

CHAPTER 13

Integrated Water-Resources Management in a River-Basin Context: The Brantas River Basin, Indonesia

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Introduction

Background

The motto of the 1999 World Water Day, “everybody lives downstream,” helps us to think of upstream-downstream relationships in water resources systems. It highlights the need to think beyond the traditional focus on isolated sites of water use entities, such as irrigation systems, hydropower plants or water purification plants. In a new paradigm shift related to integrated water resources management (IWRM) in the context of a river basin, attention is now being drawn to consider the upstream “off-site” influences on the various water use entities, as well as the downstream “off-site” impacts arising from them.

Along the path of water flowing in a river basin are the many water-related human interventions, including water storage, diversion, regulation, distribution, application, pollution, purification and other associated acts to modify the natural systems. All of these have one common effect, to impact those who live downstream of the water flow. This rather simple, but seemingly new, revelation drives home the concept that a river basin analysis of water would enhance the common understanding of the issues on overall productivity of water and related strategies. It also tends to highlight the importance of equity and sustainability issues related to IWRM.

The International Water Management Institute (IWMI) with financial support from the Asian Development Bank (ADB) is conducting a regional study on “Developing Effective Water Management Institutions.” The study is intended to help improve the management of scarce water supplies available for agriculture, within and responsive to a framework for IWRM in river basins. The Brantas river basin was selected as one of the case studies in this IWMI study, because the river basin management agency, Jasa Tirta I Public Corporation (PJT I), has been involved in preparing master plans, deciding on priorities and developing infrastructure for multiple uses. PJT I now acts as an autonomous water resources management organization for the Brantas basin, which seems typical for the requirements

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of many developing river basin situations in Asia. This case study is expected to illustrate how an effective institutional framework and a single basin organization have been developed and installed to cover multiple uses of water in a large river basin.

This paper begins with an explanation of the national water sector policy, focusing on the shifts of paradigms, basic policies, and principles of river-basin management and the corporatization of water resources in a nationwide context. The next section deals with laws governing water in Indonesia and also summarizes the role and competence of water resources stakeholders. Next, the paper introduces the Brantas river basin. In the following section, this basin is dealt with more deeply. The evolution of institutions is described: legal, financial and other aspects are explored. Finally, some achievements as well as some constraints of this institutional and legal arrangement are discussed.

National Water-Sector Policy

Paradigm Shift

Recent socioeconomic development has led to a shift in paradigms for water resources in Indonesia as in many other countries. Water that has always been regarded as a social good has transformed into an economic good with social functions. This paradigm change also affects the government role, which shifts from being a provider towards an enabler, from a centralized towards a more decentralized approach, from a single purpose towards a multi-sector approach, and towards broader participation.

In this perspective, water resources could be regarded as a national resource that must be managed wisely in order to gain the most benefit for the welfare of the people, both the present generation and future generations. Water could create conflict among the beneficiaries and among the users. Water is considered as strategic in order to sustain national development, so it requires a national commitment to conserve its sustainability. To gain a national commitment, utilization of water resources should involve public participation in every aspect, both managerial and investment, as well as financing of operation and maintenance (O&M). In this context, major points to be taken into account, especially in reviewing the available policies and legislation, include improving governance, institutional and individual capacity building, instituting demand and supply-management techniques and economic instruments, and promoting protection and conservation of water resources.

Basic Framework

Basic principles River basin management, as stated in Indonesian Government Regulation No. 35 of 1991 on Rivers, Article 2, consists of development, utilization, conservation and control of water resources. River-basin management could be defined as an effort to realize utilization of water resources to satisfy all demands, in an efficient and effective manner, with fair and even distribution, by taking into consideration conservation and control of water and its resources. River-basin management should be integrated (multi-sector), comprehensive

(upstream-downstream), sustainable (intergenerational equity) and based on an environmentally sound concept (ecosystem conservation) with the river basin (hydrological area unit) as one management unit.

These management principles are well summarized in the philosophy of “one river, one plan, and one integrated management.” One river (meaning river basin) is a hydrological unit that could cover several administrative areas defined as one management unit. In one river there should be only one integrated, comprehensive, sustainable and environmentally based concept of a development and management plan. One management system should guarantee an integration of policies, strategies, and program as well as implementation of the system for all of its reaches. The scope of river-basin management covers the management of the watershed, water quantity, water quality, flood control, river environment and water-resources infrastructure; and research and development (R&D).

Basic policy. To achieve its management objectives, the following basic policies are recommended for river basins:

- A river as a natural resource comprises social, economic and ecological aspects that should be utilized optimally for the welfare of the people.
- River-basin management should be based on environmental conservation, public service and economic viability.
- Those who obtain the utilization and amenity benefits from the water and water-resources infrastructure should gradually bear the cost of river-basin management.
- To obtain commitment, society should be involved in decisions on all management aspects (planning, implementing, supervising, controlling and funding) by means of a coordination body, referred to as a Water Resources Management Committee.
- River-basin management should be undertaken as a priority for strategic rivers by considering the local socioeconomic level, water demand and level of utilization and availability.
- Activities of river-basin management should, as much as possible, be corporatized by using the potential of both central and local government-owned corporations (BUMN and BUMD), public-private cooperation and private companies.
- Corporations are established in river basins where the beneficiaries can afford to pay contributions.

Role and Competence of the Stakeholders

Functions, tasks, rights and obligation of the stakeholders are shown in table 1. Stakeholders in water-resources management can be classified into three groups:

- The government, as the owner of the water resources and infrastructure, and to enhance the national welfare, plays the role of controlling, regulating and policing at the national and regional levels. It has also the right to have part of the revenue that the river-basin management institution gains while, on the other hand, it is obliged to contribute funding for activities towards public safety and welfare.
- The River Basin Management Agency, as the operator, has authority delegated by the government to manage water resources and infrastructure, perform river-basin management and develop the management system. The river-basin management institution has the right to collect fees from the beneficiaries as well as to receive contributions from the government for public-safety and welfare activities. It is obliged to give good services and promote public and private participation in the river-basin management, as well as give accountability for performing tasks for the government and society.
- Society, as users, has the right to receive good services and participate in decision-making processes, but it is expected to use water efficiently, take part in sustaining the environment, provide its financial responsibilities and, finally, provide constructive social control on river-basin management. Legal bodies and social bodies, such as water users associations, are included in this group.

Corporations

Purpose. Water is an economic good with a social function utilized by competing users (within and between sectors and across administrative boundaries). Therefore, a river basin should be managed by a neutral and professional institution that applies healthy corporate principles and general utilization norms on water resources based on public and private participation.

Objectives. Water-resources management should be conducted by a River Basin Management Agency (RBMA), a neutral and professional institution, that applies a balanced approach in its undertakings as well as protecting public interests in water- resources management and relying on public and private participation. Objectives of water-resources corporatization are as follows:

- Develop a river-management system that conserves the river as an integrated part of the ecosystem, while preserving its economic potentials and functions for the people's welfare.
- Improve the performance of river-basin management in a useful manner.
- Improve public and private participation in water resources management, including payment for services, in order to reduce demands on the national and regional government budgets.

- Develop a harmonious and well-motivated working environment to sustain prime-class service for public demands through competent management of water-resources infrastructure for stakeholders' satisfaction.

Scope of work. The basin corporation should develop master plans (including coordination with related agencies) in conservation, water-resources development, water-pollution control, flood control and land use of riverbanks. It should operate and maintain water-resources infrastructure, manage water and water resources and carry out watershed conservation in coordination with related agencies.

Financial sources. To achieve sustainable development, the budget for river basin management needs to be secured. This requires beneficiaries to gradually bear the cost for the river-basin management through the application of the following principles. The *beneficiaries-pay principle* consists of the *users-pay principle*, where the water users pay water use fees and taxes; and the *polluters-pay principle*, where the water polluters pay pollution fees and taxes. The *government-obligation principle* applies for funding semicommercial water use (irrigation) and social services (flood control, water-quality control, water-resources conservation).

Scope of Activities

Water-resources development. Water-resources development is an attempt to optimally use water potentials and prevent loss of capacity. Considering the uneven distribution of water availability during the year, it may be necessary to carry out water-resources development so that it will be useful for the welfare of the people. In the upper reaches, reservoirs are built to control floods, store water during the rainy season and to supply water in the dry season. In the middle and lower reaches, barrages and intakes are built for various purposes (irrigation, industry, drinking water, etc.). Finally, at the estuary, barrages are built to prevent saltwater intrusion into the river. Water resources development should use a holistic approach, well planned, with sustainable and environmentally sound management, performed in stages, reviewed and adjusted to the government's national policies. Basically, water resources-development goes through stages of SIDLACOM: *design* (covering SID: Survey, Investigation and Engineering Design), *construction* (LAC: Land Acquisition, Construction), *O&M*, as well as evaluation of the development results in order to adjust future development.

Water-resources management. Water-resources management activities enhance the development benefits and prolong the life of the water-resources infrastructure. In water-resources management, O&M are the main activities during the post- development phase of managing the water-resources infrastructure. Operation is an attempt to control and allocate water and its resources to achieve optimum utilization according to the purpose and minimize negative impacts, such as flood and drought. Maintenance is an attempt to securely sustain water resources, infrastructure and the environment. The scope of activities in O&M covers a range of issues discussed in the following paragraphs.

Watershed management. Watershed conservation consists of greening, reforestation, terracing, and other related activities in the frame of increasing sustainability of the watershed. To implement watershed conservation, it is necessary to establish coordination among related institutions. The RBMA plays an important role, especially preparing recommendations on the water-resources conservation program based on a Watershed Conservation Master Plan.

Water-quantity management. Water use licensing is a form of acknowledgment of water use rights as well as an instrument to control water use. The legal basis of water use licensing is the Government Regulation No. 22 of 1982 and other subordinate legislation at the provincial level. The RBMA issues technical recommendations on applications for water-use licenses. Water allocation is an attempt to manage a reservoir operation pattern (planning) based on demand proposals and water availability prediction. This allocation plan is prepared by the RBMA, then discussed and agreed in the coordination meeting of the Water Resources Management Committee (PTPA). Water distribution is an attempt to operate water resources infrastructure in order to distribute water to beneficiaries according to the agreement as stipulated in the PTPA meetings.

Water-quality management. Effluent discharge standards have set the allowable limit of concentration and amount of pollution load in wastewater discharged by a certain activity. This standard is used for effluent discharge licensing. Effluent discharge licenses provide a basis for controlling water pollution through law enforcement. The RBMA gives technical recommendations as one of the bases for approving the issuance of an effluent discharge license. Monitoring of water quality is carried out periodically, both for river water and for effluent discharge of dominant industries, tested in the laboratory. Monitoring results, evaluation and recommendations prepared by the RBMA are forwarded to the local government as a basis for law enforcement. Pollution control is carried out both in-stream (by means of flushing, increasing the capacity of river assimilation) and off-stream (at pollution sources) through implementing laws and economic instruments, as well as attempting to increase social control by society. The RBMA actively participates in the control of the pollution of water quality by preparing a Pollution Control Master Plan.

Flood-control management. Flood-control management attempts to control flood discharges by hydrological observation using telemetric equipment (Flood Forecasting and Warning System—FFWS), preparing a seasonal weather and flood prediction using a computer facility, which is connected to national and international databases, and by controlling water gates to distribute discharges. The RBMA prepares a Flood Control Management Plan and Manuals, and undertakes the control of the flood discharge by operating the infrastructure along the main river. The flood-control program is coordinated, discussed and decided upon at the PTPA forum before the onset of the rainy season. During flood disasters, the RBMA is involved in the Basin Flood Hazard Mitigation Unit, together with other concerned agencies that support the natural disaster countermeasures of the province.

River-environment management. River-corridor maintenance controls river corridor land use to protect the function of the river-safety area and to increase the benefit of the river for tourism and water sports. In any management practices, the river basin management agency

cooperates with related institutions and authorities. The government institutions act as a regulator that concentrates on guidance and regulation, while implementation of specific aspects in water-resources management is undertaken by the RBMA. In the Brantas river basin, the Provincial Water Resources Agency is the responsible institution for directing water-resources management; while PJT I acts as operator of tourism and sports activities at sites that are within its command. The RBMA implements river-environment land-use management by preparing land use patterns (planning) based on local and regional spatial planning through close coordination with related institutions in the basin, particularly the Provincial Development Planning Agency and the Provincial Water Resources Agency

Water-resources infrastructural management. The RBMA implements water resources infrastructural management mainly related to maintenance. Preventive maintenance takes the form of routine and periodic maintenance, and small repairs to prevent serious damage. Corrective maintenance covers large-scale repair, rehabilitation, and rectification to restore and increase the functions of the water resources infrastructure. Emergency maintenance involves temporary repairs that have to be done urgently due to an emergency condition, such as a flood.

R&D. To carry out water management activities it is necessary to follow knowledge development and proactively try to introduce innovations both in technology and management systems. To properly carry out water resources management, the RBMA carries out R&D, through cooperation with both national and international institutions.

Data networks and management information systems. Data sharing and information systems among government agencies should be developed and operationalized. The RBMA should develop a water resources data center for society and concerned agencies. To promote sustainability of hydrological operations and data, hydrology institutions and organizations should have appropriate administrative and budgeting arrangements along with a personnel program. Among the various data collected by the diverse institution, PJT I maintains and analyzes data on the surface water in the basin for reservoir operational purposes in maintaining water quantity, as well as quality to a certain extent, within the command area of 40 rivers in the basin. Other institutions, such as the Provincial Water Resources Agency, maintain and analyze the data on surface water for specific purposes of irrigation or flood control outside of the 40 designated rivers under PJT I in the Brantas river basin.

Water Policy

Considering the importance of water resources for the future of the nation and realizing the problems encountered in the past, the Government of Indonesia is reforming water resources policy to improve:

- the national institutional framework for water resources development and management
- the organizational and financial framework for river-basin management

- the regional water quality management regulatory institutions and implementation
- irrigation-management policy, institutions and regulations

Decentralization policy in Law No. 22 of 1999 on Local Governance states that the local governments shall have authority as much as possible in their own territories. Government Regulation No. 25 of 2000 on Central Government Authority and Autonomous Provincial Government Authority provides implementation guidance for this law. In applying these regulations in water resources management for any river basin which covers more than one district or municipality, the basic principle of “one river, one plan, one integrated management” should be kept as the basic principle for the implementation of integrated water resources development and management. This principle, of course, is intended to avoid inter-territorial conflicts.

Sectoral prioritization. It is stated in Indonesia’s 1945 Constitution that the earth, water, and all natural wealth contained in them are governed by the State and utilized as much as possible for the welfare of the people. This principle is the basis of all legislation for water resources management, such as Law No. 11 of 1974 on Water Resources, and Government Regulation No. 22 of 1982 on Water Resources Management. In particular, Government Regulation No. 22 of 1982 on Water Resources Management states the principle and fundamentals of water rights, and states that in water management the principle of public utility, harmony and conservation shall be applied.

Financing system. According to the basic legislation for water resources, Law No. 11 of 1974 on Water Resources, all the beneficiaries should be able to be involved in financing management. Society may contribute, but legal bodies, social bodies and individual water users should also contribute. It is elucidated in Government Regulation No. 22 of 1982 that any payment for water use is not a payment for the water, but is for the management service. Therefore, beneficiaries who either consume the water or only utilize the water potential should be treated equally in terms of their financial contributions.

Further legislation on financing water resources is found in Government Regulation No. 6 of 1981 on Contributions for Funding Water Resources Infrastructure Exploitation and Maintenance. This legislation states that the fee collected from the beneficiaries consists of the fee collected from those who benefit from water use and convenient water availability, and the fee collected from those who pollute the water. From these two types of fee, the water use fee has been applied, while the pollution fee is under preparation. However, according to this Government Regulation the fee may be paid to government-owned companies if they have been assigned by the government to manage the water resources. Law No.34 of 2000 revises the older Law No. 18 of 1997 on Taxes and Retribution, providing for a water tax, separate from any fees. The tax revenue goes to the province, which may redistribute it according to the development priorities and policies; and so may fund the managing agency, in this case, PJT I for the Brantas basin.

Table 1. Matrix of role and competence of the stakeholders.

Item	Government	RBMA	Society
Function	Policy and control ^a	Operator	Users
<i>Task</i>	Set up policy and regulations. Perform public authority (law enforcement, licensing, etc.). Carry out control and supervision on the task performance of the water management agency.	Carry out river utilization in the river basin, covering planning, development, utilization, control and conservation of water resources. Develop river management systems to secure the river basin function.	Use water efficiently in accordance with licenses and other authorized abstractions. Carry out treatment of respective effluent discharge according to the license received and the promulgated rules.
<i>Right</i>	Collect tax on surface water use from the beneficiaries. Share the profit of the water management agency according to the promulgated rules.	Collect contributions from the beneficiaries for the commercial services and to receive contributions from the government for social services (public safety and welfare).	Receive good services. Participate in decision making in all stages of activities.
<i>Obligation</i>	Guide the water management agency in carrying out its tasks. Contribute to funding of activities for public safety and welfare.	Render prime services to the beneficiaries. Attempt to increase public and private participation in river utilization. Accountable for task performance and fund utilization to government and the society.	Contribute to funding. Give positive social control. Conserve the environment by participating positively in water-resources conservation activities, such as greening, reforestation, terracing, etc.

^a 1. Central Government: Setting up macro policies and regulations for national level.

2. Local Government:

a. Provincial Government: Setting up policies and regulations as operational basis for the RBMA for inter-district/municipality river basin.

b. District/Municipal Government: Setting up policies and regulations as operational basis for the RBMA for river basins located in a single district/municipality.

Water Users' Participation

Water users' participation has been considered since the 1970s. Law No. 11 of 1974 states that water users can participate in the operation, maintenance and rehabilitation of water resources infrastructure. According to Government Regulation No. 22 of 1982 society is supposed to help the government in:

- controlling the destructive capacity of water on its source and environment,
- controlling and preventing water pollution, and
- protecting and securing the sustainability of infrastructural function of water resources

Particularly for the construction cost of water resources infrastructure, it is stated in the above regulation that the construction cost is borne by the government, but the members of society who obtain direct benefit from the infrastructure can participate in the financing according to their concern and ability. In the future, it is proposed in the reformed water resources policy that the society as the water users should be included in the decision-making process as well. Implementation of this stakeholder participation is described in the following paragraphs.

Water-sector apex body. A national water-sector apex body should be established to manage a coordination framework for national water resources. The apex body, comprising various ministers concerned with development and management of water resources, together with stakeholder representatives, will be responsible for guiding the development and management of water resources. The apex body will give guidance in policy formulation, resource allocation, program implementation and regulatory control in general, and inter-sectoral coordination and issue resolution in particular.

Stakeholder representatives. To promote stakeholder participation, a permanent group of stakeholders, NGOs, and public representatives will be part of the apex body. Currently, Water Resources Management Committees (PTPAs) have been set up at the provincial and basin levels in some provinces, and these will also include stakeholders. These committees, which are responsible for their respective governors, are supposed to be coordination bodies where decisions on management policies (planning, implementing, supervising, controlling, and funding) in their respective areas are made.

PTPA members currently come from the water-resources-related agencies and the water-using companies (State Electricity Company and Municipal Water Company). Other water users are represented by the related local government agencies, such as Irrigation Service, Industrial Service and Agricultural Service. However, it is planned to include all the stakeholders, such as farmer associations and industrial associations. In carrying out its tasks, the PTPA is supported by an implementing committee for each river basin area, which is called the Basin Water Resources Management Committee or PPTPA. This basin committee has a technical team for each activity area, which so far exists only for water allocation and flood control but it should be expanded to cover other areas as well, such as watershed management and water- quality control.

Private-Sector Participation

Infrastructural development is very important in supporting and realizing national development sustainability but government financial capability is very limited, so private companies should

participate in water resources development and infrastructural management in cooperation with the government. To be able to implement private sector participation, the government issued Presidential Decree No. 7 of 1998 on Cooperation between Government and Private Companies in Development and Management of Infrastructure. This decree regulates the preparation for cooperation, the selection of investors, contracting and implementation monitoring, in order to have transparency in the process, free competition for the private sector and an optimal service cost for society.

The basic concept of private sector participation is as follows:

- Private sector participation means a concession given by the government.
- The private sector has a right to have revenue.
- The government gives protection, assurance and regulation.
- Private-sector participation does not overburden the users.

Water and water resources may be developed by the private sector under the conditions that:

- The water user should have a license from the government.
- The water use is based on a principle of cooperation.
- The water user should keep conserving the ecosystem.

Water is an economic good that has a social function as well so that it should not be managed merely commercially or merely socially. Based on this concept, private sector participation in the development and management of water resources could be carried out through a partnership with the RBMA. The RBMA functions as the government's agent in managing water resources to keep the balance of the two, in order to achieve the business purpose as well as to keep the public service.

Water Laws

Water Sources

The Indonesian Constitution of 1945 gives the fundamental principle for water resources management. In Article 33 of the Constitution it is stated that the earth, water and any wealth in them are governed by the State and utilized as much as possible for the welfare of the people. At present, the basic law for water resources management is Law No. 11 of 1974 on Water Resources, which is supported by the Government Regulation No. 22 of 1982 on Water Resources Management. A new water law is under preparation, but the discussion in this section describes the situation under the existing law.

Water Uses

According to Law No. 11 of 1974 Article 5 Paragraph (1), inter-sectoral water uses are coordinated by the minister who has responsibility in water resources. Government Regulation No. 22 of 1982 gives detailed items and activities for coordination. The coordination items are: a) establishing water and water body use priority plans, b) setting priorities for water and water body use in conservation, development, and utilization plans, c) water and water body use regulation, d) regulation of the method for disposal of wastewater, as well as other waste material, e) regulation of the construction of water resources infrastructure, and f) regulation of other problems that may occur.

Coordination activities include a) collecting water quantity and quality data as well as inventories, b) collecting water demand data and recording the water balance, c) carrying out studies related to water resources conservation, development and utilization, d) preparing policy formulation in water resources development planning, e) preparing the water resources development plan based on the above policy, f) providing assistance and opinion in technology to related departments, local governments, agencies and other institutions in preparation of water resources use at national, regional and local levels, g) regulating the method and the condition as well as the registration of water resources use, h) regulating the method and the condition of wastewater disposal as well as other liquid and solid waste materials, and i) regulating the methods for supervision and control of the above policies. Water distribution is based on a water-allocation plan, which is agreed by the representatives of the water users and the water manager in the Water Resources Management Committee, Panitia Tata Pengaturan Air (PTPA).

Water Rights

The basic legislation for water rights is the Basic Constitution of 1945 Article 33 as mentioned above, which states that water resources are governed by the State and utilized as much as possible for the welfare of the people. Government Regulation No. 22 of 1982 gives the principle and the basis of water: (1) In water management regulations the principles of public utility, harmony and conservation shall be applied; and (2) A water right is a water use right. Moreover, this Government Regulation states that everybody has a right to use water for their main need in daily life and their livestock. This also conforms to the earlier Basic Agrarian Law No. 5 of 1960.

Water-Pollution Control

The legal basis for pollution control is Law No. 23 of 1997 on Environment Management, which replaced Law No. 4 of 1982 on Main Regulation of Environment Management. A Government Regulation following the new Law is under preparation, but, in the meantime, all legislation based on the previous law is still valid. According to Government Regulation No. 20 of 1990 on Water Pollution Control: (1) the responsibility for water pollution control lies with the Governor. East Java Province, which is the most advanced province dealing with water pollution control, has issued regional legislation, Provincial Regulation No. 5 of 2000

on Water Pollution Control. According to this Regulation, the Governor's responsibility can be delegated to the Head of BAPEDALDA. This means that BAPEDALDA is the agency, which coordinates all other agencies concerned with water pollution control. The RBMA, as articulated in the Ministry of Public Works Regulation on the management of the RBMA, is supposed to actively participate in supervision and control.

The legal basis for the water polluters to pay fees is stated in Government Regulation No. 6 of 1981 on Contribution for Funding Water Resources Infrastructure Exploitation and Maintenance. It says that the contribution for funding water- resources infrastructure O&M covers the funds collected as a payment from those who, due to their business activities, have caused water and water body pollution in the Corporation's river basins. Although this legislation meets the condition for river basins managed by a public corporation, the government is at present trying to set up all legislation needed for wastewater disposal licensing and fee collecting for all river basins.

Participation of Water Users

Ever since the basic legislation of water resources management was set up in Law No. 11 of 1974, participation of water users has been formulated. It is stated in this law that to secure the sustainability of infrastructural function of the water resources, the O&M of the structures should be carried out by involving the society, either legal bodies, social bodies or individuals that directly benefit from the structure. The government, central and local, operates and maintains the structures for public welfare and safety.

In regard to financing, the law states that those who directly benefit from the structure may be involved in bearing the cost of a replacement, while legal bodies, social bodies and individuals that benefit from the structure should participate in financing, in the form of a fee paid to the government.

Accountability of the Parties in Water Services

Legal instruments for ensuring the accountability of water service providers and users takes the form of a contract, which is made between the RBMA and the users who must have water use licenses. Government Regulation No. 6 of 1981, on Contributions for Funding Water Resources Infrastructure Exploitation and Maintenance, says that the obligation of the water users to pay the fee should be stated in a contract document between the RBMA and the users. However, the contract also states the obligations of the RBMA.

Conflict Resolution

In general, any conflict that may arise should be resolved in the coordination forum, such as PTPA. The PTPA can resolve water use conflicts (in quantity) effectively. However, in case it concerns the water quality and the water use fee, usually the conflict is discussed between the parties concerned based on the available legal documents. If this does not work, a mediator will be needed, since taking the case to courts is the last resort. The mediator is usually

somebody who has more power than the conflicting parties; it may be the Governor, the Regional Assembly or the Minister of Finance.

One problem with RBMA is that they have very limited public authority. They cannot stop delivering water to any water user who does not want to pay, nor can they stop wastewater disposal that pollutes rivers. Public authority is held by the Governor. As a government-owned company, PJT I is designated to act only as an operator of water-resources infrastructure, that deals with water, enhances conservation, performs O&M and does other specific tasks in water resources as ordered by the government. PJT I does have the right to stop water delivery to users who do not comply with the water service contract or refuse to pay their fee. But in terms of river water quality PJT I cannot stop the wastewater produced by the polluters. Unless a polluter-pays principle is adopted, PJT I will solely act as a water-quality monitoring institution, even though there are arguments that in its present state PJT I is supporting the government in enforcing the water-quality regulation on the Brantas river. How the government can force polluters to pay their fees is still being discussed and is part of the reform agenda.

Physical Characteristics of the Brantas River Basin

The Brantas river has a watershed of 11,800 km² and stretches 258 km from the spring at Mt. Arjuno to the point where it branches into two rivers, the Surabaya river and Porong river, both of which flow into the Madura Strait. The river flows clockwise with Mt. Arjuno and Mt. Kelud as its center. Along the main flow there are many tributaries, among which are the Lahor, Konto, and Widas rivers (as shown in figure 1). The average population density is 978 persons/km².

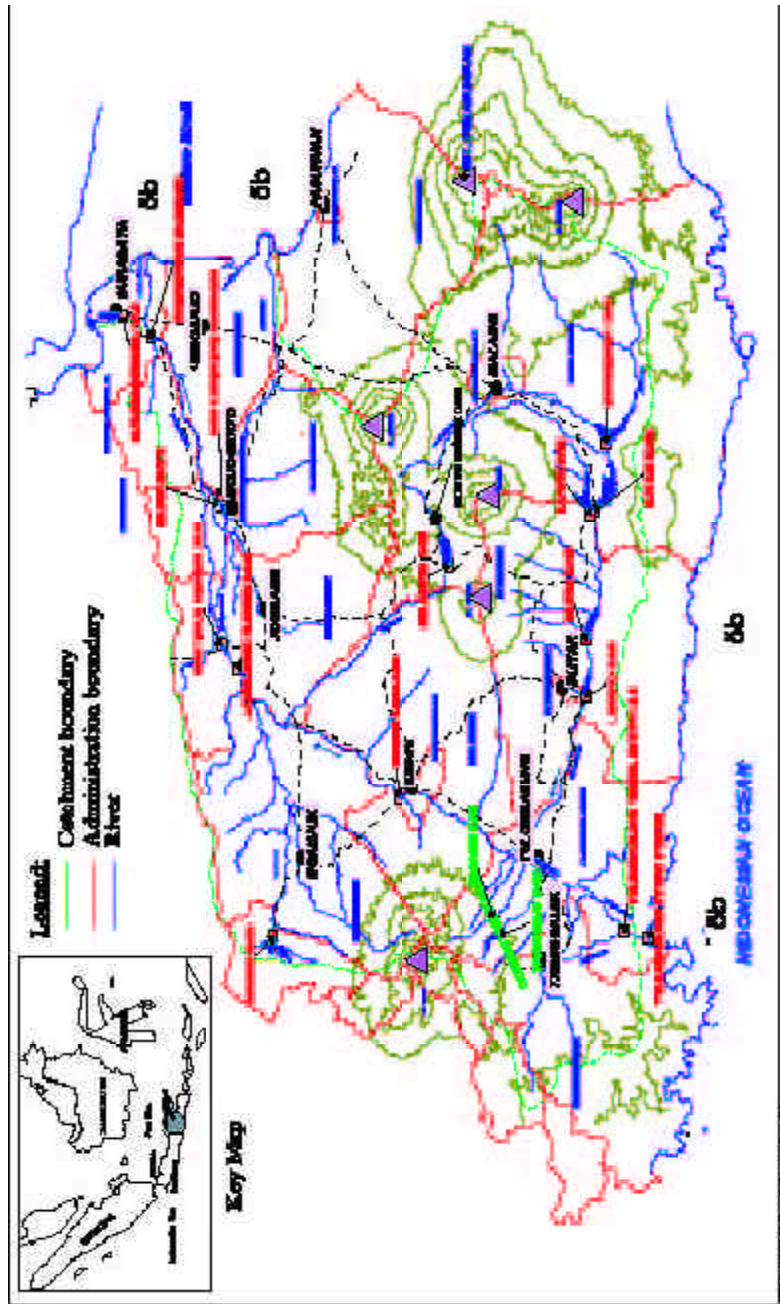
Historical Perspective

The river valley is very fertile; it has been developed since the nineteenth century, when the Dutch colonialists built irrigation and flood diversions. However, integrated water-resources development was started in 1960 through a series of master plans. In 1961, the first master plan (Master Plan I) with the main purpose of flood control was prepared using Japanese reparation funds. Large reservoirs, constructed in the upper reaches for reducing floods, also supplied water for irrigation as well as for hydropower generation.

In line with the government policy in the decade after, which was “self-sufficiency in rice production,” the first master plan was reviewed in 1973, becoming the second master plan (Master Plan II) with the main purpose of supplying water for irrigation. In this period more reservoirs and barrages were built. A flood-control project in the Ngrowo basin was continued in this period, changing a swampy area into a farmland.

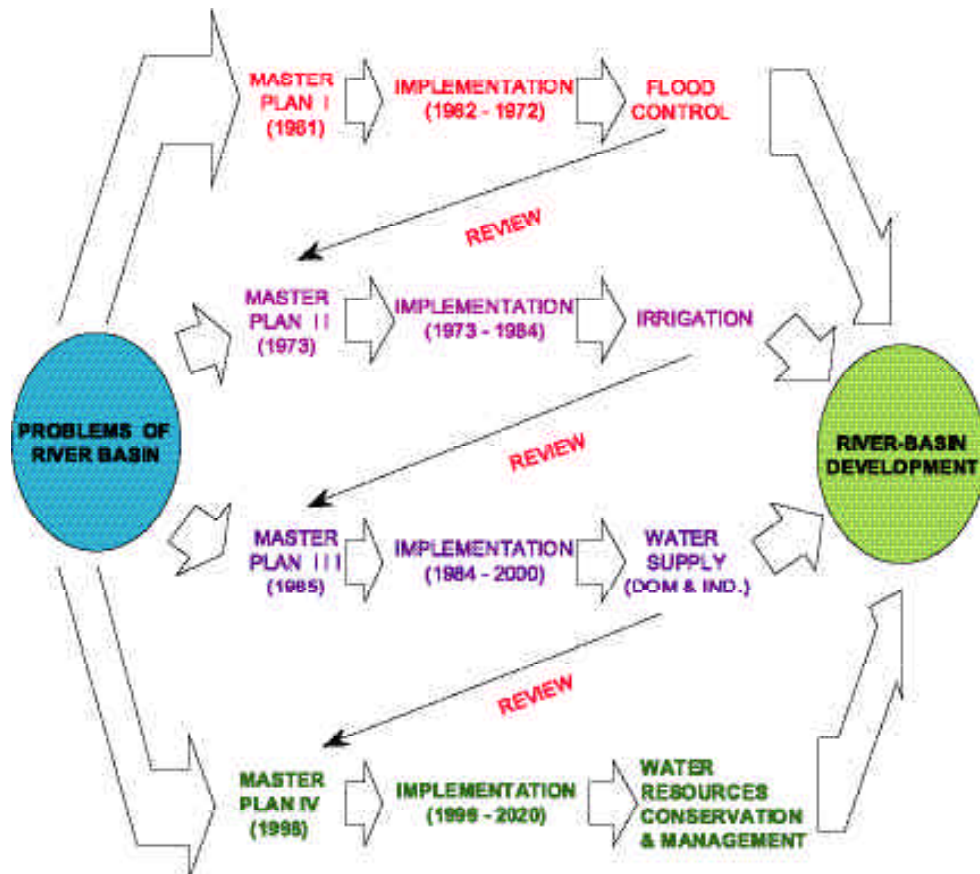
Having success with self-sufficiency in rice production, the government then started to strengthen the industrial sectors in 1980s, so that the river-basin development plan was reviewed again in 1985 to form the third master plan (Master Plan III) with the main purpose of supplying water for industry and municipalities. In this period, as the industries boomed, many land use changes occurred, from irrigated land into industrial areas as well as new

Figure 1. Brantas river basin.



settlement areas. In 1997, this process was halted by the national economic crisis. However, the Brantas river water is now used for hydropower generation, domestic use, irrigation, fishery and industrial water supply as well as for recreation. A need to review Master Plan III was then felt, with the main purpose of arranging better conservation and management of water resources. Master Plan IV was ready in 1998. Figure 2 shows the development of the Brantas basin through the master plans.

Figure 2. Master plan of the Brantas river-basin development aspects.



Water Resources in the Basin

The average precipitation in the basin is about 2,000 mm/year, of which about 80 percent falls in the rainy season. The potential surface flow is approximately 12 billion m³/year, while the total annual utilization is about 3 billion m³/year. The physical aspects of the Brantas basin are shown in table 2.

Table 2. Physical aspects of the Brantas basin.

Main River: Kali Brantas	Length	320 km
Geophysical coordinates	110° 30' and 112° 55'	East longitude
	7°31' and 8°15'	South latitude
<i>A. Catchment Area</i>		
Kali Lesti		625 km ²
Kali Konto		687 km ²
Kali Widas		1,539 km ²
Kali Brantas		6,718 km ²
Kali Ngrowo		1,600 km ²
Kali Surabaya		631 km ²
Total		11,800 km ²
<i>B. Reservoir Capacity^a</i>		
(Sengguruh, Sutami, Lahor, Wlingi, Lodoyo, Selorejo and Bening)		
Gross storage (initial/present)		525/297 million m ³
Effective storage (initial/present)		378/247 million m ³
<i>C. Water Availability</i>		
Average precipitation		2,000 mm/year
Runoff coefficient		0.50
Potential flow		11.8 billion m ³
Natural flow in the Brantas mainstream ^b (1977–1999)		7.51 billion m ³
<i>D. Water Utilization^c</i>		
Irrigation		2,400 million m ³
Domestic		209 million m ³
Industry bulk supply		139 million m ³
Maintenance flow		204 million m ³
Fisheries (irrigation return flow)		41 million m ³
Total		2,993 million m ³
<i>E. Socioeconomic Condition^d</i>		
East Java population (1999)		35.2 million
Brantas river basin population (1999)		15.2 million
East Java rice production (1999)		9 million ton
Brantas river basin rice production (1999)		2.3 million ton
Gross Domestic Product (East Java, 1999)		152.9 billion Rp
Gross Domestic Product (Brantas river basin, 1999)		89 billion Rp
Brantas basin contribution to east Java		58%

Sources: JICA (1998) and Jasa Tirta I (1998 Annual Report).

^a As computed by Jasa Tirta I Public Corporation (2001 Annual Report) from previous survey results.

^b As computed by Optimal Solutions Ltd. (2000) for the Lengkong Baru.

^c As computed by Jasa Tirta I Public Corporation (2000 Annual Report) from statistical data.

^d Quoted from “Brantas History” Final Report, Volume II–Data Book, Koei Research Institute and Jasa Tirta I Public Corporation.

Water-Resources Infrastructure

At present, there are seven earth dams, six barrages, and three rubber dams in the main river and tributaries with various purposes, as shown in table 3. The location of each can be seen in figure 2. Of the seven reservoirs of the large dams five are operated yearly, the other two, Wlingi and Sengguruh, are operated daily. For reservoirs operated yearly, the operating rule-curve of the reservoir comprises a time frame of a single calendar year. During that period, the reservoir stores water that increases the water level from a certain level to a maximum level and releases the water after this peak level is achieved until it reaches another certain level. Reservoirs operated daily have a shorter time frame, i.e., the whole process takes place in a single day. For example, Karangates is a yearly-operated reservoir with a gross storage

Table 3. Water resources infrastructures in the Brantas river basin.

Structure	River	Purpose
<i>Large dams</i>		
1. Sengguruh dam	Lesti	1. Sediment control to the Sutami reservoir
2. Sutami dam	Brantas	2. Hydropower generation 3. Water supply for domestic, irrigation and industrial uses
3. Lahor dam	Lahor	4. Hydropower generation 5. Flood control 6. Recreation 7. Water supply for domestic, irrigation and industrial uses
4. Wlingi dam	Brantas	8. Flood control 9. Afterbay of the Sutami hydropower plant 10. Water diversion for irrigation 11. Hydropower generation 12. Flood control 13. Recreation
5. Selorejo dam	Konto	14. Water supply for irrigation, and additional supply for hydropower plants downstream 15. Hydropower generation 16. Flood control 17. Recreation
6. Bening dam	Widas	18. Water supply for irrigation 19. Flood control 20. Recreation
7. Wonorejo dam	Song	21. Water supply for domestic uses 22. Hydropower generation 23. Flood control
<i>Barrages</i>		
8. Lodoyo	Brantas	24. Afterbay of the Wlingi hydropower plant 25. Hydropower generation
9. Mrican	Brantas	26. Water diversion for irrigation
10. New Lengkong	Porong	27. Water diversion for irrigation, domestic and industrial uses
11. Gunungsari	Surabaya	28. Water diversion for irrigation
12. Jagir	Wonokromo	29. Water diversion for domestic
13. Tulungagung Gate	Ngrowo/Parit Agung Canal	30. Water regulation for domestic and hydropower uses and for flood control
<i>Rubber dams</i>		
14. Jatimlerek	Brantas	31. Water diversion for irrigation
15. Menturus	Brantas	32. Water diversion for irrigation
16. Gubeng	Mas	33. Water diversion for domestic uses

of 343 million m³; downstream of this reservoir is another reservoir called Wlingi that is operated daily. This reservoir acts as an afterbay of Karangates, regulating the fluctuating water level that exits daily from the Karangates waterway.

Besides the above key infrastructure, there are also two diversion tunnels to release excessive water to the Indian Ocean, a hydropower plant on the coast of the Indian Ocean, and many more irrigation structures along the Brantas river and its tributaries.

Exploitation and Protection of Groundwater

Groundwater in the basin is used mostly for domestic, irrigation and industrial use. The users are supposed to obtain licenses from the Mining Service of the regional governments. Some groundwater, particularly for irrigation use is managed by the Groundwater Irrigation Projects under the Provincial Irrigation Service.

Barriers to Seawater Intrusion

Intrusion of seawater into the Brantas basin does not have any significant effect. The three structures furthest downstream in the basin are Lengkong Baru and Jagir barrages in the Porong river and Wonokromo river, respectively, and the Gubeng rubber dam in the Mas river. Their distances from the sea are about 50 km, 13 km, and 12 km, respectively. These structures are intended to regulate water supply, but the last two also function as barriers to the intrusion of seawater into the Surabaya city. The Brantas Delta Irrigation area downstream of the Lengkong Baru barrage never suffers from salinity.

Water Management Problems

The available water is low due to the high rate of uncontrolled losses, while water demand is always growing with regional development. Uncontrolled losses include water losses along the water distribution system that are caused by unpredicted reasons, such as cracks in the dike, losses due to absorption of water by the soil along the unlined canals, etc. However, the Brantas river basin has also been facing other problems, such as flooding due to sedimentation caused by erosion, especially from volcanoes, and pollution due to domestic, industrial and agricultural effluent discharges.

Development has been carried out in a holistic approach, a planned, sustainable and environmentally sound management system based on “one river, one plan, one integrated management” through a series of master plans. Based on these master plans, many water resources infrastructures have been built. However, so far several problems have been encountered:

Watershed management. Sedimentation in the reservoirs decreases the reservoir capacities significantly, particularly in the Sengguruh, Sutami, Wlingi and Lodoyo reservoirs. According to a 1997 survey, the effective storage of these reservoirs had been reduced to 48 percent, 58 percent, 27 percent, and 46 percent of the original volume, respectively. The sedimentation

in the Sengguruh and Sutami reservoirs resulted from soil erosion in the watershed due to deforestation and improper land cultivation management, while that in the Wlingi and Lodoyo reservoirs is mainly due to the eruption of material from Mt. Kelud, which erupted last in 1990.

Water-quantity management. The water allocation plan is a general plan of water release from reservoirs and barrages along the water distribution system that includes both intake and gate operation curves as well as water use/abstraction plans, for a certain period of time, usually one season. This water allocation plan is set from compromise among beneficiaries and is stipulated under a Governor's decree that settles matters between the users and the operator of the system for the season. If there are changes, such as increasing demand of a certain sector, then the allocation plan could be revised. In terms of water quantity, insofar as it can be supplied as required, it is based on the agreement in the provincial water resources committee (PTPA) meetings. When the available water is less than the requirement, it can be managed by controlling the demand. However, when the treatment plant capacity for domestic water supply increases in the future, the existing water allocation plan should be adjusted.

Water-quality management. Water quality still faces a big problem with the effluent discharges from industries and domestic use. The available water quantity is not sufficient to dilute the pollutants.

River-environment management. River-environment management is confronted with socioeconomic problems, which affect the awareness of the people using the river water and the river itself.

Infrastructure management. The infrastructure management in the Brantas basin is carried out as much as the budget allows; however, the biggest group of beneficiaries, the farmers, have not contributed to this management effort, so far.

Evolution of Institutions for Basin Management in Brantas

Initial Arrangements

Beginning in 1961, the development of the Brantas river basin was carried out by the Brantas River Basin Development Project (BRBDP). This project was under the Directorate General of Water Resources Development, Ministry of Public Works, and it handled the planning, design and construction of water-resources development. However, after finishing the construction, the Project continued to deal with the O&M as well. Master Plans I (1961), II (1973) and III (1985) were prepared by Japanese consultants with Japanese reparation funds and grants. The construction was also carried out with Japanese aid. A significant transfer of knowledge occurred during this period.

Limitations and constraints of institutional arrangements. Up to 1990, six reservoirs and three barrages had been built. The total investment was about Rp1,700 billion (based on a 1992 price level). The benefits of the development consists of flood control for a 50-year return period, water supply for 83,000 hectares of irrigated areas directly supplied from the main river, energy production of about 875 million kWh/year, bulk water supply for industries and municipal drinking water of about 300 million m³/year. After construction, it was necessary to maintain the function of the water resources infrastructures to ensure optimum benefit over their planned lifetime. O&M activities were performed but these activities encountered some problems.

Until 1990, the Brantas river basin had no permanent institution that could perform O&M activities in a sustainable manner. The Brantas River Basin Development Project (BRBDP) was a temporary institution whose duty was only to carry out the construction and not the O&M. The Project encountered problems in obtaining funds for these activities due to the limited National Government Budget. Lack of the O&M budget resulted in degradation of the water resources infrastructure. Weak coordination among related agencies complicated water resources management. This posed risks of water resources degradation, which in the long run would harm economic development of the basin.

Need for change. The need for applying integrated water resources management in the Brantas basin has been recognized since the 1970s when some of the infrastructure had come into operation. However, BRBDP was only a Project organization, which was temporary and did not have any power for coordination, while integrated river basin management requires a high level of coordination among many agencies. The institution that had the coordinating power was the Public Works Regional Office of east Java, but this organization was not specialized in river basin management. It was realized that river basin management has many aspects that need to be carried out seriously, and this could be done by a permanent river basin management agency.

Brantas River-Basin Management Organizations

Purpose, objective and scope of the organization. As an effort to solve the aforementioned problems, by developing a pilot corporation system in managing the river basin, in 1990, the government established a public corporation, namely Jasa Tirta Public Corporation, as a government owned company (BUMN) to manage the Brantas river basin. Table 4 gives the details of the legal basis of the corporation. Government Regulation No. 5 of 1990 established Perum Jasa Tirta for organizing general utilization of water resources in a good quality and properly for fulfilling people's needs, The corporation also carries out certain governmental tasks in managing the river basin, covering conservation, development, and utilization of the river and water sources, including giving information, recommendation, education and guidance. In 1999, the name, Perum Jasa Tirta, was changed into Perum Jasa Tirta I.

The objective is to take part in developing the national economy by carrying out the national development program in the field of water resources management with a plan according to the government policy in managing the basin. This covers comprehensive and integrated development and utilization of water resources, considering regional development,

Table 4. Legal basis for the corporation.

1. Institutional Aspect	<p>a) Law No. 11 of 1974 on Water Resources. <u>Article 3</u>: Water and its resources, including the natural riches contained therein, shall be controlled by the State. <u>Article 4</u>: The power of the Government may be delegated to its agencies at the central or regional level or to specific corporate bodies in accordance with conditions and procedures as specified by Government Regulation.</p> <p>b) Government Regulation No. 5 of 1990 on Jasa Tirta Public Corporation. <u>Article 2</u>: In order to carry out the O&M of water and water resources infrastructure, a Public Corporation has been established under the name of Jasa Tirta Public Corporation.</p> <p>c) Government regulation No. 93 of 1999 on Jasa Tirta I Public Corporation. <u>Article 2 Paragraph (1)</u>: Jasa Tirta Public Corporation, which was established by Government Regulation No. 5 of 1990, is to be continued based on stipulations in this Government Regulation. <u>Article 2 Paragraph (2)</u>: The name, Jasa Tirta Public Corporation, stated in paragraph (1) above is further changed into Jasa Tirta I Public Corporation.</p>
2. Operational Aspect	<p>a) Minister of Public Works' Regulation No. 56/PRT/1991 on general policy for Jasa Tirta Public Corporation Management. <u>Article 6</u>: The Corporation shall carry out main tasks that cover:</p> <ul style="list-style-type: none"> a) CO&M of water resources infrastructures. b) Dealings in water and water resources. c) River basin management, i.e., conservation, development and utilization of water and water resources. d) Rehabilitation of water resources infrastructures.
3. Financial Aspect	<p>a) Law No. 11 of 1974 on Water Resources Development. <u>Article 14 Paragraph (2)</u>: Communities directly benefiting from existing waterworks and structures either for their subsequent or immediate use may be required to share the related management costs. <u>Article 14 Paragraph (3)</u>: Corporations, associations and individuals directly benefiting from existing waterworks and structures either for subsequent or immediate use shall share the related costs in the form of a contribution payable to the government.</p> <p>b) Government Regulation No. 6 of 1981 on contribution for funding water resources infrastructure exploitation and maintenance. <u>Article 2</u>: Contribution to exploitation and maintenance cost of water resources infrastructure covers:</p> <ul style="list-style-type: none"> 1. Funds collected as a payment from the parties specified in Article 3 Paragraph (1) who have obtained the benefit from the use and the comfort through the availability of water, from water bodies and through the availability of water resources infrastructures as the achievements of the Corporation's management either for immediate use or subsequent use for third parties. 2. Funds collected as a payment from those who, from the activities, have caused water and water body pollution in the working area of the Corporation. <p>c) Government Regulation No. 93 of 1999 on Jasa Tirta I Public Corporation. <u>Article 45</u>: The amount of contribution for water resources infrastructure exploitation and maintenance should be stipulated in a Decree of the Minister of Public Works based on a proposal from the Board of Directors.</p>

and following the principles of environmental development and corporation management. According to the above legislation, Perum Jasa Tirta should organize the following businesses:

- Raw water supply for domestic water supply, electricity generation, plantations, fisheries, industry, harbors and flushing.
- Tourism, consultancy and other services, which can support the achievement of the objective.

The above businesses should be organized by taking into account economic principles and assurance of the safety of state property.

The scope of its main task covers the following:

- exploitation and maintenance of water resources infrastructure
- water resources dealings (any activities in water allocation and distribution for business purposes, to gain revenue from the service fee applied)
- river basin management, including conservation, development and utilization of water resources
- rehabilitation of water resources infrastructure

The vision of Perum Jasa Tirta I is to maintain, conserve and develop water resources through professional and innovative management, which is environmentally sound, in order to contribute to regional and national development. The mission of Perum Jasa Tirta I is to provide services for the public utilization of water resources and to gain profit based on sound business-management principles.

Achievements

After operating for several years, Perum Jasa Tirta I has piloted management systems and technology for advanced water-resources management. The performance of Perum Jasa Tirta I shows that the purpose of the corporation can be gradually achieved in technical, financial, management and other aspects.

Technical aspects. The Brantas river basin management is carried out based on “one river, one plan, one integrated management.” In performing planning and management activities, Perum Jasa Tirta I carries out coordination with all agencies concerned. Master Plan IV (Development and Management) was set up in 1998 in coordination with the Public Works Regional Office. This master plan was set up for nearly all management aspects related to water resources management. Setting up of the master plan in coordination with all water resources agencies concerned is one way to get agreement on inter-sectoral water allocation. The Brantas River Flood Control Master Plan was established during the preparation of the

Brantas River Master Plan, while flood control management is carried out through coordination with local government agencies and in cooperation with other concerned agencies. The Flood Forecasting and Warning System, operated with telemetry installed in 1990, is well maintained and can control floods better than the manual system. Water allocation is carried out through coordination with the PTPA members. The operation of the reservoir is prepared by Jasa Tirta I Public Corporation using computer simulation. Carrying out water allocation through PTPA is expected to reconcile inter-sectoral water allocation and obtain a fair and transparent result.

The Brantas River Pollution Control Master Plan (2020) and Action Plan (2005) were set up in coordination with the Directorate General of Human Settlements, Ministry of Public Works, while the water quality is managed with the coordination of BAPEDALDA. The NOPOLU Model is used to develop the scenario for pollution control and to calculate the river-carrying capacity through a simulation. The water quality shows improvement although the standard values have not been achieved. Pollution control is carried out by the Environment Pollution Control Committee or KPPLH, consisting of all concerned agencies, and established by a Governor's decree. In KPPLH there are 4 working teams, for the Clean River Program, Clean Town, Domestic Waste Pollution Control, and Industrial Waste Pollution Control. Perum Jasa Tirta I is Vice Coordinator I of the team for the Clean River Program. In daily operation, Perum Jasa Tirta I actively participates in the supervision and control of water quality, as it is supposed to, according to the Minister of Public Works Regulation No. 56/PRT/1991 on General Policy on Jasa Tirta I Public Corporation Management. Effluent discharge standards are currently stated in Gubernatorial Decree No. 136 of 1994; however, this is being updated, a process involving all related agencies with the coordination of BAPEDALDA.

Conservation of water resources is carried out in coordination and cooperation with related agencies in the Department of Forestry, BAPEDALDA, universities, NGOs and traditional Moslem boarding schools (*pondok pesantren*). A technical team for synchronizing the program and activities for greening in the upper Brantas basin has been established by the Assistant Governor for the Malang area, consisting of the agencies concerned, in which Jasa Tirta I Public Corporation sits as Secretary I. This team is responsible to the Assistant Governor. Public education is carried out in coordination with the Department of Home Affairs, universities, NGOs, and *pondok pesantren*. Obvious physical achievements of Jasa Tirta I Public Corporation in maintenance can be seen in the well-maintained water-resources infrastructure. The management of the river environment of certain rivers has been cleaner and nicer so they can be used for sports and tourism. The Brantas water-resources management received international acknowledgement by receiving the ISO-9001 Certificate from SGS International Certification Services in May 1997 (Certificate Number Q9755).

Financial aspects. Ever since its establishment, Perum Jasa Tirta I has been carrying out O&M of water-resources infrastructure, funded by the beneficiaries. Although it has not been fully funded by the beneficiaries, step-by-step it is attempting to apply the principle of "full cost recovery." The beneficiaries who have contributed so far are the State Electric Company (PLN), Domestic Water Supply Company (PDAM) and industries. Their tariffs are so far based on an agreement between Perum Jasa Tirta I and their representatives. They are then approved by the Minister of Public Works and legitimized by a Ministerial Decree. In the

future, the Basin Water Resources Management Committee is expected to be the forum for agreeing on the tariff for each water user using the full cost-recovery principle.

Beneficiaries' participation in funding the river management has increased, although it does not yet satisfy all the requirements. The funding rose from Rp 2.6 billion in 1991 to Rp 26.1 billion in 1998. The desire of the private sectors to participate in investment for water-resources development by establishing joint ventures had increased. However, due to the economic crisis, many joint-venture programs were postponed or canceled. Other than O&M fees, Perum Jasa Tirta I also raises funds from non-water services, such as consulting, construction, equipment rental, land rental and tourism, and from joint ventures in resource utilization.

Accountability. In general, PTPA should be the forum to which all parties have to be responsible, since agreements in water-resources management should be made in the PTPA. However, so far the PTPA handles only allocation of water quantity and flood control. For other matters, such as watershed management, water quality and river environment, each agency is responsible for their respective supervising department. As the existing coordinator in managing water quality, Perum Jasa Tirta I submits monthly reports to BAPEDALDA, particularly for water quality. An Annual Report covering operational and financial matters, and Quarterly Financial Reports are forwarded by Perum Jasa Tirta I to the Minister of Settlements and Regional Infrastructure and the Minister of Finance as the representatives of the owner.

Mechanisms for coordination and conflict resolution. A mechanism should be able to resolve any conflict that may arise in its own coordination forum. If it concerns only two parties, those parties should attempt to resolve the issue between themselves. However, if this does not work, the Governor, the Minister of Public Works or the Minister of Finance, or the House of Representatives is usually asked to be the mediator. Interagency coordination is carried out in a forum according to the problem. Inter-sectoral competition for water is addressed in two stages. In the planning stage, a Master Plan is set up. The Public Works Regional Office was the coordinator for setting up Master Plan IV in 1998. In the operational stage, issues are discussed and agreed in the PTPA. So far the PTPA is an effective forum for reconciliation of inter-sectoral competition for water.

Stakeholder participation. Coordination fora are the means for stakeholder participation, mainly involving so far the government agencies and Perum Jasa Tirta I. For public participation, Perum Jasa Tirta I together with the local governments and all agencies concerned carry out special activities, such as cleaning the river and river corridor (PROKASIH). In some cases, positive social control has been given by the public through newspapers. However, it is planned that public participation in decision making will be applied through PTPA, in which NGOs will be included as members. Financial participation has been given by the water users as mentioned in the previous section. Irrigation Water User Associations participate financially in their own irrigation schemes.

Private-sector participation. The private sector had begun to participate in water resources utilization when the economic crisis happened, and afterwards their participation was held

back. But recently, it has resumed its participation in domestic water supply. However, financial participation has been given in public education activities.

Resource mobilization and performance assessment. As consulting and construction services are part of its tasks, Perum Jasa Tirta I mobilizes its staff for these businesses. During the assignment, the performance of the staff assigned is assumed to be good as long as there is no complaint from the customer.

Data management. Data managed by Perum Jasa Tirta I covers a) hydro-meteorological data, b) water-use data, c) water-quality data, and d) financial data. So far, Perum Jasa Tirta I is not managing all intakes. Intakes for hydropower plants, domestic water supply, and some irrigation areas are managed by the water users. Some industrial intakes use flow meters, some do not. Data on water use by PLN and PDAM are obtained from the water users; as also with some irrigation areas in the downstream part of the basin. Water use by industries is measured by flow meters for those who use the meter, but for those without flow meters the water use is estimated as a constant.

Hydro-meteorological data are collected manually and through the available telemetric system of the Flood Forecasting and Warning System. Some are stored in hard copies, but most in computer files, which are then processed. Data on daily water use are collected in each concerned Division, while data on water quality are collected through the Water Quality Laboratory. Both of them are processed monthly in the Head Office. Financial data are stored in ASGL (Accounting System General Ledger) and processed monthly too. At present, Perum Jasa Tirta I, in cooperation with the Indonesian Institute of Sciences, supported with aid from the Government of Austria, is setting up a water-quality telemetric monitoring system and a Decision Support System, in which all technical data will be stored in a database system connected with water-management models.

Regulatory functions. Through its Research and Development Bureau, Perum Jasa Tirta I studies regulations in water management aspects, such as in licensing, standard of wastewater quality, tax and fee collection, etc., and forwards proposals for improvement to the agencies concerned.

Constraints

Under the decentralization policy, all natural resources are under the authority of the respective local governments. Applying this principle for the water resources in the Brantas river basin and considering that the river basin covers 14 district and municipal areas, it would be difficult for each local government to separately manage the water resources in its area of the basin. To overcome this problem, the district and municipal governments could make agreements for managing the water resources of the Brantas river basin by giving concessions to Perum Jasa Tirta I. That could help assure the sustainability of the water resources and good public service, private and public participation and help resolve potential conflicts among the local governments, and among sectors and users. A change of the ownership

authority of natural resources under decentralization should not affect the O&M or give negative impact to the user.

Financial support for the sustainability of the management of water resources has not been given by all beneficiaries, especially farmers even though they are the biggest water user group. According to Government Regulation No. 6 of 1981 on Contribution for Funding Water Resources Infrastructure Exploitation and Maintenance, the fee from the farmers should be collected as a the deduction from the land tax collected by the local government. This mechanism has not been applied. Supported by Law No. 34 of 2000, this Government Regulation will be improved in the reformed national water-policy program, adjusted to the decentralization policy as well as the water-resources financial-system arrangement.

A general financing system for water resources corporations, which can support the water management, has been formulated but not written in any legislation as yet. This system, which includes water-use fee tariffs and effluent-discharge fee tariffs as well as their collection mechanisms, is included in the reformed water resources policy program to be established. Apart from the above constraints, as a pilot agency, Perum Jasa Tirta I is at present getting ready for dealing with various aspects of water-resources management in the basin.

Technical aspects. To improve water-resources management by means of enhancing R&D activities, individual capacity-building and demand- and supply-management techniques, the following points are under consideration:

- Decision support systems in all engineering aspects of water-resources management, covering database management systems. This project is carried out in cooperation with the Indonesian Institute for Sciences (LIPI).
- Telemetric water-quality monitoring system with an up-to-date model reference laboratory for water quality and environmental analysis for the twenty-first century. This project is also carried out in cooperation with LIPI.

Financial aspects. To improve governance in water-resources policy, a cost-allocation concept of beneficiaries' contribution to the water-resources management cost is prepared by applying economic instruments, e.g., the full cost-recovery principle. Up to 1999, only O&M cost recovery was applied to certain beneficiaries (PDAM, PLN and industries), while farmers still received water free of charge. Effluent-discharge fees have been formulated but have not yet been applied.

Management aspects. To promote protection and conservation of resources, the following activities are being considered:

- Public and private participation in water-resources development and management will be more widely opened.
- Application of the Brantas river basin management system in four river basins: Bengawan Solo, Jratunseluna and Serayu-Bogowonto in Central Java as well as Jeneberang in South Celebes.

Legal aspects. Due to the reforms in the national water resources policy and the decentralization policy, the following legislation concerning Perum Jasa Tirta I will be modified:

- Government Regulation No. 6 of 1981 on Water Resources Infrastructure Exploitation and Maintenance Fee
- O&M fees from farmers should be adjusted to the new financial system.
- Government Regulation No. 93 of 1999 on Jasa Tirta I Public Corporation.
- Due to the decentralization policy, the local governments are supposed to receive part of the revenue from the natural resources in their respective areas.

Conclusions

Water-resources management should be undertaken in an integrated (multi-sector), comprehensive (upstream-downstream), sustainable (intergeneration) and environmentally sound concept, for fair and just results. In line with this ideal, the river basin as a hydrological unit is considered as one management unit, under implementation of the decentralization concept in an autonomous spirit that embraces river-basin management trans-boundary aspects. River basins should be managed by a neutral and professional institution that applies healthy corporate principles and general utilization norms in water resources, based on public and private participation.

Participation of the public and private sectors, and of the community is an important aspect in performing better water-resources management in the context of the paradigm shifts. Both public and private sectors are involved at each decision-making level through coordination fora, and water-resources beneficiaries should bear development and management costs. Role sharing among the beneficiaries could be divided into three parts:

- Government as the owner of the water resources and their infrastructure, plays the role of controlling and regulating at the national and regional levels exercising its public authority.
- The River Basin Management Agency has a concession to manage water resources and its infrastructure, including receiving contributions and rendering water-resources services.
- Society acts as users that have the right to receive services and participate in decision making, but are expected to use water efficiently and take part in sustaining the environment.

The concept of a River Basin Corporation developed and implemented in the Brantas river basin shows good achievement and is expected to be applied gradually in other river basins in Indonesia.

Literature Cited

JICA. 1998. *The study on comprehensive management plan for the water resources of the Brantas river basin in the Republic of Indonesia, Final Report, Main Report*. The Republic of Indonesia, Ministry of Public Works, Directorate General of Water Resources Development.

Optimal Solutions Ltd. 2000. Development of reservoir operating rules in the Brantas River Basin. Report submitted to Perum Jasa Tirta, Malang, East Java Indonesia. Duplicated.