

Chapter 4

Future Prospects



Surabaya-Malang Highway. With its remarkable economic growth, Surabaya faces a large number of issues requiring immediate attention such as water supply and development of sewer and road networks. (1996)

1. Future Directions in Development

(1) Assistance policy of the Japanese government

The Japanese government is following a policy of continued assistance to Indonesia. The reasons for this include: Indonesia is important politically and economically as one of Japan's neighboring countries; Indonesia shoulders an important role in international terms; and there is expected to be a great deal of aid requested in the future to make the economy sustainable. The primary areas for assistance are as listed below. (Basic Materials for Economic Cooperation, April 1996, Economic Cooperation Bureau, Ministry of Foreign Affairs)

- 1) Assurance of nondisparity (balanced development of the entire nation)
 - Eradication of poverty
 - Assistance to fundamental livelihood sectors (Basic Human Need [BHN])
 - Population and family planning including measures against AIDS
 - Development of East Indonesia (correction of regional disparity)
- 2) Assistance to sectors related to human development and education (Improvement of educational standards and development of human resources to support sustainable growth)
 - Improved primary and secondary education
 - Higher quality of teachers
 - Improved education for engineers and technicians
 - Environmental preservation (measures for environmental issues that emerge with rapid development efforts)
- 3) Assistance with reorganization of industrial structure
 - Assistance with management of macro economy
 - Promotion of lower-end industries
 - Promotion of agriculture (diversification of agricultural products, production of crops with high added value)
- 4) Development of infrastructure (creating an environment for sustainable introduction of investment)
 - Electricity
 - Water resources
 - Transportation
 - Communications

(2) Development policy of Indonesian government

The Indonesian government launched the second 25-year long-term development plan in 1994 along with the sixth 5-year development plan. Below are the three principles of development inherent in them:

- 1) Development of human resources
- 2) Improvement of livelihood
- 3) Correction of economic disparity and eradication of poverty (balanced development, emphasized investment on un- and low-developed regions outside of Java Island)

The objectives of economic policies are also established in a specific manner as follows:

- 1) To achieve a no-loan economy by 2019 when the 25-year long term development plan ends.
- 2) To promote privatization and private participation (Funds for public works and infrastructure development projects to be increased by 75% with private money by 2019.)

Based on the above policies, the Indonesian government is currently concentrating on the development of East Indonesia (east of Nusa Tenggara) as a regional policy, by promoting the privatization of state-run enterprises and the development of public infrastructure with public funds (based on BOT or BOO method).

(3) Future direction of the Brantas River Basin Development

Based on the basic principles of the two governments described earlier and the approach of the Brantas Project so far, also taking local needs into consideration, this section examines the future direction of the Brantas River Basin Development from the following viewpoints: (a) balanced development, (b) establishment of an operation and maintenance system, (c) education and training of engineers, (d) development in consideration of improved water environment, (e) privatization, (f) water resources development, (g) review of the master plan.

(a) Balanced development

Brantas projects have been implemented one after another based on the master plan which was reviewed once every decade, as explained earlier. After examining the economic disparity developing within the basin, the third master plan has proposed balanced development. Agricultural and irrigational developments have been pursued as

target sectors in the Brantas Basin. The basin has now reached an average planting rate of 180% with the highest planting rate for one area within Brantas Basin reaching 230%. In comparison, the upper reaches of Lesti, those of Ngrowo, Widas basin, and surrounding areas are all below 130%. The income of the farming households in these regions is little more than one third of the average income of the entire Brantas Basin. The third master plan stipulates the following development projects for these regions:

1) Lesti region

Construction of Genteng Dam, Lesti Dam, and small-scale dams; irrigation planning and volcanic disaster prevention planning (The Brantas Office embarked on the preparation work for the Lesti Dam construction, but has not entered into the construction work yet.)

2) Ngrowo region

Construction of Wonorejo Dam and small-scale dams, and irrigation planning (The Wonorejo Dam is under construction, mainly intended for city water supply to the Surabaya area.)

3) Widas region

Construction of upper reach small-scale dams, irrigation planning, and flood control planning (River improvement work and artificial retarding basin construction work are now in progress as part of the flood control plans.)

There is still potential for irrigation development in these regions, and further needs including industrial development of cities, education for and transfer of residents. In fact migration of the residents from the Ngrowo basin has begun to occur as Tulungagung and Kediri are making progress in industrialization, which is helping to reduce income disparity.

(b) Establishment of project operation and maintenance systems

Typically, development projects are executed with foreign aid funds until completion, followed by post-completion operation and maintenance being carried out by the local authorities concerned. There are however several projects that have failed to produce the initially intended effects due to either financial or technical problems of the recipient countries.

In the case of the Brantas Basin, the execution body of a project continues on to the operation and maintenance phases after completion, as well as when starting a new project, enabling the post-completion operation to progress smoothly.

The Public Water Service Corporation (Perum Jasa Tirta) evolved from the Brantas Office in 1990 is now engaged in the post-completion operation and maintenance. Although Perum Jasa Tirta seems to be operating fairly efficiently, the Indonesian government is considering the transfer or division of some functions of the company

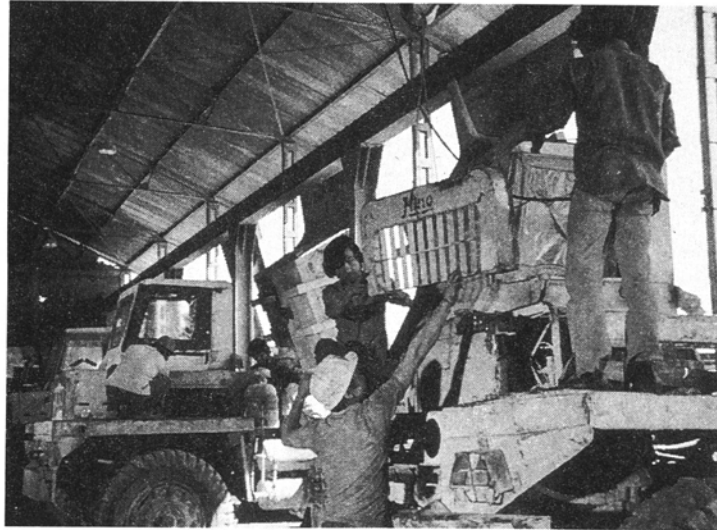
because of the large number of completed projects and the government's private participation promotion. The present situation requires that this company be strengthened.

(c) Education and training of engineers

As stated earlier, the Brantas Project was implemented on the basis of foreign contractors in the first phase, then shifted to government-run work in the second phase, and is now under way through mostly local contract work. It is recognized that the first phase of the Project was the era of basic training of local engineers; the second, that of on-site training marked by their participation in construction work for experience; and the current phase is one of execution on their own. In fact, recent years have seen an increase in the number of local contractors joining projects, although the numbers vary with the difficulty of the project.

That the Brantas Project adopted a government-run work method for a fixed time, turned out to be beneficial in the efficient training of Indonesian engineers. Engineers involved in such assignments were dispatched to other river basin projects in Indonesia, bringing about the effective utilization of engineering resources. This can be said to have been an indirect but very important effect of the Brantas Project.

Today, engineers engaged in the Brantas Project are active in development projects nationwide. Engineer training and education are still urged since an increased number of engineers are needed for the government to launch full scale development projects throughout the nation. This is the reason some government officials prefer to execute other government-run work through the Brantas Project or any suitable project. To date, the technology transfer has focused on design and construction management, and as a result the transfer of what is generally called software is lagging behind. Staff trained in such areas as planning, organization, and system and post-completion maintenance are needed in the field.



Repair shop in Karangates Dam

(d) Development aimed at improved water environment

The Brantas Project has been persistent to date towards the goal of developing basic infrastructure, which in turn leads to economic growth. In the early phases of the Brantas Project, infrastructure was provided for water, power, irrigation, and traffic networks rather than for water demand itself. Later, based on the infrastructure thus established, the local economy accelerated. Following this, additional projects were continually implemented prioritizing flood control and irrigation.

The Brantas Basin is enjoying remarkable economic growth as a center for food supply to the entire country of Indonesia along with the rapid industrialization of urban Surabaya and in-basin regional cities resulting from the developing infrastructure. With this progress, however, the water quality of the Brantas River, especially Surabaya River and its branches, is deteriorating and environmental improvement is needed. Accordingly, Brantas River Basin Development was required to include considerations of water environment such as water amount, water quality, watershed, and protection of the ecosystem.

Currently, water purification efforts are being undertaken in Surabaya municipality using river maintenance flow to dilute the river water, but the situation calls for more than dilution, the pollutants need to be reduced. What is needed is the construction of domestic and industrial wastewater treatment facilities and sewers.

How to achieve sustainable growth and at the same time maintain harmony with the environment is also an issue to be addressed. This is currently a popular development concept worldwide. Future development should take into consideration “protection of the ecosystem,” and “compatible, harmonious development concerning water,” as President Director Rusfandi Usman of the current Public Water Service Corporation pointed out. This type of river development can be seen in the Netherlands, the former suzerain state of Indonesia. Amid the Brantas Basin, with the residents experiencing higher income, public welfare, and improved living environment and standard, further efforts should be made for water improvement. These efforts should be directed toward development focusing on health improvement and compatibility, or harmony with water.

(e) Privatization

The Indonesian government is pushing forward privatization and private participation aimed at the establishment of a self-supporting economy as previously mentioned. Based on this fundamental policy, private participation efforts in the sectors of electricity, telecommunications, and transportation are under way. Like efforts are also being expended on water resources development and water supply projects.

Against this backdrop, the government plans to privatize the Public Water Service Corporation for water and river management, and is likely to do so sooner or later, as some Western nations have already privatized their counterparts. Challenges to be addressed towards this effort are listed as follows:

- 1) Is it appropriate to transfer water supply projects, indispensable to people's livelihood, to profit-oriented private companies? Required are the establishment of a legal system to define the responsibilities of companies in charge and a management system consisting of the government, and qualified engineers and management staff .
- 2) Can companies collect water charges? A governmental subsidy system should be established in light of people's ability to pay.
- 3) Currently water resources development projects are conducted by the Brantas Office, with post-completion maintenance and operation being handled by the Public Water Service Corporation. How will the operations be shared between them? Establishment of a legal system is needed to clearly define the operations to be shared after privatization.

(f) Water resources development

The Wonorejo Dam, under construction and scheduled for completion in 1999, is intended primarily for water supply to the rapidly expanding industrial urban area of Surabaya. The plan to develop Madura Island, across the Madura Strait to the east of Surabaya, also needs a water supply for its execution. (There is a plan underway to erect a bridge connecting Java to Madura.) Therefore further water resources development of the Brantas River is urged.

The total dry season water requirement for the year 2000 is estimated at 1,870,000,000 m³ (for the six months between June and November) while the present available water supply is 830,000,000 m³ in a drought year, usually occurring once a decade. Inevitably the year 2000 will face a water shortage. The Wonorejo Dam will create a water reserve of 110,000,000 m³ when completed but this amount still falls short of the expected requirement. Therefore it is necessary to continually construct dams according to the water demands as listed in Table 4-1 of the third master plan which recommends dam projects for mainly water supply purposes.

In Indonesia, which is characterized by a clear distinction between dry and rainy seasons, the active storage capacity of a dam reservoir contributes significantly to the increase in dry season flow rate. Other than dam solutions, there is groundwater development potential in Umbulan located east of the Brantas Basin. The third master plan includes many proposals such as allowing water from the Ngrowo to flow back into the Brantas River.

The Beng Dam is planned especially for seasonal adjustment to pump up water flowing in the Brantas main stream in the rainy season for storage and subsequent use in the dry season. Future development methods of this kind are likely to be required in the Brantas Basin.

The hydroelectric power developed to date accounts for only 27% of the potential water power, leaving considerable potential for future development. It should be reviewed for implementation according to demand on the third master plan projects including irrigation, water supply, flood control, watershed management, water system management, project maintenance systems for maintained and furthered project effects, environmental project proposals, and others.

Table 4-1 Dams for suggested feasibility studies

Planned project	Active storage capacity (1 mil. m ³)	Dam point
Genteng Dam I	70	The Lesti branch
Selorejo II	63	The Konto
Beng Dam	147	The Beng

(g) Measures against sediments at existing dams

It has been 25 years since the completion of Karangates and Selorejo dams; Wlingi, 18 years; and Sengguruh, 8 years. Sediment removal has been carried out several times for Wlingi Dam, which is intended for volcanic disaster prevention as well as water supply. Other dams are also in advanced stages of sedimentation, marking a noticeable decline in practical storage capacity. Especially Sengguruh and Karangates, both critical to water supply, are in need of prompt survey and examination to cope with sediment. The plan to construct the Lodoyo drainage canal for future flood control countermeasures has already been described. The first master plan proposed equipping the canal with a discharge function. It is among our suggestions to review in detail the implementation of this proposal along with the dredging of reservoirs.

(h) Review of the master plan

Ten years have passed since the formulation of the third master plan in 1985. Many projects worked out in the plan are yet to be implemented, seemingly because the Indonesian government's development efforts emphasize undeveloped regions (particularly Eastern Indonesia outside of Java). The review should consider the above items from (a) to (g). Among others, a surge in water demand urges new water resources development. With the advancement of industrialization in the municipality of Surabaya and in the Regency of Sidoarjo, there is land use conversion taking place from irrigated areas to industrial sites in the Brantas Delta. Newly created water demands by this conversion should also be considered.

2. Comprehensive Plan for Water Resources Management

(1) The JICA Study in 1997 – 1998

Recognizing the importance of the emerging problems pointed out in the preceding section, the Government of Indonesia requested the Government of Japan to carry out the Study on the Comprehensive Plan for the Water Resources Management in the Brantas River Basin (hereinafter referred to as “the Study”) in September 1996. After the signing of the Scope of Works between the two governments, JICA (the Japanese International Cooperation Agency) being entrusted by the Government of Japan had started the Study in February 1997.

Based on the understanding that the Brantas river is currently on the way from the stage of development to that of management, the JICA Study has focussed on the managerial aspects covering such areas as institutional, organizational and managerial aspects, human resources development and community and beneficiaries participation activities. While such technical fields as watershed management, flood control management, water supply management, water quality management and river environment management were studied as well.

The water demand in the Brantas basin in the target year of 2020 was secured to be met through the new water resources development projects including the Beng Dam Projects and through water saving measures including the lining of irrigation canals, the efficiency raising of industrial water use and so on. While such organizational reforms as the establishment of the administrative line of the Ministry of Public Works in the Brantas, the consolidation of three government agencies in the Brantas basin and the limited liability cooperation wholly owned by government of the Perum Jasa Tirta were proposed in the Study.

The draft final report of the Study was submitted to the Government of Indonesia in March 1998 and the seminar on the said report is scheduled to be held in Jakarta and Surabaya in May 1998.

(2) The Master Plan

1) Purpose of the Study

The Brantas functions as the most important source of water supply in the East Java Province. Currently, almost all the water of the Brantas has been utilized and some measures for enhancing water supply becomes indispensable to meet the increasing water demand. Meanwhile, the quality of river water has been deteriorating these years due to the urbanization and industrialization being emerged centering around Surabaya district.

Under these situations, the strengthening of water resources management system aiming at either an efficient use of water or an appropriate water resources management is urgently required. Thus the JICA study pursues the following:

- (a) To prepare the master plan for the comprehensive water resources management in the Brantas river basin
- (b) To transfer the technology to counterpart staffs

2) Basic Concept of the Water Resources Management

The basic concept of water resources management is understood in this study as stated hereunder. The target year is set at the year 2020.

(a) Purpose and scope of water resources management

The purpose of the water resources management lies in supporting the sustainable society building. For this purpose, it is required for the responsible agency to supply water in time to meet the demand. The following covers the scope of water resources management:

- (i) Watershed management
- (ii) Flood management
- (iii) Water supply management
- (iv) Water quality management
- (v) River environment management

(b) Basic Principles of Water Resources Management

The following constitutes the basic principles of the water resources management in this study:

- (i) Principle of “one river, one plan and one management”
- (ii) Full-cost recovery principle
- (iii) Polluters-pay principle

- (iv) Service to receive principle

(c) Socio-economic Framework in 2020

The socio-economic framework in 2020 was set up for this study on the basis of the Second 25-year Development Plan and the Sixth REPELITA having started in 1994/95 both of which were prepared by the Government of Indonesia. The major indices of the framework is shown below, which was applied for water demand projection and other planning in this study:

- GRDP growth rate : 7.6% per annum
- Population : 17.7 million
- Per capita GRDP : US\$ 5,700

3) Master Plan for the Comprehensive Water Resources Management in the Brantas River Basin

The master plan for the comprehensive water resources management in the Brantas river basin is proposed as shown hereunder and the following is recommended for its implementation.

(a) Recommendation for Overall Water Resources Management

- (i) Clarification of definition of the basin water resources management:
The water resources management is defined as all the water related management including (i) watershed management, (ii) flood management, (iii) water supply management, (iv) water quality management and (v) river environment management.
- (ii) Understanding and consensus of the basic concept and principles of water resources management
- (iii) Clarification of the necessity of the maintenance/management of river facilities

(b) Recommendation on Managerial Aspects

a) Strengthening of water resources management system

- (i) The Ministry of Public Works(MPW) shall be primarily responsible for supervising the water resources management in the Brantas river basin while PJT shall be responsible for its implementation.
- (ii) The Basin Water Resources Management Committee shall be newly established.

- (iii) The New PJT shall be established through consolidating PKB, PGKS and PJT.

b) Development of organization/management of PJT

- (i) The New PJT shall be established in 2002.
- (ii) The New PJT which will be still Perum status shall be transformed to Persero Jasa Tirta in 2005.

(c) Master Plan for the Comprehensive Water Resources Management in the Brantas River Basin

a) Projects Incorporated in the Master Plan(cf. Figure S.1)

The projects to be implemented towards 2020 as components of the master plan are recommended as follows:

- (i) Dam construction for water supply
 - Beng dam
 - Genteng I dam
 - Kedungwarak dam
- (ii) Countermeasures for sedimentation in the existing dams
 - Dredging works in Wlingi and Lodoyo dams
 - Extension of the existing by-pass channel
- (iii) Water saving measures
 - Improvement of existing irrigation channel(Concrete lining of channels)
 - Re-cycling use of industrial water
- (iv) Flood control
 - Implementation of proposed Widas flood control project
 - Construction of Lodoyo diversion channel
 - Improvement of the existing FFWS
- (v) Watershed conservation
 - Experimental Research
- (vi) Sabo
 - Sabo works for Mt.Kelud eruption
 - Sabo works in Lesti and Upper Brantas river basins
- (vii) Monitoring of water quality
- (viii) Improvement of river environment
- (ix) Introduction of the inter-agency information system
- (x) Implementation of human resources development

b) Investment Cost of the Master Plan

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).

c) Implementation Schedule of the Master Plan

Implementation schedule of the projects in the master plan is presented in Figure S.1. Implementation schedule of the Pre-consolidation 3-year Program and Action Plan towards 2020 is shown in Figure S.2.

4) Pre-consolidation 3-year Program

The establishment of New PJT through consolidating PKB, PGKS and PJT is proposed in 2002 in this study. For its smooth realization, the “Pre-consolidation 3-year Program” is recommended hereunder covering the preparation in both managerial and technical aspects.

(a) Managerial Aspects

- Detailed study on organization of PKB, PGKS and PJT
- Confirmation of the tasks of water resources management
- Clarification of the responsibility and authority of the related agencies
- Coordination of works among member agencies of Basin Water Resources Management Committee
- Preparation of the prospectus for New PJT
- Institutional preparation for the establishment of New PJT
- Training and education of New PJT staffs

(b) Technical Aspects

- Preparation of master plan for watershed management and water quality control
- Conducting the feasibility study on water resources development plan
- Preparation of the river inventory and establishment of a rule for sharing the management responsibility for river structures
- Planning of the inter-agency information system

The program will be completed within three(3) years starting from the beginning of 1999 and completing in 2002. Some specialists and/or consultants will be employed for the implementation considering both its wide scope and short period. The scope of works to be done by the specialists/consultants will include the following.

- (i) Preparation of the implementation program for the Pre-consolidation 3-year Program
- (ii) Detailed study of the current organization of PKB, PGKS and PJT
- (iii) Support of preparing the brief paper for establishing the New PJT
- (iv) Support of amending the institution and legislation
- (v) Support of preparing the specifications for technical related matters
- (vi) Support of preparing the internal regulations in administrative sectors

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

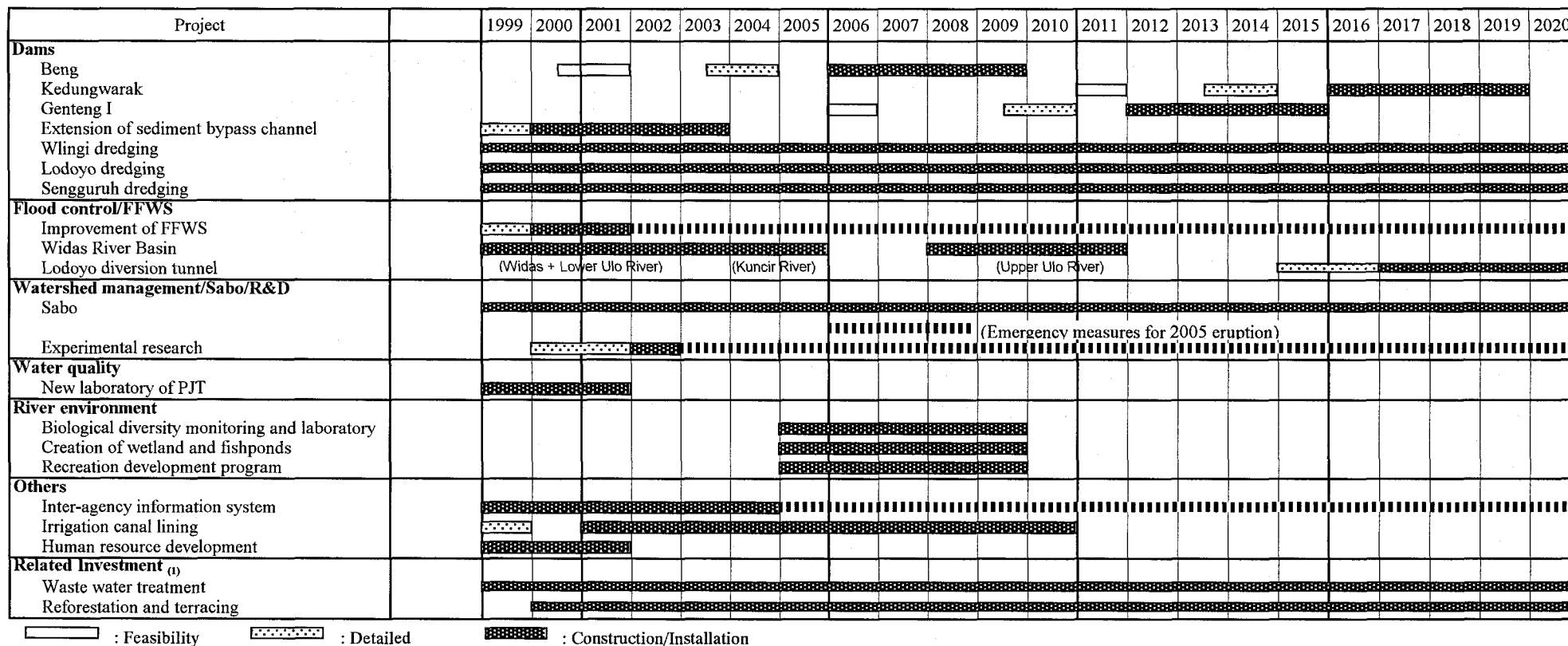
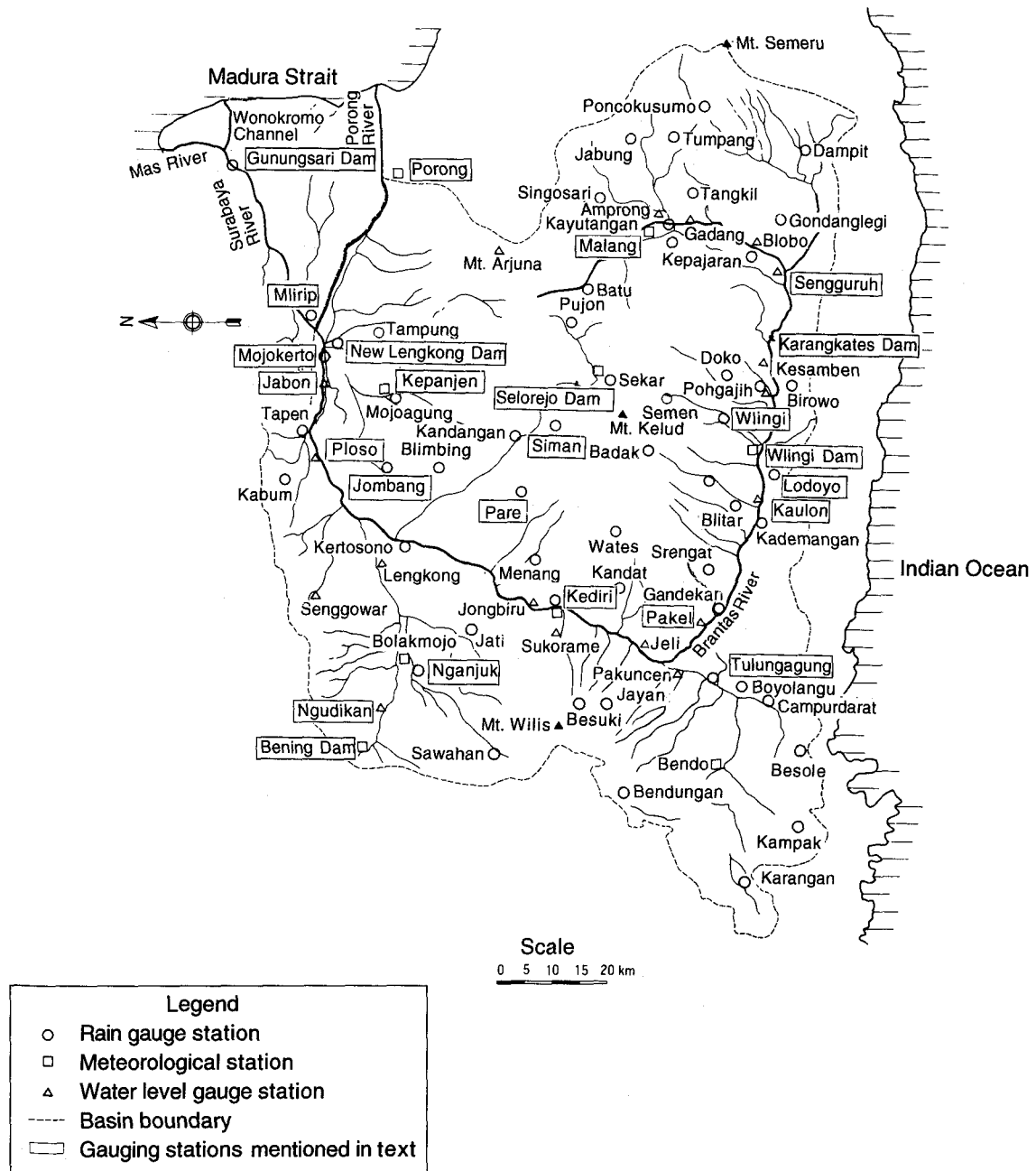


Figure S.2 Implementation Schedule of Pre-consolidation 3-year Program and Action Plan

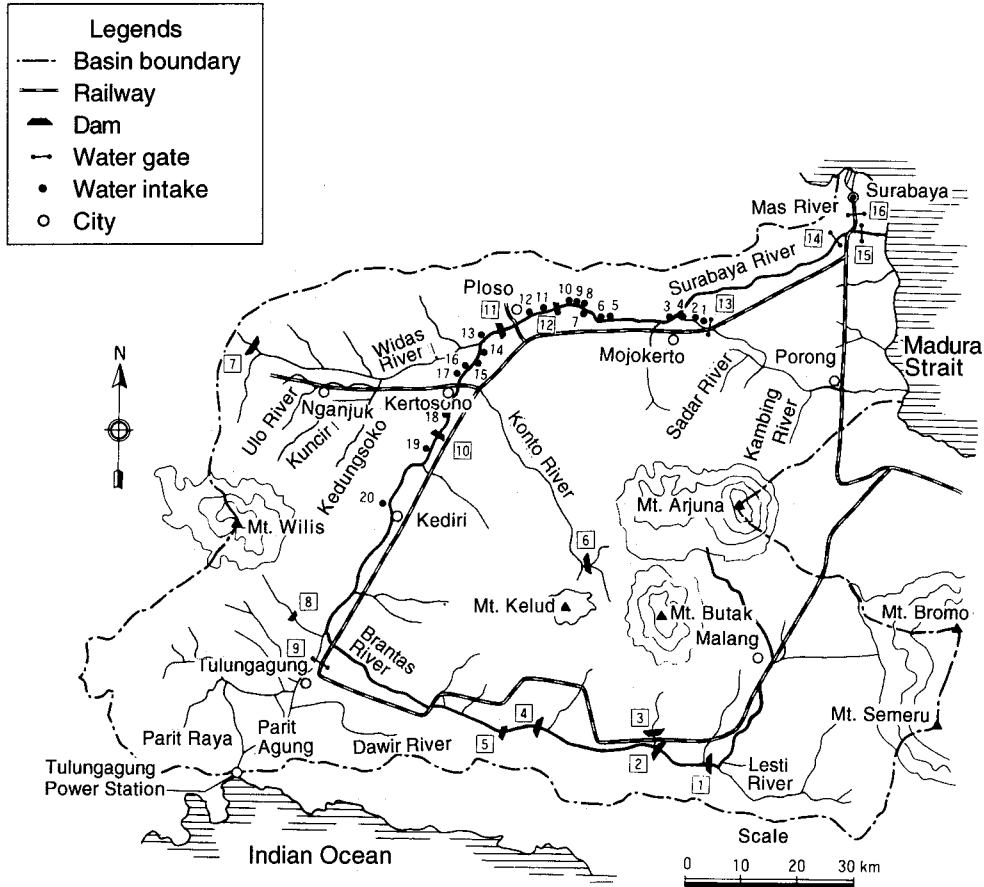
	1999	2000	2001	2002	2003	2004	2005
	3 YEAR PROGRAM						
	← Action Plan →						
Establishment of New PJT	▬						
PJT(Perum to Persero)				▬			
3 YEAR PROGRAM							
Establishment of Water Resources Management System							
Establishment of MPW line	▬						
Clarification of sector responsibility		▬					
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	▬						
Master Plan Formulation on Watershed Management and Sabo	▬						
Water Quality Control Program							
Establishment of new laboratory in Malang	▬						
Master plan formulation on water quality improvement	▬						
Water Resources Development							
Preliminary survey for Beng dam construction	▬						
Pre-feasibility study on 3 dam projects and F/S for Beng dam		▬					
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	▬						
ACTION PLAN							
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				▬			

Locations of Meteorological and hydrological stations in Brantas Basin



ATTACHMENT 2

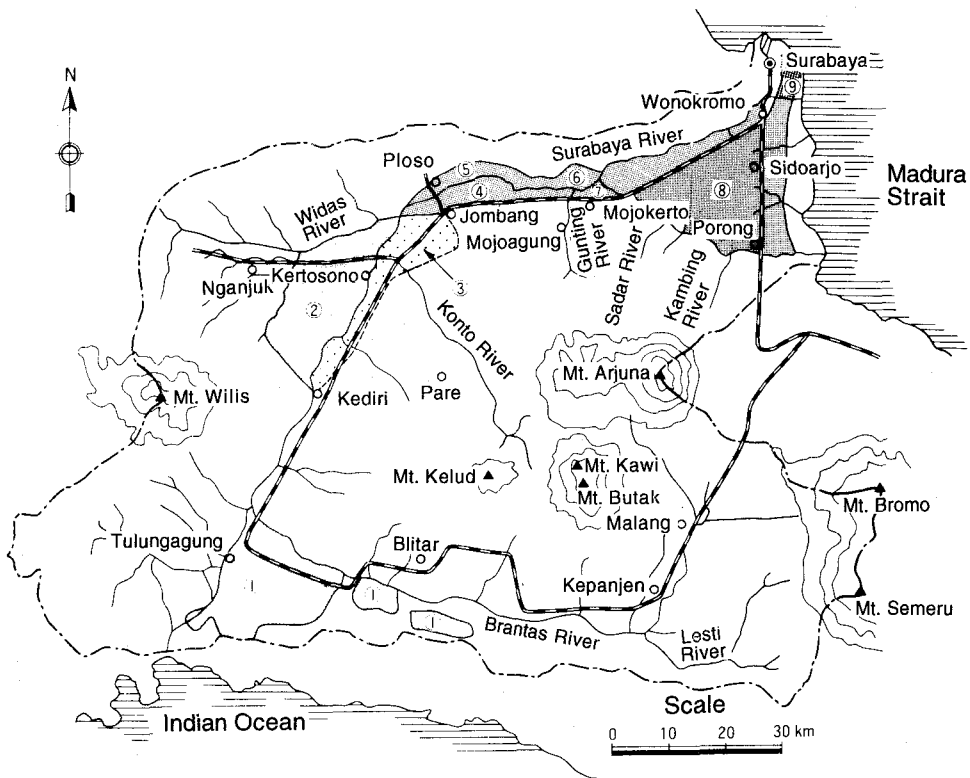
Major river facilities on Brantas River



Notes:

Dam		Water gate and barrage		Water intake			
1	Sengguruh	9	Tulungagung	1, 2	Voor Canal	12	Gottan
2	Karangkates	10	Mrican Barrage	3	Jatikulon	13	Jatimlerek
3	Lahor	11	Jatimlerek Rubber Dam	4	Mlirip	14	Tunggorono
4	Wlingi	12	Menturus Rubber Dam	5	Losari	15	Turipinggir
5	Lodoyo	13	New Lengkong	6	Gedek	16	Pengkol
6	Selorejo	14	Gunungsari	7	Sotowuluh	17	Kedungkudi
7	Bening	15	Jagir	8	Kedungsari	18	Besuk
8	Wonorejo	16	Wonokromo	9	Watespinggir	19	Banjarsari
				10	Keboan	20	Mrican
				11	Bebekan		

Irrigation Area in Brantas Basin

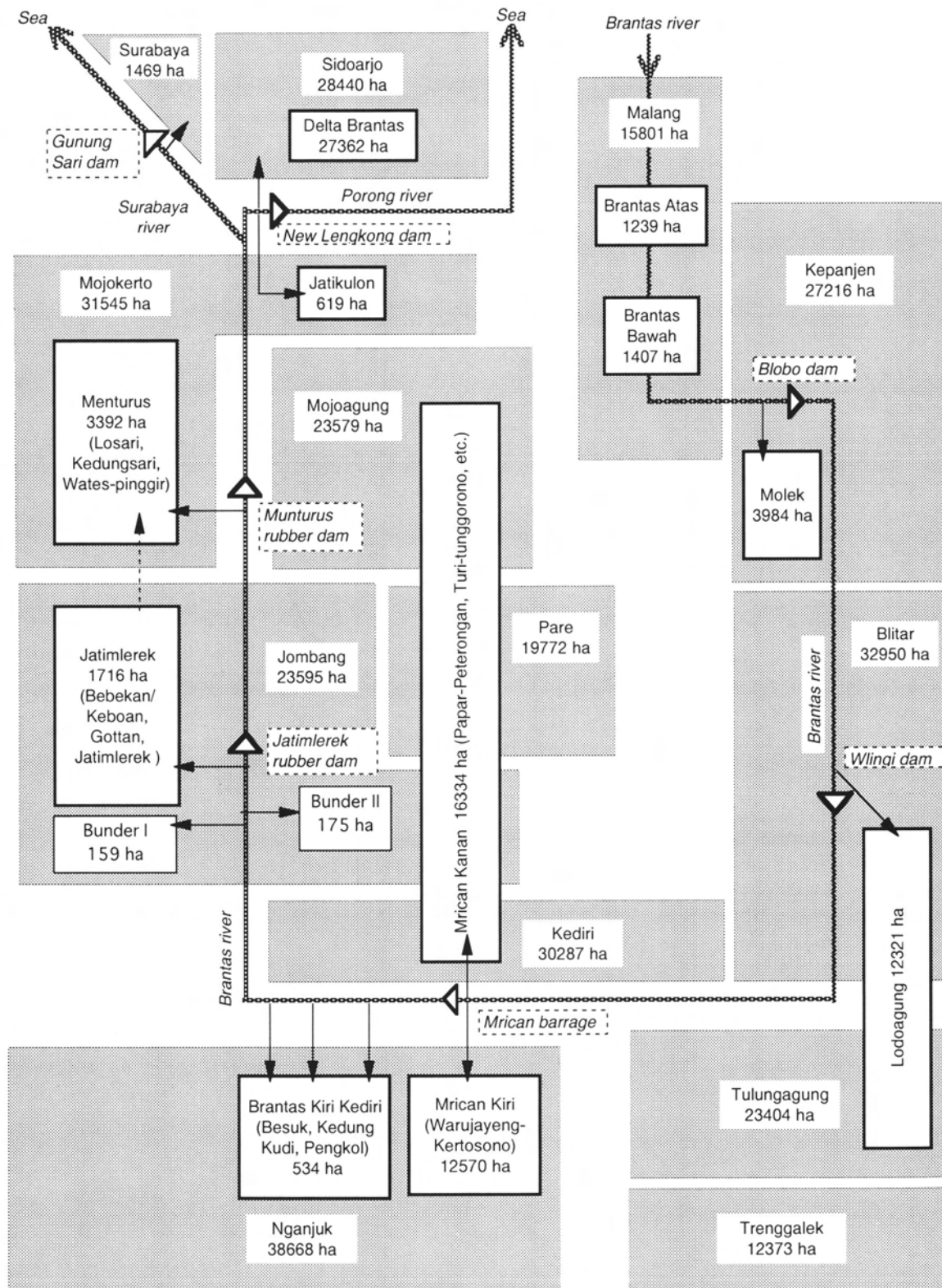


Legend	
—	Basin boundary
—	Railway
○	City
■	Irrigation area

- ① Lodoyo-Tulungagung
- ② Mrican-Warujayeng-Kertosono
- ③ Papar-Peterongan
- ④ Turi-Tunggorono
- ⑤ Jatimlerek-Bunder
- ⑥ Mojokerto-Gottan-Losari
- ⑦ Jatikulon
- ⑧ Brantas Delta (Porong-mangetan)
- ⑨ Simowau

ATTACHMENT 4

Configuration of Irrigation Areas Irrigated by The Brantas River Main Stream



Note ;

- Nganjuk
38668 ha Name of Water Resources Branch Office (Caban Dinas Pengairan) and its commanding area
- Lodoagung
12321 ha Name of representative irrigation system taking irrigation water from Brantas main stream
- Mrican barrage Name of representative intake structure on the Brantas main stem

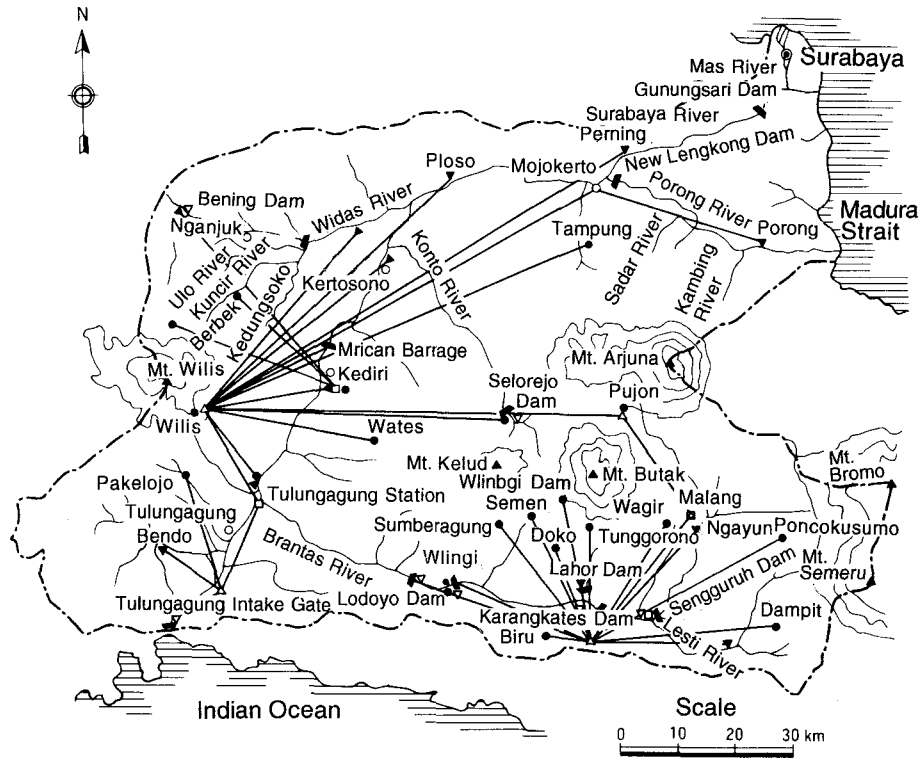
Source ; Daftar Penetapan Baku Sawah Tahun 1996 Dinas Pekerjaan Umum Pengairan Daerah Propinsi Daerah Tingkat I Jawa Timur
Illustrated by JICA Study Team

ATTACHMENT 5

Time distribution of storm rainfall at Karangkates

Date of occurrence	Feb. 3, 1970	Nov. 15, 1970	Apr. 30, 1973	Nov. 5, 1974	Nov. 7, 1974	Jan. 26, 1975	Sep. 5, 1975	Jan. 18, 1977	Jan. 31, 1977	May 29, 1977	Average	
Time of occurrence	10:00	11:00	15:00	13:00	14:00	16:00	15:00	14:00	24:00	14:00		
Rainfall ratio by hour (%)	0-1	97	49	58	42	45	21	14	18	39	50	43.3
	1-2	2	46	36	17	4	6	48	24	56	50	28.9
	2-3	1	3	5	32	0	34	38	32	3		14.8
	3-4		2	1	9	27	36		10	2		8.7
	4-5					9	3		5			4.3
	5-6					10			7			
	6-7					5			3			
	7-8								1			
	8-9											
Total amount of rainfall (mm)	85.3	74.2	69.2	116	75.5	99.5	96.5	83.4	96.0	68.5		

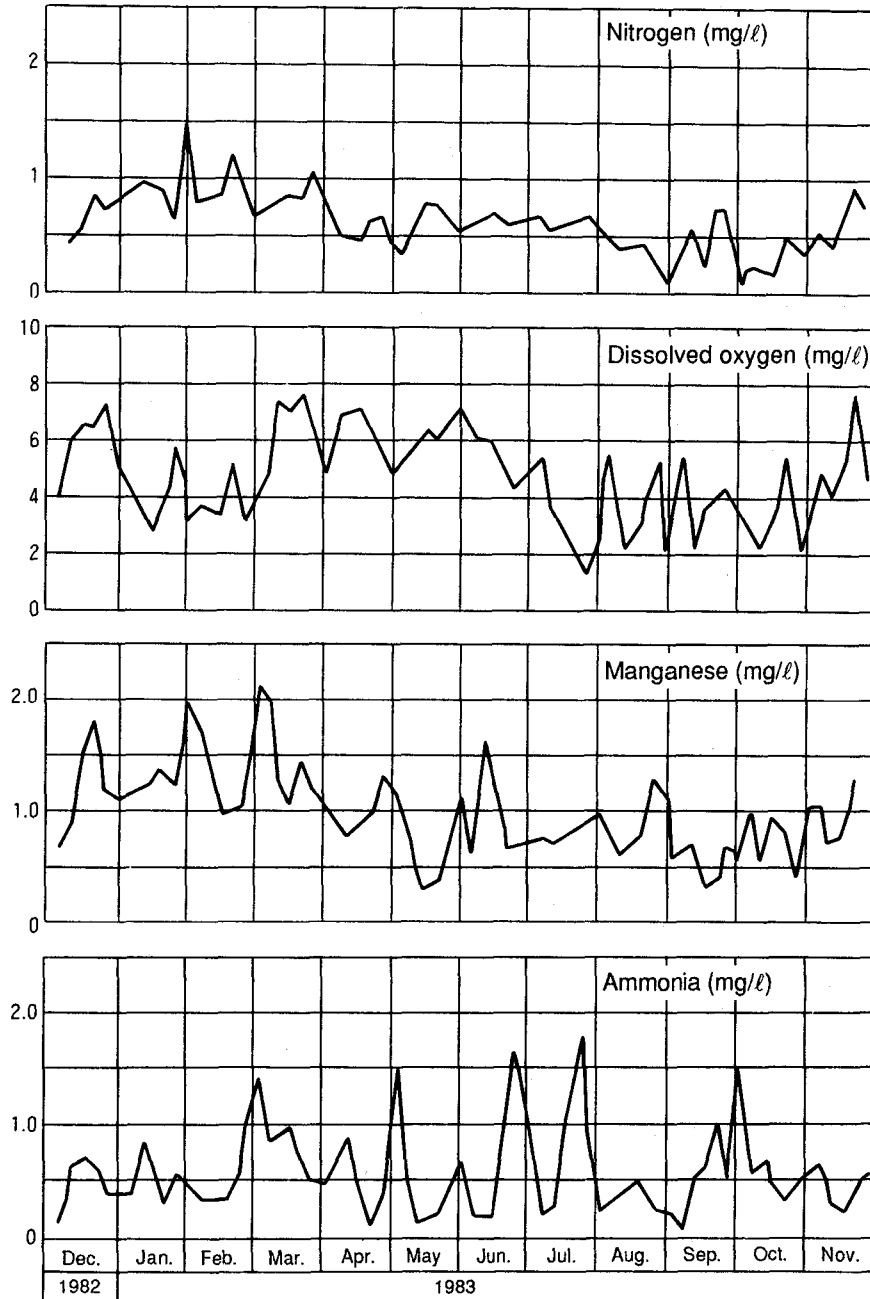
Hydrologic network of flood warning and prediction system



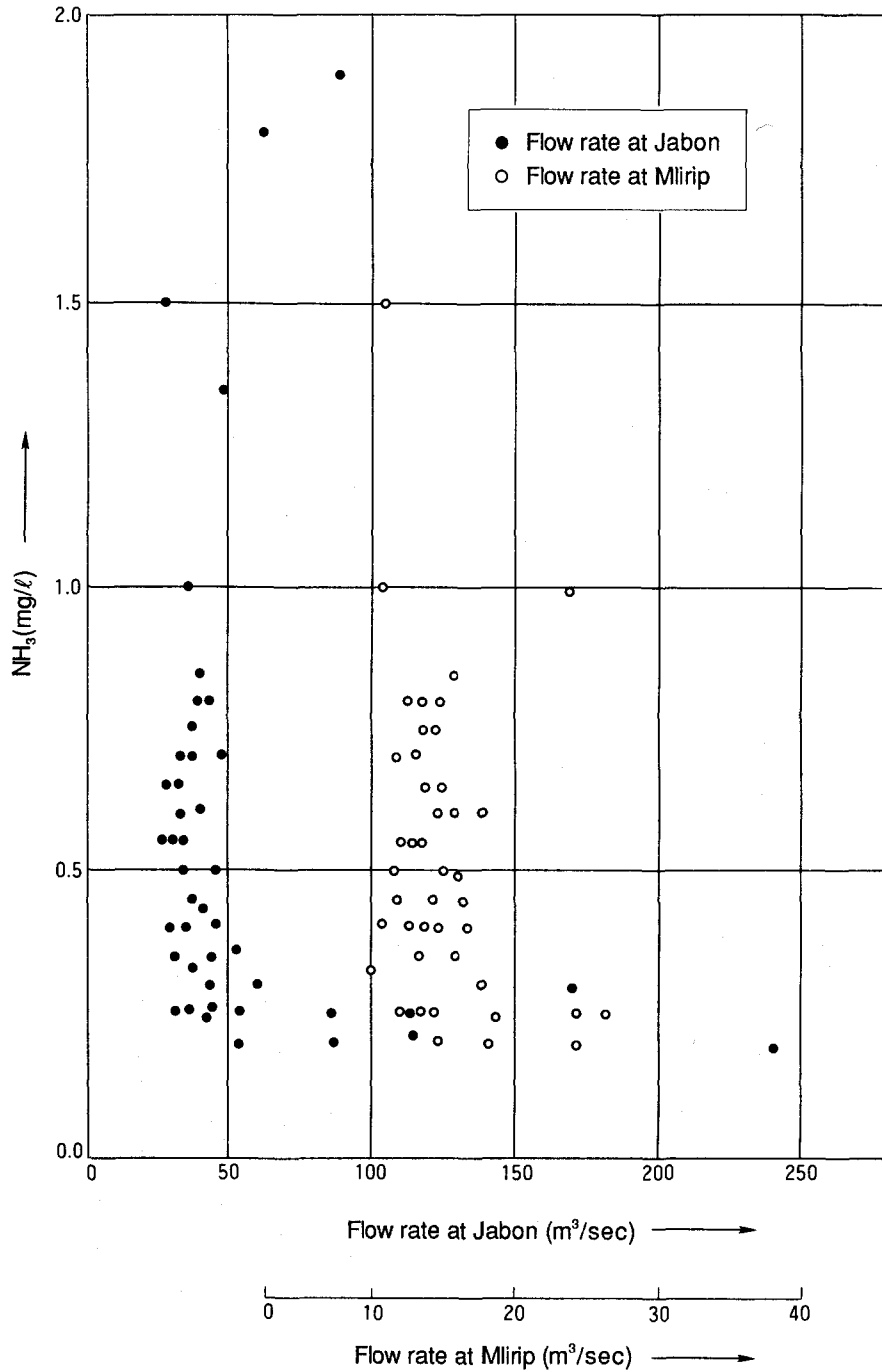
Legend	
---	Basin boundary
○	City
●	Rain gauge station
∇	Water level and overflow gauging station
▼	Water level gauging station
△	Relay station
⊙	Monitoring station
■	Integration and control station
□	Sub integration and control station
—	Radio communication network

ATTACHMENT 7

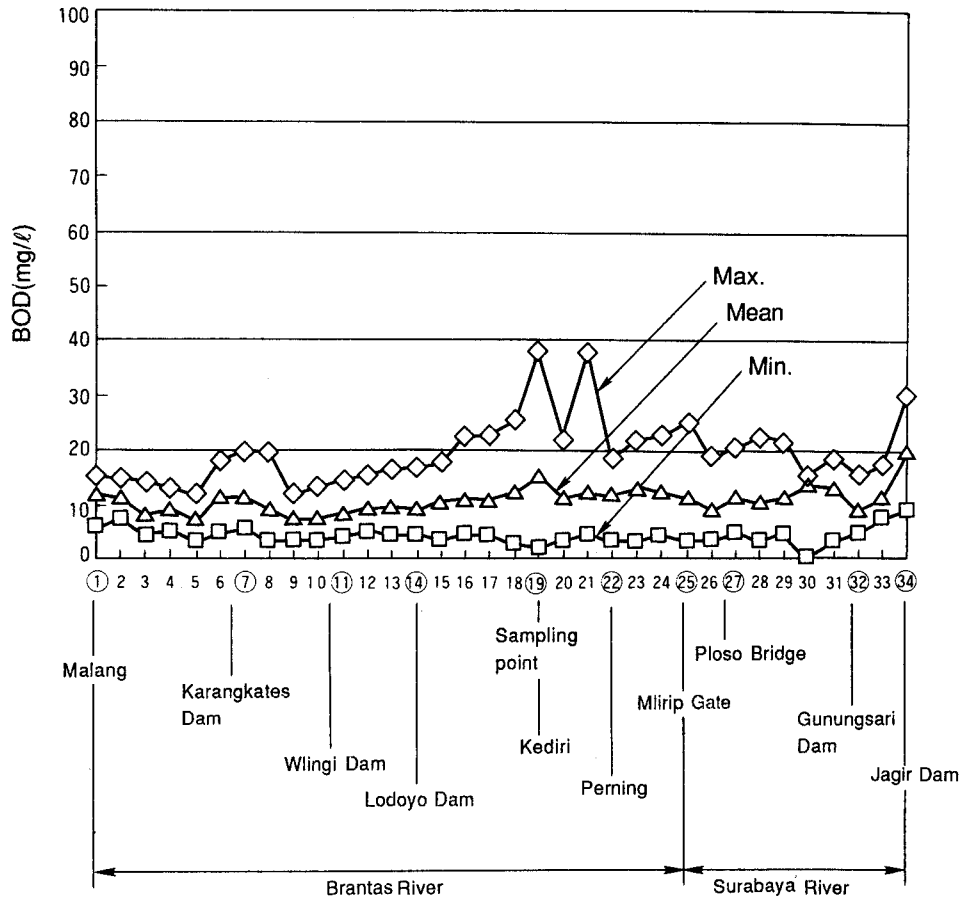
Annual variations in water quality at Gunungsari Dam



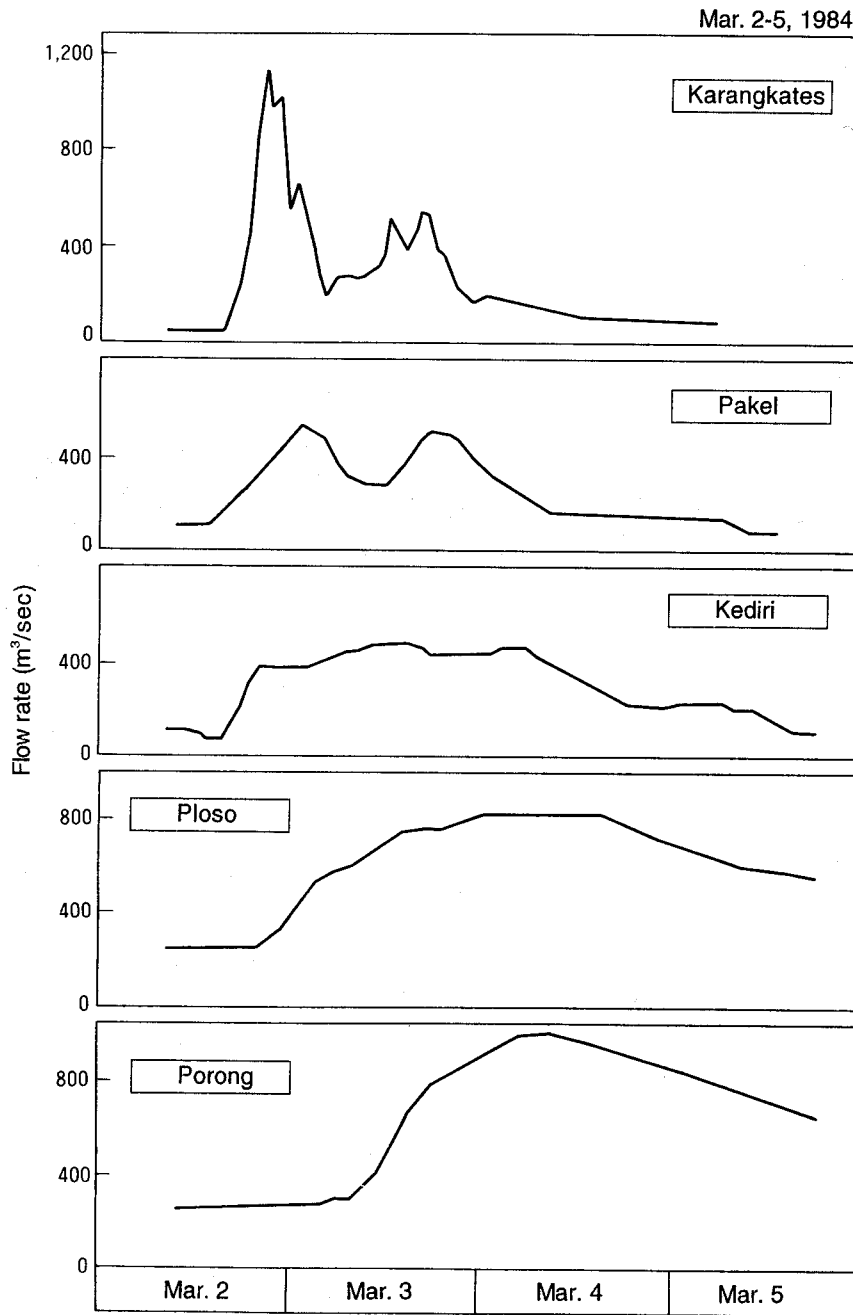
Relationship between water quality and flow rate (1983)



Water quality of Brantas and Surabaya



Flood hydrograph



Source: Master Plan II