM, existing facilities <sup>(2)</sup>	18,151	30,966	71%
OM, proposed facilities	0	41,563	-
Total	142,007	199,438	40%

\* The figures are average of three years between 1994 and 1996.

(1) Expenditure by PKB and PGKS for past expenditure

(2) Expenditure by PJT for past expenditure

The proposed investment cost at 127 billion Rupiah per year is almost equivalent to the past total expenditures of the two organizations (PKB and PGKS), indicating that the magnitude of the proposed investment program is within a realistic level.

The operation and maintenance costs for the existing facilities should be increased by 71%. The proposed 31 billion Rupiah per year, which is equivalent to about 1% of the investment costs of the existing facilities, is the costs needed to operate and maintain the existing facilities appropriately and adequately. The cost spent by PJT in the past has not been sufficient to maintain a desirable level of operation and maintenance works.

A new mechanism is required to finance the increased operation and maintenance costs. A new financial arrangement should include the expansion of revenue from water charges based on the "beneficiary-pay-principle" and the subsidy from the government based on the "government obligation principle."

In total, an increase by 40% is envisaged including both investment and OM costs. This level of expenditure would be attainable with new financial set-up arranged for financing increased OM costs, both for the existing facilities and the planned facilities.

#### VII.3.2 Economic Evaluation

##### (1) Objective and Target Area of Analysis

An economic evaluation is carried out for a set of measures proposed as the components of

the water resources management plan. The objective of an economic evaluation is to analyze the magnitude of economic feasibility of the measures proposed. The following measures are analyzed by quantitative method deriving such indices as IRR, B/C ratio and cost comparison and qualitative manner for which monetary valuation of benefit is difficult. Table VII.3 presents a summary of the results of the economic evaluation.

- (a) Water supply :
  - Dams (Beng, Kedungwarak, Genteng)
  - Dredging work and sediment diversion channel
  - Water saving measures (irrigation canal lining and industrial water saving)
- (b) Flood control :
  - Widas River
  - Lodoyo diversion tunnel
  - Improvement of FFWS
- (c) Watershed management and Sabo
- (d) Water quality :
  - Monitoring system
  - Wastewater treatment systems
- (e) River environment
- (f) Others :
  - Inter-agency information system
  - Human resource development

**(2) Water Supply**

**(a) Dams**

Economic feasibility of the three dams proposed is analyzed by deriving economic internal rate of returns (EIRR) for each project based on the following assumptions.

- (i) The amounts of water for domestic and industrial uses are allocated according to the demand forecast in 2020 considering saving as follows.
  - Domestic water : 86 %
  - Industrial water : 14 %

Based on these proportions, the following amount of water are assumed for the three dam projects.

(Unit : 10<sup>6</sup> m<sup>3</sup>)

Project	Domestic Water	Industrial Water
Beng dam	126	21
Kedungwarak dam	46	8
Genteng I dam	60	10

- (ii) Investment cost is divided into local and foreign currency portions and a

standard conversion factor at 0.8 is applied to the local currency portion.

- (iii) Agriculture production foregone is calculated as the cost of land.
- (iv) Economic benefit of domestic water supply is derived based on Rp. 790 / m<sup>3</sup>, which is the average willingness-to-pay of PDAM and non-PDAM customers surveyed by the JICA study team. Since this value is for purified water reaching customers, the portion for raw water is derived based on the proportions of costs of dams for domestic water portion and water purification and distribution systems. The costs for water purification and distribution systems is estimated based on Rp. 4,100 per m<sup>3</sup> for investment cost and 3% of the investment cost for OM cost. Rp. 4,100 per m<sup>3</sup> is derived by processing the data of the integrated urban development projects in Surabaya and East Java financed by the World Bank. The following proportions and raw water benefits are derived.

Dam	Proportion (%)		Raw water Benefit (Rp/m <sup>3</sup> )
	Raw water supply	Purification/ distribution	
Beng dam	27	73	216
Kedungwarak dam	34	66	265
Genteng I dam	41	59	326

- (v) Economic benefit of industrial water supply is derived based on Rp. 176 / m<sup>3</sup>, obtained from the contribution of industrial water supply to the industrial value added assumed at 0.32%, based on the East Java Input-Output table and interview surveys with factories.
- (vi) Power supply benefit is derived based on a concept of alternative thermal power generation as follows. The alternative thermal types are assumed taking into consideration the capacity and possibility of peak power generation.

- Beng dam : diesel assumed, Rp. 7,696 million per year
- Genteng I dam : gas turbine assumed, Rp. 17,470 million per year

EIRRs are derived as follows.

- Beng dam : 18.6 %
- Kedungwarak dam : 10.0 %
- Genteng I dam : 13.3 %

(b) Water saving

(i) Irrigation canal lining

The amount of irrigation water to be saved by canal lining is 123.2 million m<sup>3</sup> per

year in 2020. EIRR is derived with the assumption that the saved water be used for irrigation, domestic and industrial uses in the proportions projected for 2020. The following table summarizes the amount of water, benefit per volume and total benefit for respective use.

Water use	Water volume (10 <sup>6</sup> m <sup>3</sup> /year)	Benefit per volume (Rp./m <sup>3</sup> )	Total benefit (Rp.10 <sup>5</sup> /year)
Irrigation	66.0	136	8,976
Domestic	48.5	356	17,266
Industrial	7.6	176	1,338
Total	123.2	-	27,920

An EIRR is derived at 19.3 %.

(ii) Industrial water saving

The present study proposes promotion of industrial water saving. The water demand forecast assumes the target of 48% reduction in industrial water demand by saving. The cost for industrial water saving is to be borne by each industry with a set of government support measures in technical and financial aspects. The cost needed for achieving this saving target is difficult to estimate with little information on cost in a standardized form, reflecting the fact that there is a wide variety in pattern of industrial water use, applied technology and cost. To show a magnitude of cost needed, a previous JICA study in Thailand was referred to. (" Final Report for the Study on the Effective Use of Industrial Water in the Kingdom of Thailand ", JICA, March 1989). The costs analyzed here, therefore, is an indicative one.

The average cost for industrial water saving was estimated to be 4.7 Baht per m<sup>3</sup> including reclamation of industrial water (reuse of industrial effluent after treatment) and 1.4 Baht per m<sup>3</sup> excluding the reclaimed water in 1989. These are annualized costs per m<sup>3</sup> estimated with a 15-year facility life and 12% as discount rate, for a suburban area of Bangkok with 59 factories surveyed. In the present analysis, the latter value 1.4 Baht per m<sup>3</sup> is used on the basis that the cost for reclaiming industrial effluent is included in the cost estimated for industrial effluent treatment presented in Chapter V.3 " Water Quality ". This can be divided into investment cost (72%,) and OM cost (28%). Converting this value to Indonesia in 1997, total of Rp.200 Rupiah per m<sup>3</sup> divided into Rp. 144 per m<sup>3</sup> for investment and Rp.56 per m<sup>3</sup> for operation and maintenance derived. To make a comparison with dam costs, present values of investment and OM costs for 50 years were derived. The following compares the costs for industrial water saving with those of water resources development.

(Unit: Rp./m<sup>3</sup>)

Project	Investment	OM	Total
Water saving	1,199	521	1,720
Beng dam	1,651	249	1,900
Kedungwarak dam	2,664	764	3,428
Genteng I dam	3,837	17	3,854

a. Present values of construction and OM costs per m<sup>3</sup>  
(50 years, 12%)

b. Power portion of Beng and Genteng I excluded

c. 1% of investment cost as OM cost

The cost needed for industrial water saving is lower than the costs for water resources development. Industrial water saving, therefore, should be promoted in parallel with water resources development.

(c) **Dredging works and sediment diversion channel**

The present study proposes dredging works for the Wlingi, Lodoyo, and Sengguruh dams. Dredging works at these dams would result in maintaining the present functions of these dams in water supply and power generation. Extension of the sediment bypass channel would help reducing the sediment discharge into the Wlingi and Lodoyo reservoirs, thus contributing to maintaining the existing functions of these dams.

(3) **Flood Control**

The proposed flood mitigation projects include those for the Widas River Basin and the Lodoyo Diversion Tunnel. Flood protection works in the Widas River Basin were included in the 1985 master plan. So far about 66% of the proposed works in terms of construction cost is completed. The project proposed in the present study corresponds to the remaining 34% portion. The Lodoyo Diversion Tunnel is also a project proposed in the 1985 Widas master plan and included in the present study. The 1985 master plan calculated the following EIRRs for the two projects.

Widas River flood control : 14.1 %

Lodoyo flood diversion tunnel : 11.9 -14.5 % for a number of cases

Since no major changes in socio-economic conditions are observed in the project areas since the time of the 1985 master plan, these results in economic analysis are considered still valid.

The improvement of the existing Flood Forecasting and Warning System (FFWS) aims at a better low flow management. With the improvement completed, low flow conditions can be monitored more accurately, thus providing more reliable data for water allocation during dry season. Coordination and decisions among parties concerned can be made quickly and based on the actual conditions of river flow.

(4) **Watershed Management and Sabo**

(a) **Watershed management**

Watershed management by reforestation and terracing would contribute to reducing sediment discharge into the Brantas River. Economic benefit of reduced sediment discharge is derived in terms of reduction in river excavation cost to be incurred under the without-project condition as follows.

- a. Reduction in river excavation volume : 6.92 million m<sup>3</sup> per year
- b. Wash load : 56 %
- c. Excavation cost : Rp. 10,793 per m<sup>3</sup>
- d. Economic benefit (a.\*(1-b)\*c) : Rp. 32,863 million per year
- e. Total investment cost : Rp.162,294 million

An EIRR is derived at 23.7 %.

(b) **Sabo**

Economic benefits of the proposed Sabo works are measured by the saving of river excavation cost.

**(Lesti Basin)**

- Total volume of sediment volume to discharge into river under no-project condition : 15.09 million m<sup>3</sup>
- Excavation cost : Rp. 10,793 per m<sup>3</sup>
- Total cost saved : Rp.162,866 million

**(Kelud Basin)**

- Total volume of sediment volume to discharge into river under no-project condition : 52.0 million m<sup>3</sup>
- Excavation cost : Rp. 10,793 per m<sup>3</sup>
- Total cost saved : Rp. 561,236 million

Since the costs of these projects occur over a 15-year and 7-year periods, corresponding benefits are allocated to each year in proportion to the construction costs. Costs and benefits thus estimated are compared by benefit-cost ratio and net present value (NPV) applying 12% discount rate as follows. B/C ratio and NPV are applied, since the costs and benefits appear in parallel.

	B/C ratio	NPV (million Rp.)
Lesti	1.80	51,271
Kelud	1.46	69,522



(c) **Experimental research**

Watershed management experimental research aims at clarifying co-relations between watershed management activities such as reforestation and terracing and effects in sediment discharge and flood discharge. The result of experiments would provide basic data that could be used as the basis for the planning and implementation of watershed management works.

(5) **Water Quality**

(a) **Water quality monitoring**

The study proposes the enhancement of the existing PJT's water quality monitoring system. A better monitoring system is an important component of the water quality management system that generates benefit indirectly. With a monitoring system covering a larger area and clarifying the water quality condition more accurately, the effectiveness of counter measures and pollution control plan will be significantly improved. The improvement in water quality, thus, will be achieved through various direct measures such as waste water treatment facilities and river maintenance flow on the basis of a better monitoring system.

(b) **Waste water treatment**

Treatment of domestic waste water and industrial effluent as well as agriculture waste water is an indispensable measure in the Brantas River Basin where the remaining room for water resources development is limited. By maintaining the water quality of the Brantas River at an appropriate level, less than 6 mg per liter by 2020, various benefits are envisaged such as reduction in water purification cost, preserving natural species and maintaining existence and recreational value of Brantas.

(6) **River Environment**

The present study proposes the following measures.

Biological diversity monitoring and laboratory	:	Rp. 480 million
Creation of wetland and fish ponds	:	Rp. 44 million
Recreation development program	:	Rp. 648 million
Total	:	Rp. 1,172 million

An economic analysis of river environment preservation is carried out applying simplified travel cost approach. By this method, economic benefit is measured by the cost visitors spend for visiting and spending their time at the place. Costs include transportation cost, time cost, admission fee etc. The idea is that visitors' actual expense reflects the minimum level of satisfaction they feel by visiting the place. In the present analysis, travel cost for the Selorejo Reservoir and Sutami Reservoir are estimated as proxy to the recreational development proposed in the study. Table VII.4 summarizes the result of estimating economic benefit of

Selorejo and Sutami in the recreational aspect. It is estimated that economic benefits of Selorejo and Sutami for recreational purpose are Rp. 979 million and Rp. 715 million per year respectively. Assuming that the same level of economic benefit realized as Sutami, which would be likely, the proposed environmental preservation program would give an EIRR at 60%, showing extremely high economic viability.

**(7) Other Measures**

**(a) Inter-agency information system**

The idea of an inter-agency information system is to create an environment in which various water-related organizations, both public and private, can share the information on water resources and related issues through linking by a computer system. By being able to collect needed information quickly, beneficiary organizations will enjoy making timely and right decisions in addition to saving in various administrative costs for communication and data processing.

**(b) Human resource development**

Various measures for water resources management of Brantas proposed in the present study could be implemented effectively and efficiently with qualified manpower taking responsibility in the proposed works. The proposed human resource development program in technical and managerial aspects would be a prerequisite for PJT proposed to transfer to a Persero in the year 2005.

**VII.4 Recommendation**

**VII.4.1 Present Condition and Problems on W.R.M of the Brantas**

Present condition and problems on the current W.R.M. system of the Brantas River Basin which are described in Chapter III are summarized hereunder. These problems are repeatedly presented hereunder dividing into technical and managerial aspects. The technical problems are discussed first since these are closely related to the managerial problems and the latter would be more important.

**(1) Technical Problems**

**(a) Review and /or update of the master plan**

- 1) A Master Plan (M/P) of the Brantas River Basin Development was firstly formulated in 1961. The Brantas river basin water resources development has been taken place extensively since 1961 based on this first M/P.
- 2) The M/P was reviewed twice in 1972 and 1985 respectively taking into account the changes of basin economic condition and water requirement at those stages. 1961 M/P proposed the development schemes with the priority on flood control and hydropower development. 1972 M/P emphasized on the development of irrigation, flood control, and water supply. 1985 M/P which

is the latest one has put the emphasis on the water supply and equitable development within the basin.

- 3) The water resources development of the Brantas was extensively implemented up to 1985, declined thereafter. This seems to be because that the Government changed its policy to shift development fund to other underdeveloped areas for promoting equitable development nationwide and also the Brantas Development Executing Agency (ex-PKB) was divided into two organizations i.e. PKB and PJT.
- 4) Industrial development and population increase especially in Surabaya metropolitan area has been realized owing to the water resources development. However, such development has brought about further increase of water demand. The M/P should be updated taking into account the changes of basin condition.
- 5) Kelud and Semeru Debris Control Project (PGKS) have undertaken Sabo works around the Kelud Volcano for treating erupted materials, and reducing sediment inflow into the main Brantas. However, the project being undertaken is based on the very old Sabo M/P which is not reflect the present basin condition of sediment balance. The Sabo works is still one of the most important issues in the basin. The M/P should be reviewed including Sabo Works.

(b) Watershed Conservation and Sediment Control

- 1) Watershed conservation aims, as a final goal, at reducing land erosion and debris production, reducing flood magnitude, and water conservation. It is one of the important factors of the water resources management.
- 2) At present, forest development and conservation, and land conservation have been implemented. However, watershed conservation in view of the above issues has been little conducted.
- 3) Watershed conservation would be different basin by basin in view of its topography, geology, hydrology, forest coverage, etc. Therefore, a specific measure by objective basin should be implemented. Since there are many unknown technical factors in the Brantas River Basin, quantitative planning on watershed conservation would be very hard at this moment.
- 4) Land use in the mountainous area should be harmonized between economic forestry and watershed conservation. At present, the basin upstream area has been considerably devastated and existing reservoirs have seriously been suffered from sedimentation due to the sand brought from the upstream. The Sabo works and watershed conservation at present are rather poor.
- 5) The riverbed in the main Brantas has been descending. This seems because that sediment supply to the main Brantas has been reduced because of sediment trapping by Sabo dams, sand pockets, and existing reservoirs in the upstream reaches as well as illegal sand mining in the middle and lower reaches of the

Brantas. This fact implies that the Brantas would accept more sediment inflow. At present, debris control works have been conducted on the basis of the M/P which was formulated in 1970, 28 years before and as the urgent countermeasures against the last eruption of Kelud in 1990. The basin condition has been noticeably changed at present. The M/P and basic plan of the countermeasures should be updated urgently.

- 6) Sedimentation in Sengguruh and Sutami Reservoirs are serious problems. Dredging works has been undertaken. The origin of the sediment is the land erosion in the Lesti River. The large-scale sediment control works are essential but implemented are small scale ones.
- 7) Sedimentation in Wlingi and Lodoyo reservoirs is the continuous problems until the rest of the Kelud eruption. The Government has conducted continuously dredging works and constructed sediment by-pass channel which conveys sediment directly to the downstream of Wlingi reservoir. This channel works might need to be improved.

(c) Flood control management

- 1) Design flood of the Brantas is 50-year flood for the main Brantas and 10-50 years flood for the tributaries.
- 2) River improvement works have been almost completed for the main Brantas, the Porong and the Surabaya and presently being implemented for the tributaries.
- 3) People and properties in the surrounding areas of the Brantas are increasing year by year. This increase is owing to the economic development due to industrialization in Surabaya and its surroundings. In order to upgrading safety against flood for those people and properties, upgrading of design flood would be required in the future. Lodoyo diversion tunnel project which has been recommended in the last M/P is not implemented yet. This project is essential to upgrading the safety.

(d) Water resources development and water supply management

- 1) Water resources development in the Brantas has been considerably progressed. However, further development will be required to fulfill the water demand increase in future due to the economic development in the basin. At present Wonoredjo dam project is under construction, and new dam project(s) will be needed following Wonoredjo.
- 2) Exploitable water resources are limited, and new projects would become more and more expensive. Water saving and precise water allocation management would be necessitated. Dam construction and effective use of water by saving are economically comparable at present.
- 3) In terms of water saving, irrigation and industrial water saving should be considered. Proper water allocation should be adopted in due consideration of

changes of land use and industrial structures.

**(e) Water quality management**

- 1) River water quality is seriously deteriorated throughout all the Brantas from Malang city in the upstream and Modjokerto/Surabaya cities in the downstream. According to the regulation of East Java Province, river water quality should be within 6 mg/l, however it is more than 10 mg/l in many places regardless of wet and dry seasons. Water quality improvement is essentially needed
- 2) Major reason of water quality deterioration is due to i) untreated waste water from domestic sewerage, industrial manufacturer, and livestock breeding which has been drained into the river without any treatment, and ii) illegal waste abolition.
- 3) Indonesian Government is undertaking river-cleaning campaign, but its effort is still to be continued. Community awareness building as well as construction of industrial wastewater treatment system and secure of maintenance flow is required.

**(f) River environment management**

- 1) River environment can be discussed in terms of biodiversity and river use. Number of fish species has been decreased as compared with those at the beginning of 1900<sup>th</sup>. Biodiversity is one of the important factors of the river environment. The Government has endeavored to improve river water quality and river environment.
- 2) The Government has made effort to protect biodiversity and river environment including river use for recreation. River use is still limited in time and place, but progressing such as recreational use of reservoir, boating, fishing, river festival, regatta, etc. The Government has planned more effective use of river areas.
- 3) Sewerage system and industrial waste treatment have been little progressed. River environment may not be improved without river water quality improvement. Further effort will be needed.
- 4) Multiple natural river creation in due consideration of biodiversity and river front management would be an issue for the future.

**(2) Managerial Problems**

**(a) Overall water resources management system**

- 1) Water resources management should cover entire area of the river from uppermost reaches up to the outlet estuary. Water Resources Management should cover watershed management in the uppermost area, flood control and river use in the middle and lower reaches, appropriate allocation of water suited to water requirement, and water quality and environment conservation. These

works are closely related each other, and may not be treated as single issue. The river should be put under an unified management

- 2) Organizations relating to the W.R.M. in the Brantas are counted for as many as 34 organizations. Needless to say, their activities are essential, but it is not unified yet
- 3) At present, there are two management lines, i.e. i) Public Works. Central Government, and ii) Provincial Government, and many agencies belonging to these lines.
- 4) Many agencies by sector are related to the water resources management, and their right and responsibility are not clear in terms of main- and /or sub-tasks. PJT is responsible agency for the Brantas river basin W.R.M. However, its tasks are rather limited. A unified management system should be established yet. As really, responsibility of PJT is unclear.
- 5) The Brantas River is one of the very important rivers in Indonesia in economic and social point of view. Surabaya city which is the second largest city in Indonesia, is located in the lowermost reaches of the Brantas, Water supply to Surabaya and Gresik region should be considered by not only the Brantas, but also the Solo river, Umbulan Spring, etc. Furthermore, the Brantas should be considered as the water source to the other areas outside the Brantas such as Madula Island. Thus, comprehensive management of the Brantas is needed.
- 6) The present W.R.M. System involves problems as i) unclear tasks and duty (flood control/Sabo, water quality control, and river environment), ii) no responsible organization in some sectors (watershed management, and river environment), iii) subdivided organization (PKB, PGKS, PJT). Re-organizational setup would be necessary.
- 7) There is a plan to set up BALAI as a water resources management agency, through it is not finally decided yet. A plan in the Brantas proposes 3 BALAIs. Such subdivision of a basin would bring about some problems in W.R.M., i.e. water resources development, operation and maintenance, water allocation and water right, etc.

(b) Managerial problems in PJT

- 1) According to MPW decree, PJT's tasks are i) maintenance and management of the facilities, ii) dealing water, iii) river basin management (water conservation, water resources development, and iv) rehabilitation.
- 2) PJT has undertaken a part of i) and ii), but little activities on iii) and iv). These works have been undertaken by other agencies. There is a different opinion about water resources management, although the basis is unclear, that " Water resources development should be the tasks of PKB, and operation and maintenance of the completed project facilities are under the tasks of PJT ". This statement is contradiction to the Minister Decree.
- 3) River basin boundary of PJT's responsibility is not clearly defined whether the

entire basin including the entire main and tributaries, or the main Brantas and specified tributaries only (40 river basins are specified in the Minister Decree). Should the W.R.M. (water resources development and water supply inclusive) be the responsibility of PJT, responsible areas should cover whole the river basin.

- 4) Revenue of PJT comes from i) PLN, PDAM, private industries as water charge, and ii) self- business such as recreation, land lease, leasing construction equipment, selling sand, etc.
- 5) PJT has been evaluated as a very healthy company in terms of financial status. According to the balance sheet in 1996, PJT got a profit due to the revenue in excess of the annual expenses. However, the revenue was mostly from PLN and PDAM which are rather easier to pay with direct revenue from the customers. However, PJT received no revenue from irrigation water supply which is the largest sector of water supply by the Brantas. To say in other word, it implies that PLN and PDAM have paid more than reasonable water charge. While, the expenses of PJT was rather less, since PJT did not do sufficient maintenance works because of no return from such works.
- 6) PJT has not received any payment on operation and maintenance of facilities such as watershed management, flood control, and Sabo, etc. all of which serve to indefinite many beneficiaries. Without revenue, PJT cannot conduct these works sufficiently. The Government should share these expenses.
- 7) Water charges to PLN and PDAM have been determined through negotiations on unit rates basis. There are no any reasonable criteria and/or formula to determine the unit rate. Although, such problem does not come up to reality, PLN would ask PJT to lower the water unit rate and to minimize its annual increasing rate. Reasonable water rate calculation system, water charge system, and overall water charge and payment system should be established urgently
- 8) Number of present staff of PJT is accounted for 436 persons. Since those people are rather older age, young people should be employed to sustain PJT's business operation. Furthermore, engineering capacity of PJT seems to be declining.

#### **VII.4.2 Recommendation**

The previous chapter presents the countermeasures and action plan by sector. Hereunder, the recommendations are expressed covering common aspects to all sectors as well as by sector summarizing the previous expressions. It is recommended that all countermeasures presented in the previous chapter are implemented accordingly.

##### **(1) Recommendation on Overall W.R.M.**

##### **(a) Definition of W.R.M.**

- 1) There are many terms relating to the W.R.M. such as "Water Resources

Management”, “Water Management”, “River Management / River Environment Management”, “Water Resources Development”. These terms are used confusedly.

- 2) “Water Resources Management” is used seemingly, in a narrow sense, water conservation/watershed conservation, water resources development to create water, and water allocation management. “Water Management” is used as water allocation, and water quality management in many cases. “Flood Control” is used differently from W.R.M. Herein, “Water Resources Management” is used in a wide sense to cover all the water-related management including flood control, water management, etc.
- 3) “Water Management (river environment management)”, and “water resources development” are important fields of supply side management but a part of “Water Resources Management”. Water Resources Development seems to be understood as a mainstream of the W.R.M. in many occasions. The final goal of the W.R.M. is to support sustainable society building, and the water resources development is just one of the component of W.R.M.
- 4) W.R.M. covers all inclusive i) watershed management, ii) flood control management, iii) water supply management including water resources development, and water supply, iv) water quality management, v) river environment management. Water Resources Management should cover the entire stretches from uppermost reaches to the lowermost reaches.
- 5) It is recommended that Water Resources Management be defined clearly as mentioned above and specified in the related law and regulations. This definition should be known well by all the inhabitants as well as related agencies.

(b) Basic principle of W.R.M.

Basic Principle of W.R.M. which presented in Chapter IV is repeatedly shown hereunder. W.R.M. is to be executed following this basic principle

- 1) The objective of W.R.M. is to support sustainable society building.
- 2) One River- One Plan- One Management principle
- 3) Full Cost Recovery Principle
  - Beneficiaries pay principle: beneficiaries should pay equivalent to benefit they receive.
  - Government obligation principle: Government should share the cost of the W.R.M., which provide the services to indefinite beneficiaries.
  - Polluter’s pay principle: Polluter should pay the cost for recovering self-polluting and/or treatment of self-pollutant.
  - Service to receive principle: W.R.M. organization may receive equivalent to the services they provide.



(c) Clarification of maintenance and management

- 1) All the facilities constructed need these operation and maintenance (O&M) and management cost. Generally speaking, O&M cost would be equivalent to 0.5-3% of the capital cost according to the nature of facilities.
- 2) The concept of O&M cost is at present not so clearly understood by W.R.M. related agencies. Reduction of O&M cost would result in shortening facilities lifetime and/or considerably large cost for re-construction or rehabilitation work later.
- 3) It is recommended that recognizing need of O&M, the Government should issue regulations to clarify the Government obligation principle and the Government shares the cost based on the "Full Cost Recovery" principle as described above.

In accordance with the above basic principle, it is recommended that the W.R.M. system of the Brantas River should be strengthened and all the proposed projects as presented in the previous Chapter be implemented. Hereunder, recommendation and suggestions are given in technical and managerial aspects.

(2) **Recommendation on Managerial Aspect**

(a) **Restructuring of overall W.R.M. Organization**

- 1) Unified management system should be established, and rights and responsibilities of each organization should be clearly setup.
- 2) MPW should be the supervising authority of PJT.
- 3) PJT should be the implementing agency of W.R.M. for the Brantas river basin.
- 4) Basin Water Resources Management Committee (BWRMC) should be setup. Its function is assumed as;
  - a) Coordination among all the related agencies on water resources management,
  - b) Preparation and submission of Recommendation to MPW and get an approval therefrom.
- 5) New Water Resources Management organization through equal consolidation of PKB, PGKS, and PJT should be set up. Name of new organization should be decided by the Government, but tentatively called as New PJT for Study Team's convenience.
- 6) The tasks of New PJT are assumed as primary management (raw water management). All the agencies concerned shall continue their current obligations in principle. Basic obligated works are enumerated below.
  - a) Overall management and coordination: New PJT
  - b) Watershed management: Land Conservation Bureau

- c) Flood control and Sabo: New PJT
- d) Water quantity management:
  - Water resources development and raw water supply: New PJT
  - Watershed conservation: New PJT
  - Water supply management to end users: Respective agencies
- e) Water quality management:
  - River water quality management: New PJT
  - Domestic, industrial, and livestock breeding: Respective agencies
- f) River environment management: New PJT
- g) Basin Water Resources Management Committee: Secretariat by New PJT
- 7) Institutional arrangement should be setup to realize the above obligatory assignment to the related agencies on the basis of above principle.

(b) Restructuring of New PJT

Assuming New PJT will be established in 2002, the following organizational setup is recommended.

- 1) New PJT will continue the obligations undertaken by PKB, PGKS, and current PJT and will do new obligations of W.R.M. in a sense of the big picture.
- 2) New PJT will do profit oriented business as currently doing as well as the public services for W.R.M. To implement these works, New PJT is to be re-organized
- 3) As for W.R.M., New PJT shall do public service under the supervision by MPW
- 4) As for profit oriented business, New PJT is suggested to do the water-related business and its surroundings. A competitive business operation should be considered.
- 5) New PJT's property management should be strengthened. National Government property and self-property should be clearly managed.
- 6) To establish water charge system in accordance with the basic concept of W.R.M. as presented previously.
- 7) New PJT is obligated to promote beneficiaries and community participation on the W.R.M.
- 8) New PJT should be obligated to strengthen its staffing through staff training in order to implement high quality and effective W.R.M.

New PJT, so far explained above, will have the same status as " PERUM " according to the present institution. It is recommendable for New PJT to shift " PERSERO " status in 2005. The purposes of this movement are as follows.

- a) Privatization of public service in accordance with Government policy
  - b) Reactivation of PJT by means of competitive operations in profit oriented business, and thus government cost saving in W.R.M.
- 9) New PJT after shifting PERSERO is obligated to operate itself taking into account the following.
- a) Acquisition of fund and capital from stock exchange market and/or private investor become possible.
  - b) Internal reserve of profit, and re- investment of the profit become possible.
  - c) New PJT is expected to be re-activated through profit oriented business which will result in more effective operation of W.R.M.
  - d) New PJT after PERSERO is obligated to do the business clearly dividing into public service and profit oriented business.
  - e) W.R.M. should be of public service obligation. So as not conducting excessively profit oriented business, W.R.M activities shall be strictly supervised by MPW.

**(3) Recommendation on Technical Aspect**

**(a) Review of master plan**

- 1) New PJT should do the review /updating of M/P by itself.
- 2) Review of M/P should be done timely according to the changes of basin economic and social conditions and hydrological changes.
- 3) M/P should be updated at least once every 10 years.

**(b) Strengthening watershed management**

- 1) The Ministry of Forest now undertakes forestry issues. New PJT should formulate watershed conservation plan in a position of a overall W.R.M. body, and submit it to Forest and Land conservation bureau for its implementation.
- 2) New PJT should recommend Forest and Land conservation Bureau to conduct experimental reforestation and terrace farming.
- 3) New PJT is obligated to review the result of the said experimental works, and review the overall watershed conservation plan.

**(c) Flood control and Sabo works**

- 1) The biggest problem in the Brantas is the debris effluent from the eruption of Kelud and Sumeru Mountains. Eruption of Kelud has occurred once every 15 years on average and each eruption produced huge amount of debris, which come into the Brantas. New PJT should continuously implement Sabo works until the rest of Kelud volcano.

- 2) New PJT should do periodical observation of riverbed changes and sediment deposit in the existing Sabo facilities every year. Thus, it should do the review of overall Sabo plan.
- 3) New PJT should prepare ledger sheets of existing river facilities including history of construction, operation and maintenance, and should update it.
- 4) For more effective use of existing FFWS, telemetering system including observation stations and telecommunication system should be improved, and computer control system should be upgraded.

(d) Water Resources Development and Water supply

- 1) F/S of Beng dam project
  - a) Beng dam is recommended to be implemented after Wonoredjo dam project which is now under construction. It is recommended New PJT to conduct F/S as soon as possible.
  - b) Prior to the F/S, a priority study should be done including necessary compensation, environmental impact assessment, etc. for determining finally the project next to Wonoredjo among the alternative dam development projects proposed.
- 2) To accelerate water saving
  - a) Water saving in irrigation and industrial water uses should be promoted in economic point of view that water saving cost is comparable with new dam development and also from the view point of retaining possible dam site for future development
  - b) New PJT should prepare the overall water saving plan and submit it to the related agencies with recommendation of its implementation.
  - c) Irrigation water saving (canal lining) is recommendable to be undertaken by provincial irrigation service.
  - d) Industrial water saving (including industrial wastewater treatment and increase of productivity) is recommendable to be undertaken by Industry and Trading Ministry and Provincial Industry Bureau.
- 3) To accelerate low water management
  - a) New PJT should do periodical review of dam and reservoir operation rule taking into account water demand changes.
  - b) Low water management rule (for water allocation in drought year/drought season) should be prepared and noticed to all the related agencies.
  - c) Water supply to end-users is to be managed by respective agencies. This should be authorized by Government regulation.
  - d) New PJT should establish/ upgrade the necessary control facilities for low water management.

- (e) To accelerate water quality management
- 1) River water quality management should be a tasks of New PJT
    - a) Water quality management is at present under the responsibility of BAPEDALDA. River water quality should however be under the responsibility of New PJT. Necessary institutional arrangement should be done.
    - b) New PJT is requested to upgrade its own water quality test facilities, and reinforcing its own staff
  - 2) Industrial wastewater treatment and sewerage systems should be established by the related agencies. This should be clearly announced through regulations
  - 3) Target of river water quality is set at 6 mg/l. This target may be realized by means of water treatment system for domestic, industrial, and livestock wastes and maintain river maintenance flow. Among those, river maintenance flow should be managed by New PJT and others are the obligation of respective agencies.
  - 4) New PJT should prepare the basic plan on water quality control and submit it to the related agencies with recommendation for their implementation
  - 5) New PJT should conduct investigation and research on natural river self-purification capacity.
- (f) River environment
- 1) River environment management is of New PJT's task.
  - 2) New PJT should prepare river environment standard and management rules for the Brantas, and submit it to the related agencies after getting approval of higher authority
  - 3) River environment standard should include river water quality standard, rules for river water use, and definition and delineation of river area, and rules for river area use
  - 4) New PJT is obligated to conduct investigation, research, planning and implementation on protection of natural biota and creation of multiple natural river

#### **VII.4.3 Conclusion**

This JICA Study started in February 1997, and will finish in July 1998. The Study presented many recommendations during this rather short period. The Study Team acknowledges many thanks for extensive cooperation of PKB, PGKS, and PJT as a counterpart.

W.R.M. is recognized nowadays as one of the important issues worldwide not only Indonesia in view of the environmental protection. Water resources development in the Brantas is known as the most advanced one in Indonesia. However, W.R.M. would be more and more important with the development progress.

It would be very expectable that this study will be a good guide for implementation of W.R.M in the Brantas first. It is expected further that realization of this program is one of the examples in Indonesia and is adopted further for expanding to the other river basins.

This Study presents a lot of recommendations in both hard and soft components on

strengthening W.R.M. in the Brantas. Its realization would need much time, cost and effort by all the related agencies. It is a real expectation that with its realization, this program would contribute to welfare of the people living in the Brantas basin, thus further to the sustainable development of whole Indonesia

During the Study, economic crisis due to devaluation of Rupiah currency has happened since June 1997. In spite of the Government effort, such economic condition is still continued. However, expectation, after several years, is that a steady development of Indonesia will take place again. This Study may not take into account such unforeseen economic crisis on the macro-economic forecast and several economic indices for the Study. During the preparatory works as recommended in this Chapter, this very serious fluctuation of Rupiah exchange rate would be settled and the proposed plan is realized.

**Table VII.1 Operation and Maintenance Cost of the Brantas River Basin Management Plan**

Project	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 -
<i>(Unit: million Rp. in 1997 price level)</i>																							
<b>Dams</b>																							
Beng	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kedungwaruk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Genteng 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Extension of Sediment Bypass Channel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wingsi dredging	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lodoyo dredging	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senguruh dredging	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>River Improvement/FRWS</b>																							
Improvement of FRWS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wadus River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lodoyo diversion tunnel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Watershed management/Sabot/R&amp;D</b>																							
Sabot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Experimental research	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Water quality</b>																							
New laboratory of PJT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>River environment</b>																							
Biological Diversity Monitoring and Inhabit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Creation of wetland and fishponds (a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recreation development program (a)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Others</b>																							
Inter-agency Information System	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation canal lining	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Human resource development	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>GRAND TOTAL</b>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Related Investment (b)</b>																							
Waste water treatment (a)	0	770	1,540	2,810	4,080	5,350	6,620	7,890	9,160	10,430	11,700	12,970	14,240	15,510	16,780	18,050	19,320	20,590	21,860	23,130	24,400	25,670	26,940
Reforestation and terracing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total of related investments</b>	0	770	1,540	2,810	4,080	5,350	6,620	7,890	9,160	10,430	11,700	12,970	14,240	15,510	16,780	18,050	19,320	20,590	21,860	23,130	24,400	25,670	

(a) % of investment cost assumed.  
 (b) Related to Water Resources Management Plan, but not included in the program cost.

**Table VII.2 Proposed Investment and O/M Plan and Current Expenditure of PJT, PKB and PGKS**

(Expenditures of PJT, PKB and PGKS)

(Unit : Rp.million)

Year	PKB	PGKS	PJT	Total
1995	71,139	30,607	14,638	116,384
1996	133,096	28,878	18,765	180,739
1997	90,999	16,850	21,049	128,898
Average	98,411	25,445	18,151	142,007

Source : PKB : actual fund application

PGKS : Approved budget

PJT : actual revenue

(Proposed investment and OM costs)

**1. Average annual investment amount of WRMP**

Total investment until 2020 :

Rp. 2,791,998 million (including VAT)

Period :

22 years

Average annual investment amount :

Rp. 126,909 million per year

**2. Operation and maintenance cost of WRMP :**

Rp. 41,563 million per year at full development stage from 2021

**3. Operation and maintenance cost of the existing facilities in a desirable manner :**

Rp. 30,966 million per year

**Total of 1, 2 and 3.**

Rp. 199,438 million per year



**Table VII.3 Summary of Results of Economic Analysis**

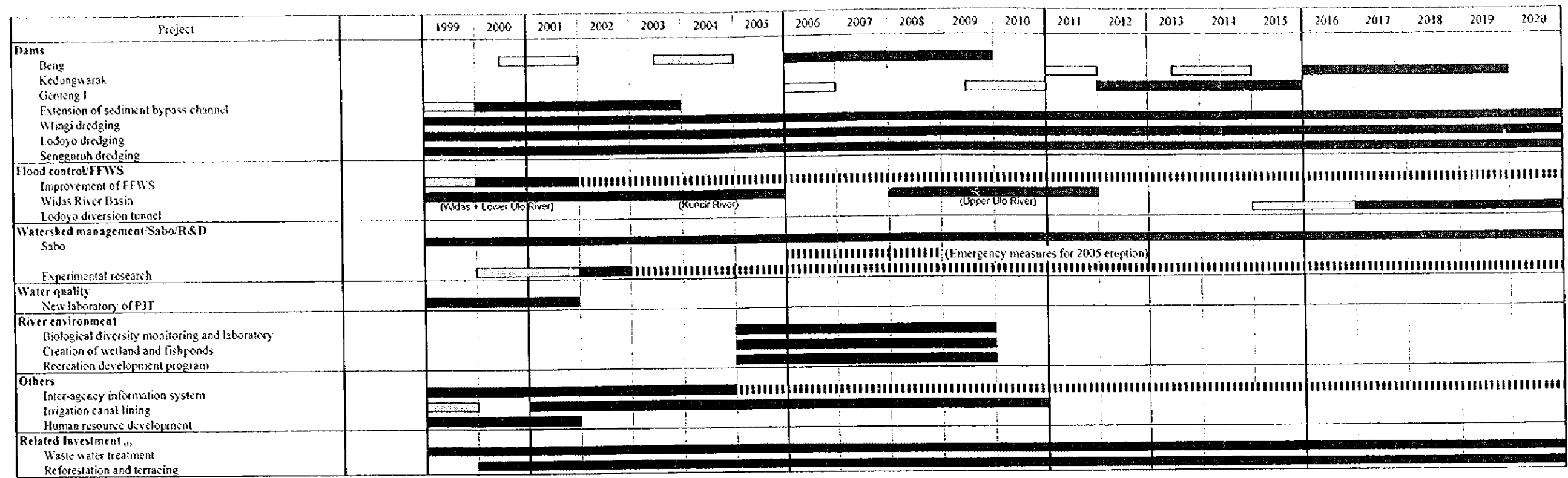
Measure	Result	Benefit
<b>Dams</b>		
Beng dam construction	IRR : 18.6 %	Domestic and industrial water supply, power generation
Genten I dam construction	IRR : 13.3 %	Domestic and industrial water supply, power generation
Kedungwarak dam construction	IRR : 10.0 %	Domestic and industrial water supply
Dredging of Wlingi, Lodooyo, Sengguruh	-	Maintain the existing functions
Sediment diversion channel	-	Sediment reduction in Wlingi and Lodooyo dams
<b>Water saving</b>		
Irrigation canal lining	IRR : 19.3 %	Saving in irrigation water demand and partial conversion to industrial/domestic uses
Industrial water saving	-	Most economical measure for limiting demand (creating water)
<b>Flood Control</b>		
Widas	IRR : 14.1 %	Flood damage mitigation
Lodooyo diversuin tunnel	IRR : 14.5 %	Flood damage mitigation, reduction in sediment in Wlingi/Lodooyo reservoirs
Improvement of existing FFWS	-	Better low flow management
<b>Water shed management</b>		
Reforestation and terracing	IRR : 23.7 %	Reduction in sediment discharge into river
Experimental research	-	Clarification of reffestation effects
<b>Sabo</b>		
Mt. Kelud	B/C : 1.46	Reduction in sediment discharge into river
Lesti/Brantas	B/C : 1.80	Reduction in sediment discharge into river
<b>Water quality monitoring</b>		
	-	Prerequisite for water quality improvement
<b>River environment</b>		
	IRR : 59.6 %	Creation of recreation opportunities
<b>Inter-agency information system</b>		
	-	Improved efficiency in data collection and decision making
<b>Human resource development</b>		
	-	Prerequisite for an appropriate water resources management

\* discount rate of 12% applied

**Table VII.4 Recreational Benefit of Selorejo and Sutami Reservoirs**

Item	Unit	Selorejo	Sutami
<b>(Conditions)</b>			
Number of visitor	person/year	126,000	92,000
Number of income earners	person/year	42,000	30,667
Travel cost	Rp./person	1,200	1,200
Time value	Rp./person/day	16,700	16,700
Admission fee	Rp./person	1,000	1,000
<b>(Result)</b>			
Travel cost	million Rp.	151	110
Time value	million Rp.	701	512
Admission revenue	million Rp.	126	92
Total	million Rp.	979	715

Figure VII.1 Implementation Schedule of Water Resources Management Master Plan for the Brantas River Basin



Legend:  : Feasibility Study  : Detailed Design  : Construction/Installation

Investment Schedule

(Unit : million Rp. in 1997 price level)

Project	Total	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
<b>Dams</b>																							
Beng	265,397	0	0	0	0	1,740	3,769	27,850	65,410	70,409	70,409	25,810	0	0	0	0	0	0	0	0	0	0	0
Kedungwarak	143,847	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,055	2,287	13,459	34,532	38,426	38,426	15,662	0
Genteng I	290,662	0	0	0	0	0	0	0	0	0	0	3,542	7,674	6,776	58,273	80,930	80,930	52,537	0	0	0	0	0
Extension of sediment bypass channel	50,729	1,209	12,380	12,380	12,380	12,380	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wlingi dredging	202,683	14,428	14,428	14,428	14,428	14,428	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679	7,679
Lodoyo dredging	198,056	9,215	9,215	9,215	9,215	9,215	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993	8,993
Sengguruh dredging	14,278	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649	649
<b>Total</b>	<b>1,165,652</b>	<b>25,501</b>	<b>36,672</b>	<b>36,672</b>	<b>36,672</b>	<b>38,412</b>	<b>21,090</b>	<b>45,171</b>	<b>82,731</b>	<b>87,730</b>	<b>87,730</b>	<b>46,673</b>	<b>24,995</b>	<b>24,097</b>	<b>75,594</b>	<b>99,306</b>	<b>100,538</b>	<b>83,317</b>	<b>51,853</b>	<b>55,747</b>	<b>55,747</b>	<b>32,983</b>	<b>17,321</b>
<b>Flood control/FFWS</b>																							
Improvement of FFWS	56,667	7,617	8,016	446	0	0	856	61	61	1,086	6,133	6,989	5,108	61	0	0	856	61	61	1,086	6,133	6,989	5,047
Widas River	124,236	1,292	5,882	18,727	19,745	20,074	17,890	12,973	0	0	695	5,398	13,130	8,430	0	0	0	0	0	0	0	0	0
Lodoyo diversion tunnel	421,998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,130	9,671	100,342	100,341	100,341	99,173
<b>Total</b>	<b>602,901</b>	<b>8,909</b>	<b>13,898</b>	<b>19,173</b>	<b>19,745</b>	<b>20,074</b>	<b>18,746</b>	<b>13,034</b>	<b>61</b>	<b>1,086</b>	<b>6,828</b>	<b>12,387</b>	<b>18,238</b>	<b>8,491</b>	<b>0</b>	<b>0</b>	<b>856</b>	<b>12,191</b>	<b>9,732</b>	<b>101,428</b>	<b>106,474</b>	<b>107,330</b>	<b>104,220</b>
<b>Watershed management/Sabo/R&amp;D</b>																							
Sabo	559,992	1,890	19,055	19,325	34,800	34,801	34,801	34,801	63,763	47,450	47,450	18,488	18,488	18,488	18,488	18,488	18,488	18,488	18,488	18,488	18,488	18,488	18,488
Experimental research	6,984	0	482	0	781	674	160	162	860	165	165	165	165	860	165	165	165	165	860	165	165	165	165
<b>Total</b>	<b>566,976</b>	<b>1,890</b>	<b>19,537</b>	<b>20,105</b>	<b>35,474</b>	<b>34,961</b>	<b>34,963</b>	<b>34,966</b>	<b>64,623</b>	<b>47,615</b>	<b>47,615</b>	<b>18,653</b>	<b>18,653</b>	<b>19,348</b>	<b>18,653</b>	<b>18,653</b>	<b>18,653</b>	<b>18,653</b>	<b>19,348</b>	<b>18,653</b>	<b>18,653</b>	<b>18,653</b>	<b>18,653</b>
<b>Water quality</b>																							
New laboratory of PJT	4,500	500	500	3,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>River environment</b>																							
Biological diversity monitoring and laboratory	480	0	0	0	0	0	0	96	96	96	96	96	96	0	0	0	0	0	0	0	0	0	0
Creation of wetland and fishponds	44	0	0	0	0	0	0	9	9	9	9	9	9	0	0	0	0	0	0	0	0	0	0
Recreation development program	648	0	0	0	0	0	0	130	130	130	130	130	130	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>1,172</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>234</b>	<b>234</b>	<b>234</b>	<b>234</b>	<b>234</b>	<b>234</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Others</b>																							
Inter-agency information system	17,714	42	191	241	2,583	2,608	67	0	0	1,997	1,997	0	0	0	1,997	1,997	0	0	0	1,997	1,997	0	0
Irrigation canal lining	160,365	4,719	1,976	15,691	15,691	15,691	15,691	15,691	15,691	15,691	15,691	15,691	15,691	0	0	0	0	0	0	0	0	0	0
Human resource development	18,000	6,000	6,000	6,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total</b>	<b>196,079</b>	<b>10,761</b>	<b>8,167</b>	<b>21,932</b>	<b>18,274</b>	<b>18,299</b>	<b>15,758</b>	<b>15,691</b>	<b>15,691</b>	<b>17,688</b>	<b>17,688</b>	<b>15,691</b>	<b>15,691</b>	<b>0</b>	<b>1,997</b>	<b>1,997</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1,997</b>	<b>1,997</b>	<b>0</b>	<b>0</b>
<b>GRAND TOTAL (without VAT)</b>	<b>2,537,280</b>	<b>47,561</b>	<b>78,774</b>	<b>101,383</b>	<b>110,165</b>	<b>111,746</b>	<b>90,557</b>	<b>109,096</b>	<b>163,340</b>	<b>154,353</b>	<b>160,095</b>	<b>93,638</b>	<b>77,577</b>	<b>51,936</b>	<b>96,244</b>	<b>119,956</b>	<b>120,047</b>	<b>114,161</b>	<b>80,933</b>	<b>177,825</b>	<b>182,871</b>	<b>158,966</b>	<b>140,194</b>
<b>VAT (10%)</b>	<b>253,728</b>	<b>4,756</b>	<b>7,877</b>	<b>10,138</b>	<b>11,017</b>	<b>11,175</b>	<b>9,056</b>	<b>10,910</b>	<b>16,334</b>	<b>15,435</b>	<b>16,010</b>	<b>9,364</b>	<b>7,758</b>	<b>5,194</b>	<b>9,624</b>	<b>11,996</b>	<b>12,005</b>	<b>11,416</b>	<b>8,093</b>	<b>17,783</b>	<b>18,287</b>	<b>15,897</b>	<b>14,019</b>
<b>GRAND TOTAL (with VAT)</b>	<b>2,791,008</b>	<b>52,317</b>	<b>86,651</b>	<b>111,521</b>	<b>121,182</b>	<b>122,921</b>	<b>99,613</b>	<b>120,006</b>	<b>179,674</b>	<b>169,789</b>	<b>176,105</b>	<b>103,002</b>	<b>85,335</b>	<b>57,130</b>	<b>105,868</b>	<b>131,952</b>	<b>132,052</b>	<b>125,577</b>	<b>89,026</b>	<b>195,608</b>	<b>201,158</b>	<b>174,863</b>	<b>154,213</b>
<b>Related Investment (1)</b>																							
Waste water treatment	3,995,000	77,000	77,000	127,000	127,000	127,000	127,000	127,000	186,300	186,300	186,300	186,300	188,300	220,300	220,300	220,300	220,300	220,300	221,800	221,800	221,800	221,800	283,800
Reforestation and terracing	162,294	0	1,009	8,069	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064	8,064
<b>Total of related investments</b>	<b>4,157,294</b>	<b>77,000</b>	<b>78,009</b>	<b>135,069</b>	<b>135,064</b>	<b>135,064</b>	<b>135,064</b>	<b>135,064</b>	<b>194,364</b>	<b>194,364</b>	<b>194,364</b>	<b>194,364</b>	<b>196,364</b>	<b>228,364</b>	<b>228,364</b>	<b>228,364</b>	<b>228,364</b>	<b>228,364</b>	<b>229,864</b>	<b>229,864</b>	<b>229,864</b>	<b>229,864</b>	<b>291,864</b>

(1) Related to Water Resources Management Plan, but not included in the program cost.



Figure VII.2 Implementation Schedule of Pre-consolidation 3-year Program and Action Plan

	1999	2000	2001	2002	2003	2004	2005
	<b>3 YEAR PROGRAM</b>						
	<i>Action Plan</i>						
Establishment of New PJT							
PJT(Perum to Persero)							
<b>3 YEAR PROGRAM</b>							
Establishment of Water Resources Management System							
Establishment of MFW line	█						
Clarification of sector responsibility		█					
Establishment of BWRMC			█				
Preparation of Consolidation			█				
Development of Corporate Management							
Water charge system			█				
Assets management		█					
MIS improvement	█						
Reform of organization	█						
Human Resources Development							
Preparation of human resources development program	█						
Implementation of training program	█	█					
Staff selection and placement for establishment of New PJT	█	█					
Water Quality Control Program							
Establishment of new laboratory in Mafang	█	█					
Water Resources Development							
Preliminary survey for Beng dam construction	█	█					
Maintenance of Existing River Facilities							
Ledgers of the rivers(including river facilities and water right) and O-M work demarcation		█	█				
Establishment of Inter-agency Information System							
Preparation of system introduction	█	█					
<b>ACTION PLAN</b>							
Preparation for Persero				█	█	█	█
Watershed Conservation, Sabo, Flood Control							
Survey and monitoring of illegal sand mining	█	█	█	█	█	█	█
Flood damage survey				█	█	█	█
Preparation of flood control manual				█	█	█	█
Preparation of flood hazard map				█	█	█	█
Water Quality Control							
Establishment of water quality control system			█	█	█	█	█
Institutional arrangement based on the Master Plan			█	█	█	█	█
Preparation of waste water treatment map			█	█	█	█	█
Pilot project of "Gappei Jokaso"			█	█	█	█	█
Water Resources Development							
Survey for Beng Dam Project	█	█	█	█	█	█	█
Selection of consultant, Detailed design etc. for Beng dam project				█	█	█	█
Operation and Maintenance of River Facilities							
Stipulation of operation rule for all river facilities				█	█	█	█
Establishment of authorized method of OMR budget estimate				█	█	█	█
Consensus among beneficiaries about OMR cost allocation					█	█	█
Effective Operation of Water Resources							
Tentative Operation Rule for Wonorejo dam Project Facilities				█	█	█	█
Low flow forecasting system including Sutami and Wonorejo dams				█	█	█	█
Monitoring and Information System							
Introduction of inter-agency information system				█	█	█	█











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