JASA TIRTA I PUBLIC CORPORATION

Integrated Water Resources Management: Water for Multipurpose

Experience in the Brantas River Basin, East Java


Visit of Cambodian Delegates to the Brantas River Basin

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Malang, 20-21 February 2013

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I. Introduction

This handout is prepared for the Visit of the Cambodian Delegates, to address briefly the water resources management experience in the Brantas River Basin, East Java, Indonesia. This handout will underline how integrated water resources management was planned and executed in the context of the basin, by various means, stage-wisely development, and comprising institutional developments as well. Integrated water resources management means sharring water for multipurpose use, in an efficient and effective manner.

1.1 Integrated Water Resources Management

At its simplest, integrated water resources management (IWRM) is a logical and appealing concept. Its basis is that the many different uses of water resources are interdependent. That is evident to us all. High irrigation demands and polluted drainage flows from agriculture mean less freshwater for drinking or industrial use; contaminated municipal and industrial wastewater pollutes rivers and threatens ecosystems; if water has to be left in a river to protect fisheries and ecosystems, less can be diverted to grow crops. There are plenty more examples of the basic theme that unregulated use of scarce water resources are wasteful and inherently unsustainable.

Integrated (management) means that all the different uses of water resources are considered together. Water allocations and management decisions consider the effects of each use on the others. They are able to take account of overall social and economic goals, including the achievement of sustainable development. This also means ensuring coherent policy making related to all sectors. As we shall see, the basic IWRM concept has been extended to incorporate participatory decision-making. Different user groups (farmers, industries, hydropower, communities, environmentalists…) can influence strategies for water resource development and management. That brings additional benefits, as informed users apply local self-regulation in relation to issues such as water conservation and catchment protection far more effectively than central regulation and surveillance can achieve.

Management is used in its broadest sense. It emphasizes that we must not only focus on development of water resources but that we must consciously manage water development in a way that ensures long term sustainable use for future generations (Cap-Net, 2005a).

Integrated Water Resources Management is defined by the Global Water Partnership (GWP) as a process which promotes the coordinated development and the management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

IWRM is therefore a systematic process for the sustainable development, allocation and monitoring of water resource use in the context of social, economic and environmental objectives. It contrasts with the sectoral approach that applies in many countries. When responsibility for drinking water rests with one agency, for irrigation water with another and for the environment with yet another, lack of cross-sectoral linkages leads to uncoordinated water resource development and management, resulting in conflict, waste and unsustainable systems.

1.2 Why Do We Need Integrated Water Resources Management?

Water is vital for human survival, health and dignity and a fundamental resource for human development. The world's freshwater resources are under increasing pressure yet many still lack access to adequate water supply for basic needs. Growth in population, increased economic activity and improved standards of living lead to increased competition for, and conflicts over, the limited freshwater resource.

Here are a few reasons why many people argue that the world faces an impending water crisis:

- Water resources are increasingly under pressure from population growth, economic activity and intensifying competition for the water among users;
- Water withdrawals have increased more than twice as fast as population growth and currently one third of the world's population live in countries that experience medium to high water stress;
- Pollution is further enhancing water scarcity by reducing water usability downstream;
- Shortcomings in the management of water, a focus on developing new sources rather than managing existing ones better and top-down sector approaches to water management result in uncoordinated development and management of the resource.
- More and more development means greater impacts on the environment.
- Current concerns about climate variability and climate change demand improved management of water resources to cope with more intense floods and droughts.

Box 1 **Water Crisis - Facts**

Only 0.4% of total of global water in the world is available for humans.

Today more than 2 billion people are affected by water shortages in over 40 countries.

263 river basins are shared by two or more nations.

2 million tons per day of human waste are deposited in water courses.

Half the population of the developing world is exposed to polluted sources of water that increase disease incidence.

90% of natural disasters in the 1990s were water related.

The increase in numbers of people from 6 billion to 9 billion will be the main driver of water resources management for the next 50 years.

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II. Water Resources in the Brantas River Basin

2.1 Geographical Features of the Brantas River Basin

The Brantas River Basin is located in the Island of Java, of the Republic of Indonesia. It runs through the western section of the East Java Province. The basin is situated from Latitude 7^{o} 1' to 8^{o} 15' South and Longitude 110^{o} 30' to 112^{o} 55' East. The river mainstream traverses 9 regencies and 5 municipalities. Starting at the upper regions of the river they are Malang, Blitar, Tulungagung, Kediri, Nganjuk, Jombang, Mojokerto, Sidoarjo, and Surabaya City, including portions of Pasuruan and Gresik. A general view of the Brantas River Basin is shown in **Figure 1**.

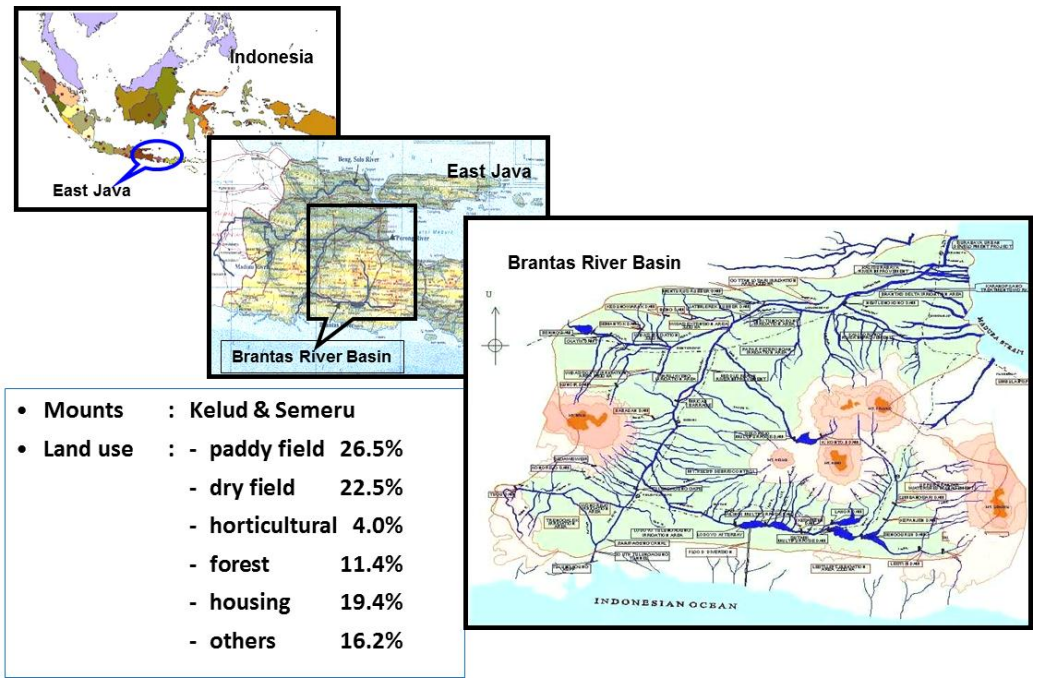


Figure 1 – Map of the Brantas River Basin

Volcanoes within the Brantas Basin are Mount Arjuna (3,339 m), Mount Kelud (1,724 m), Mount Semeru (3,676 m), and othersmall ridges here and there. Mount Semeru is constantly active. While Mount Kelud has erupted on a large scale on an average of once every 15 years: 1901, 1919, 1951, 1966, and 1990. The total volume of ejecta is estimated at 100-200 million m^3, having a decisive effect on local society as well as the environment.

The Brantas River is characterized by a clockwise watercourse centering on Mount Kelud. This is influenced by the process of mountain uplift and the volcanic ranges. The Brantas originates from the southeastern side of Mount Arjuna located in the center of its basin. The uppermost stream starts its course eastward south around the Semeru volcanic zone, and then runs to the west parallel to the Southern Mountains. It changes its course again to the north to avoid older volcanoes and Mount Wilis, and the runs past the foot of

Mount Wilis and Mount Kelud to reach Surabaya City. Thus the Brantas travels past all the major volcanic ranges in the basin.

2.2 Physical and Social Features of the Brantas River Basin

The population in the basin in 2010 (about 16 million) close twice that of 1960 (8.37 million), shortly after the Brantas River Basin Development Project (BRBDP) started. Surabaya City alone showed a remarkable increase of 2.27 times compared to the 1.84 times of Java Island during the same period. With a population of 2.94 millionas of 2009, Surabaya is the biggest commercial and industrial city next to Jakarta. Also, being a port city equipped with modern facilities, it serves as a hub of domestic trade. With the availability of a plentiful labor force, Surabaya City has become industrialized and urbanized, thereby creating a sharp increase in economic activities.

The average specific runoff of the Brantas River (average runoff per 100 km²) is 3,4 m³/sec at the Sutami Dam on the upper river, and 2,7 m³/sec at Jabon on the lower river. From the comparison of specific runoff among the Brantas and major rivers of the world, the runoff percentage of small and medium scale Indonesian rivers show trends similar to that of rivers in Japan, whereas large river such as Solo and Brantas tend to have the same characteristics as those in Asia.

Rice yield in the Brantas Basin 1965 was 1,107 million tons. It went up to 2,299 million tons in 2004 even though there was only a slight increase in paddy field area. A comparison between 1965 and 1993 yields shows that the rate of increase in the Brantas Basin was 2.33 times in contrast to 2.29 times for the entire country. This can be said to be a direct result of advanced intensive agricultural methods, based on the availability of irrigation water in the dry seasons.

The rice yield per unit area was 5.67 tons/ha on the national average as of 2004, showing a considerable increase from 3.48 tons/ha in 1965. The yield for the Brantas basin was 3.69 tons/ha in 1965 and 5.84 t/ha in 2004. This was due to improvement of rice varieties, introduction of chemical fertilizers, and an increase in double cropping made possible by secured irrigation water in dry season.

The national installed capacity for power generation was 13,600 MW as of 1993. of these, hydroelectric power generation makes up 2,179 MW or 16% of the total installed capacity for power generation. The total installed capacity in East Java is 3,682 MW; of which 275 MW are hydroelectric. The installed capacity for hydroelectric power generation in the Brantas Basin is 263 MW, which are 12.3% of the total in Indonesia and 97.8% of that in East Java.

The electrification ratio in villages reached 54.7% in 1993 at the end of the fifth 5-year development plan. In the sixth plan, the policy «further efforts for power development» was presented with a target value of 79%. The electrification ratio on Java Island was 76.1% as of 1993, exceeding the national average of 54.7% by over 11%. The Brantas

Basin was among the areas on the island with the highest electrification ratio, being 15% in 1970 and more than 85 % in 1993 and 90% in 2005.

Table 1 – Physical features of the Brantas River Basin

Main river course: Brantas	Length 320 km
Administrative location: Province of East Java	110°30' and 112°55' Eastern Longitude, 7°31' and 8°15' Southern Latitude
Passing through 14 regencies	
A. Main Tributaries and Basins	
Lesti	625 km^2
Konto	687 km^2
Widas	1,539 km^2
Brantas	6,718 km^2
Ngrowo	1,600 km^2
Surabaya	631 km^2
Sum	**11,800 km^2**
B. Water Availability	
Average precipitation	2,000 mm/year
Run-off coefficient	0.50
Potential flow	11.8 billion m^3
C. Surface Water Utilization	
Irrigation water	2,400 million m^3
Domestic-residential supply	158 million m^3
Industry bulk water	131 million m^3
Maintenance flow	204 million m^3
Fisheries	41 million m^3
Sum	**2,934 million m^3**

2.3 Water Resources Development in the Brantas River Basin

WRDM could be defined as an effort to realize utilization of water resources to satisfy all demands, in an efficient and effective manner, fair and even distribution, by taking into consideration conservation and control on water and its resources.

WRDM should be undertaken integrated (multi-sector), comprehensive (upstream-downstream), sustainable (inter-generation) manner and based on an environment sound concept (ecosystem conservation) with the river basin (hydrological area unit) as one management unit. These principles are well summarized in the philosophy of **One River, One Plan, and One Management**:

a. One river (meaning river basin) is a hydrological area unit that could cover several administrative areas defined as one management unit which cannot be separated.

b. In one river there is only one integrated, comprehensive, sustainable and environment based concept of development and management plan

c. For one river applies only one coordination system of management which guarantees an integration of policies, strategies and program as well as implementation of the system for all of its reaches.

Water resources development is an attempt to optimally use water potentials and to prevent it from its destroying capacity. At the upper reach, reservoirs are built to control flood and store water during rainy season and to supply water in the dry season. At 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 salt water intrusion into the river.

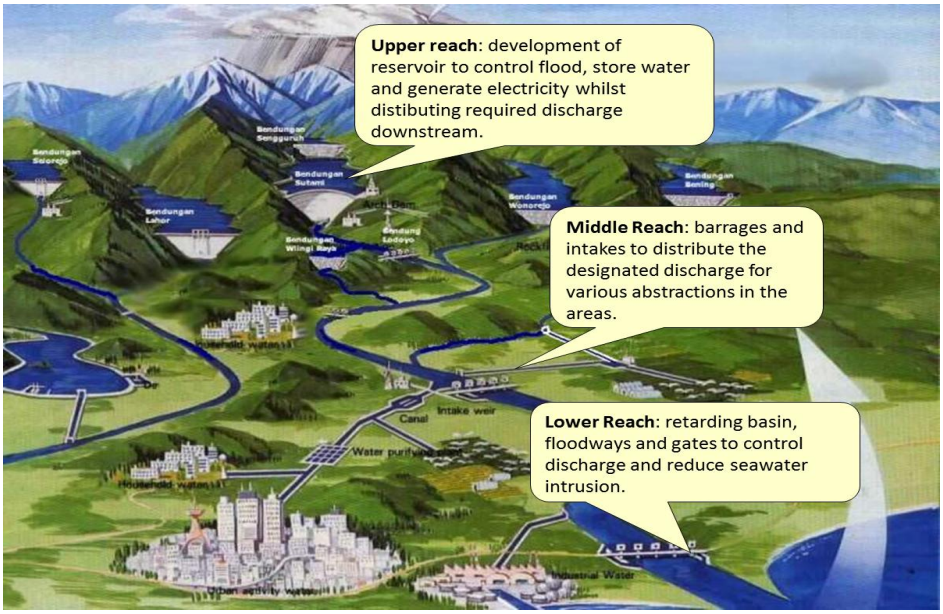


Figure 2 – Principle of water resources development

Water resources in the Brantas River Basin have been developed since almost 1,200 years ago. However modern development in water resources took place just as early as the end of the 19th century introduced by the Dutch for agricultural purposes. Comprehensive water resources development in the Brantas River Basin was introduced after the Indonesian Government requested the preparation of a water resources development scheme as part of war reparation assistance undertaken by Japanese Government after the Second World War.

The plan was carried out based on (the initial) «one river, one plan, one management» principle application in Asia. Volcanic ejectas produced by the Mount Kelud caused riverbed aggradation of the Brantas River and its main tributaries. This sediment deposition decreased the river discharge capacity for carrying flood. This incurred flooding almost every year, resulting in personal injury, crop damage and loss of asset. Accordingly, flood prevention was given a top priority in the initial stages of the development.

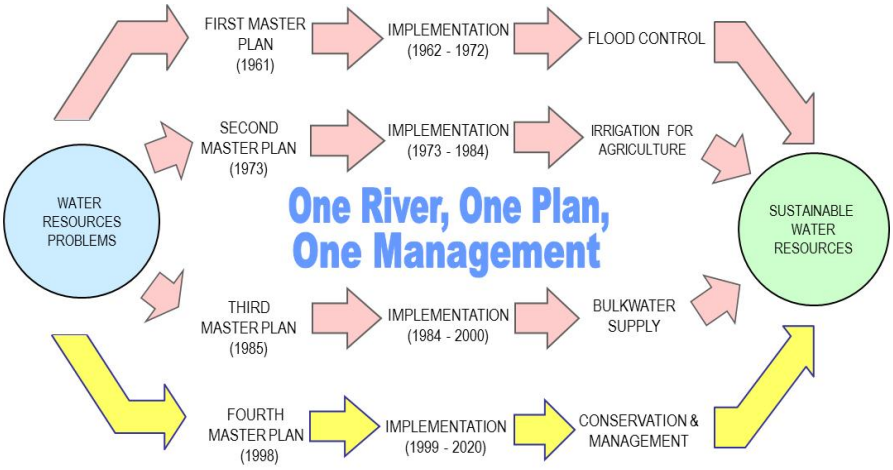


Figure 3 – Water resources development master plans of the Brantas River

However, the initial development was stage-wisely planned, and resulted into the following sequences of plans:

- Master Plan I (completed in 1961) emphasizing on flood control by developing dams at the upper reaches and river improvements in the middle and lower reaches to increase flood relief capacity.
- Master Plan II (completed in 1973) emphasizing on irrigation development to support the government policy on food sustainability by developing dams, barrages and technical irrigation schemes.
- Master Plan III (completed in 1985) emphasizing on water supply for domestic and industrial uses to support the government policy on industrialization.
- Master Plan IV (completed in 1998) emphasizing on conservation and effective water resources management to face the environment problems and challenge on the implementation of effective water governance.

The water resources development in the basin has resulted into a set of infrastructures, composed of: 8 (eight) reservoirs, 4 (four) river-improvement-schemes, 4 (four) barrages, and 3 (three) rubber dams etc.

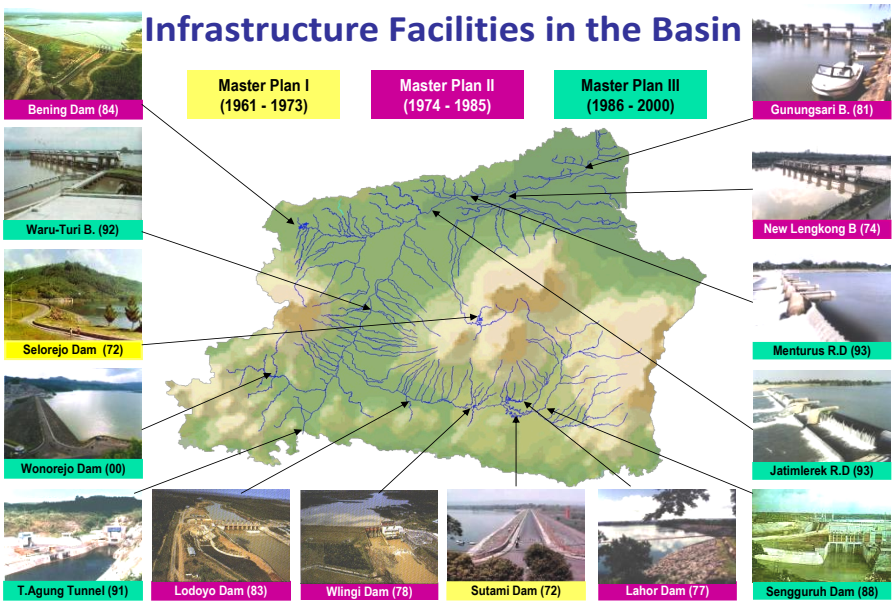


Figure 4 – Main infrastructures in the Brantas River Basin

All related infrastructures in each master plan can be seen in the following table:

Table 2 – Master plans, objectives and completed infrastructure

Master Plans (M/P)	M/P Objectivities	Planned Project	Construction Period
Master Plan I[1]	To control flood by constructing large reservoir in the upstream area and improving the discharge capacity of the river in the downstream area. To utilize completed reservoir for supplying irrigation water and electricity generation	South Tulungagung Drainage System	1959-1962
		Karangkates Multipurpose Reservoir	1962-1973
		Selorejo Multipurpose Reservoir	1961-1975
		Kali Porong River Improvement	1963-1972
		Lengkong Barrage	1971-1977
		Brantas Delta Irrigation	1971-1973
		Karangkates HPP Expansion (Lahor Dam)	1973-1977
Master Plan II[2]	The emphasize provision of irrigation water in support of the national drive for self-sufficiency in food production, we well as flood control and utilization of water potential for electricity and recreation activities	Wlingi Multipurpose Reservoir	1975-1978
		Lodoyo Barrage and Power Station	1977-1984
		Kali Surabaya River Improvement	1974-1981
		Brantas Middle Reach River Improvement	1975-1983
		Widas Dam Irrigation PJ (incl. Bening Reservoir)	1977-1984
		Sengguruh Reservoir and	1982-1988

[1] Government of Indonesia (1961), Comprehensive Report on the Kali Brantas Overall Project – Nippon Koei K.K.

[2] Ministry of Public Works, Government of Indonesia (1973), Report on the Brantas River Basin Development Plan.

Master Plans (M/P)	M/P Objectivities	Planned Project	Construction Period
		Power Station	
		Tulungagung Divertion Improvement	1989-1991
		Waruturi Irrigation (including Mrican Barrage)	1988-1992
		Lodoyo Irrigation	1977-1985
		Kelud Debris Control PJ (Debris Check dam)	1972-1978
Master Plan III[3]	To emphasize fulfillment of the predicted (until the year 2000) demand of domestic and industrial water, particularly in Surabaya and its surrounding areas.	Brantas Middle Reach River Improvement (II)	1984-1993
		Tulungagung Power Generation	1989-1991
		Kediri Nganjuk Groundwater Irrigation	1982-1986
		Wonorejo Reservoir and Power Generation	1994-2000
Master Plan IV[4]	Management and conservation of water resources including improvement of operation, maintenance and rehabilitation of water resources infrastructures.		

The development of the Brantas River Basin is a comprehensive multipurpose project, which uses dams, and reservoir for development of water resources, resulting benefits in flood control, irrigation, and power generation, domestic and industrial water supply.

Table 3 – Purpose of water resources infrastructures in the Brantas River Basin

No	Structure	River	Purpose
A	**Large Dams**		
	Selorejo Dam(1970)	Konto	Water supply for irrigation, and additional supply for hydropower plants at the D/S, hydro power generation, flood control, recreation
	Sutami Dam(1972)	Brantas	Water supply for domestic, irrigation, industry, hydro power generation, flood control, recreation
	Lahor Dam(1975)	Lahor	Water supply for domestic, irrigation, industry, flood control
	Wlingi Dam(1978)	Brantas	Afterbay of Sutami Hydro power, water diversion for irrigation, hydro power generation, flood control, recreation
	Bening Dam(1984)	Widas	Water supply for irrigation, hydro power generation, flood control, recreation
	Sengguruh Dam(1988)	Lesti	Sediment control to Sutami reservoir, hydro power generation

[3] Ministry of Public Works, Government of Indonesia (1985), Final Report for the Study of Widas Flood Control and Drainage Project Part I and Part II Study.

[4] Ministry of Public Works, Government of Indonesia (1998), Final Report of O&M and Rehabilitation of Brantas River Basin Development.

No	Structure	River	Purpose
	Wonorejo Dam(2000)	Bodeng Song	Water supply for domestic, hydro power generation, flood control
B	**Barrages**		
	New Lengkong (1974)	Porong	Water diversion for irrigation, domestic, and industry
	Gunungsari(1981)	Surabaya	Water diversion for irrigation
	Jagir (rehabilitation)(1981)	Wonokromo	Water diversion for domestic
	Lodoyo (1983)	Brantas	Afterbay of Wlingi hydro power, hydro power generation
	Tulungagung Gate(1986)	Parit Agung	Water regulation for domestic, hydropower, and flood control
	Wonokromo(1990)	Mas	Flood control
	Mrican(1992)	Brantas	Water diversion for irrigation
C	**Rubber Dams**		
	Gubeng(1990)	Mas	Water diversion and control for domestic purpose
	Jatimlerek(1993)	Brantas	Water diversion for irrigation purpose
	Menturus(1993)	Brantas	Water diversion for irrigation purpose

Summary of the development benefits are specified in Figure 5. There is no flood occur from main stream, water supply for irrigation, hydropower, domestic and industries was increased by 225%, 535%, 171% and 230% respectively from those in 1960.

Benefit	Unit	Before Development (1960)	After Development (1990)
Flood control	Inundation area	Flooding annually (60,000 ha)	Controlled
Irrigation	Harvest intensity	0.8 x / year	1.8 times / year (225%)
Electricity	Million kWh	170	910 (535%)
Domestic water supply	Million m^3	73	125 (171%)
Industrial water supply	Million m^3	50	115 (230%)
Water quality	Average BOD/year	-	12 – 16 mg/lt
Infrastructure facilities	Condition	-	Less maintained

Figure 5 – Summary of benefits in the Brantas Basin

2.4 Problems After the Construction Period

Since 1961 the Brantas River Basin development has been carried out by a distinctive unit under the Ministry of Public Works, namely: Brantas River Basin Development Project (BRBDP).

Under the BRBDP, various benefit are obtained, like flood control for 50 year return-period scale, water supply for 83,000 ha of irrigated areas having 1.8 cropping intensity

which directly supplied from the reservoirs, production of about 910 million kWh/year, bulk water supply for industries and municipal drinking water of about 240 million m^3/year. However, the BRBDP can not cope with further maintenance and operation activities of the developed infrastructures.

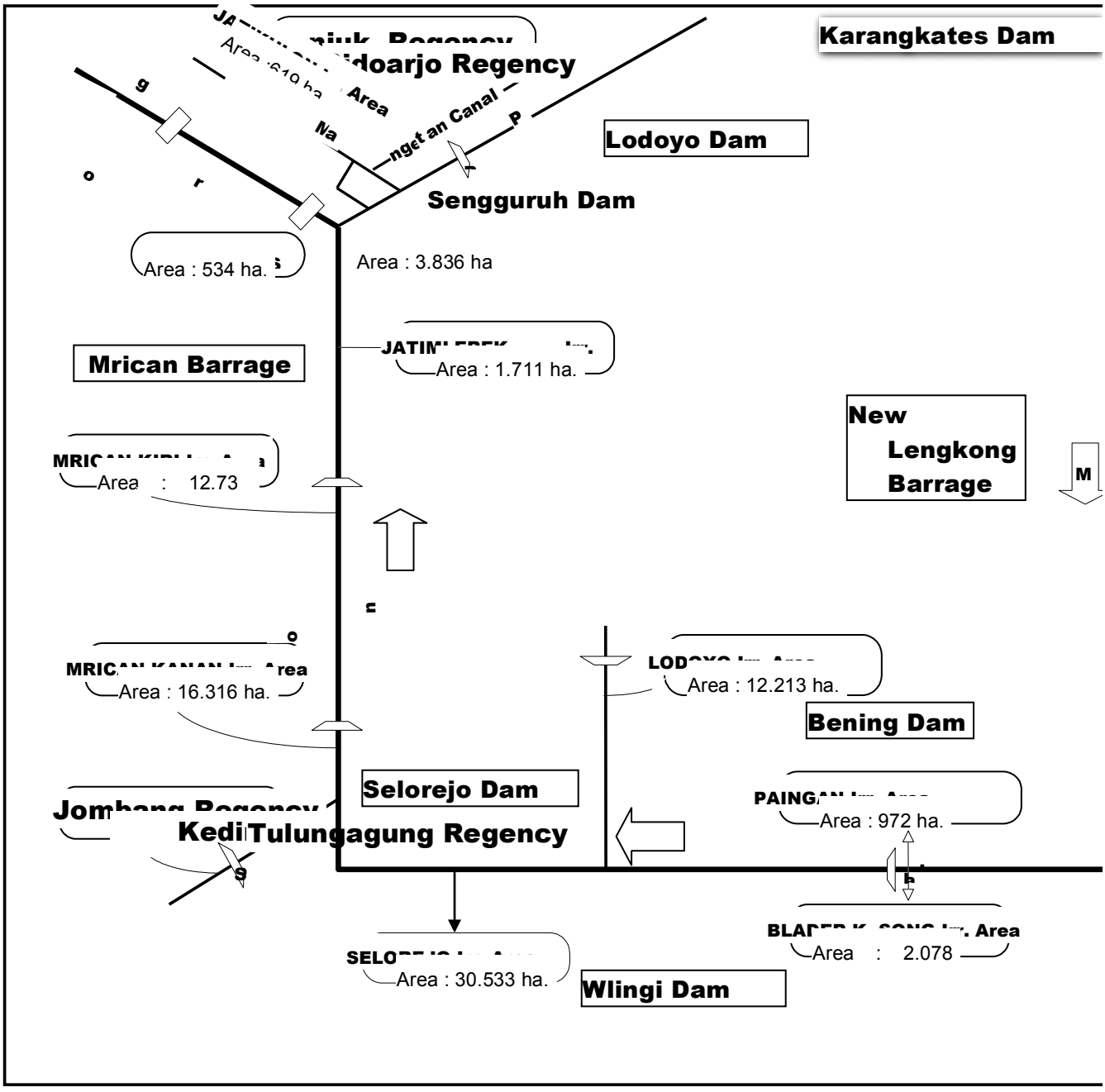


Figure 6 – Irrigation area within the Brantas River water supply system

As we know, the water resources development cycle consists of planning (2-5 years), construction (5-10 years), operation and maintenance (10-100 years), and afterwise the evaluation phase (Figure 7). Construction phase aims to materialize the infrastructure to achieve the intended benefits. After the construction phase, we have to deal with an utilization period to achieve the objectives of the project, namely the operation and

maintenance phase (the longest phase of the cycle that could end up to 50-100 years of economic benefits).

Figure 7 – Water resources development cycle

Adequate operation and maintenance (O&M) activities is considered necessary to maintain the function of the water resources infrastructures and to ensure optimum benefit at their planned lifetime.

After almost 30 years period of constructions (1961-1990), the BRBDP encounters this phase, whereas the following difficulties were met:

a. Institution, as no permanent institution is established to perform O&M activities in a conceptual and sustainable manner; the BRBDP is however a temporal institution whose duty is only to carry out the construction.

b. Lack of funding as the BRBDP is limited to the national government budget and can not abstract water service fee directly from the users.

c. Lack of O&M budget allocatoin resulted in degradation of the water resources infrastructures, and less coordination among related agencies complicated the water resources management.

These difficulties posed risk of water resources degradation, which in the long run shall harm economic development of the basin.

To realize the development objectives, a **permanent and neutral institution supported by professional staffs and adequate budget** is required to perform effective operation and maintenance of the systems.

2.5 Water Resources Management in the Brantas River Basin

Water resources management are activities that enhance the development benefits as well as prolong water resources infrastructure life-time, which mainly consist of operation and

maintenance activities. In water resources management, operation and maintenance activities are the main activities during the post development of the infrastructures.

- Operation (O) is an attempt to control and allocate water and its resources in order to achieve optimum utilization according to the purpose and minimize negative impacts such as flood and drought.
- Maintenance (M) is an attempt to secure sustainability of water resources, its infrastructure and the environment itself.

Scope of water resources management covers watershed management, water quantity management, water quality management, flood control management, river environment management, water resources infrastructure management, and research and development supported by data network and information system.

a. **Watershed management** consists of regreening, reforestation, terracing and other related activities in the frame of increasing sustainability of the watershed function. At a basin-scale, the RBO plays an important role, especially prepares recommendation on water resources conservation program.

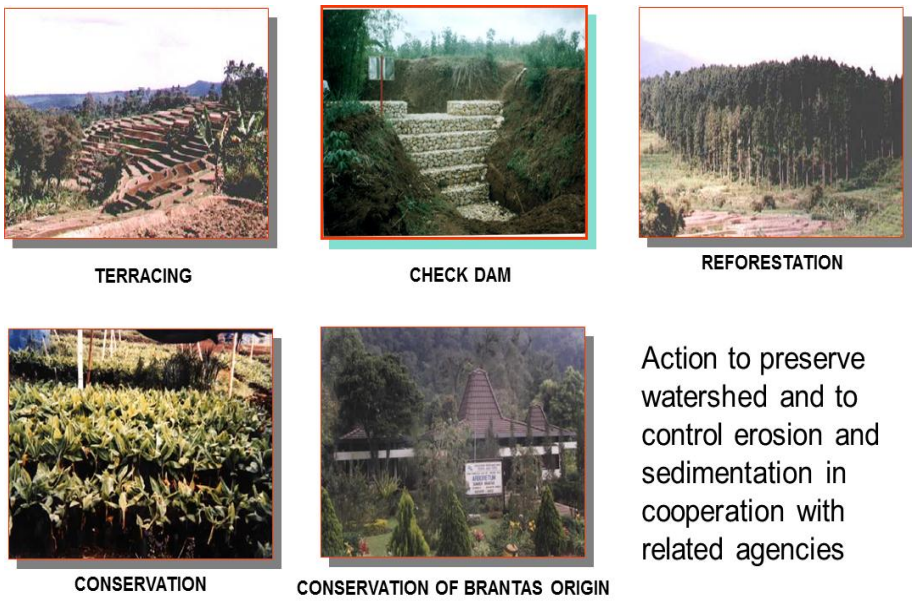


Figure 8 – Watershed management

b. **Water quantity management** consists of two main activities: (1) w*ater use licensing* as a form of acknowledgment on water use right as well as an instrument to control its use; (2) *water allocation* as an attempt to manage reservoir operation pattern which is planned based on demand proposals and water availability prediction; (3) *water distribution* where the RBO operates water resources infrastructures in order to distribute water to beneficiaries according to the agreed operation plan.

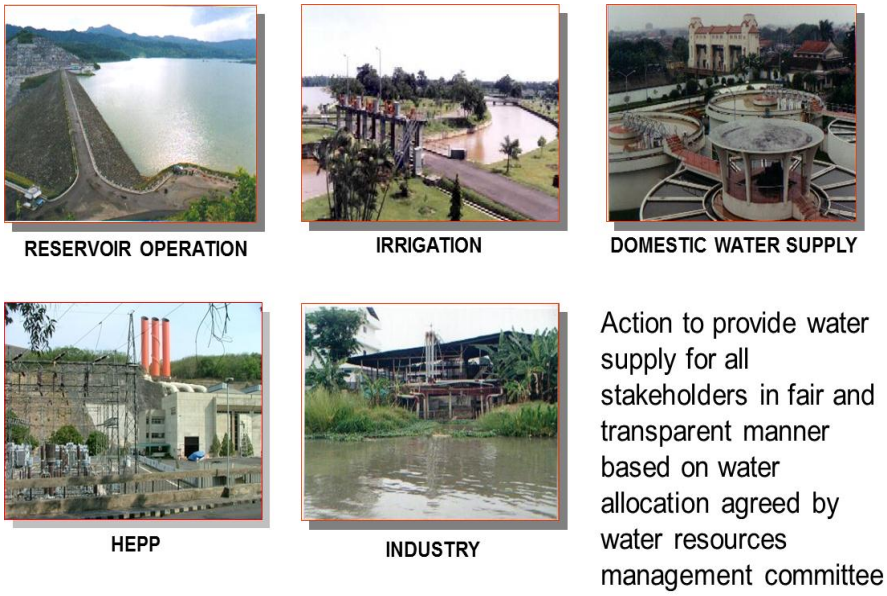


Figure 9 – Water quantity management

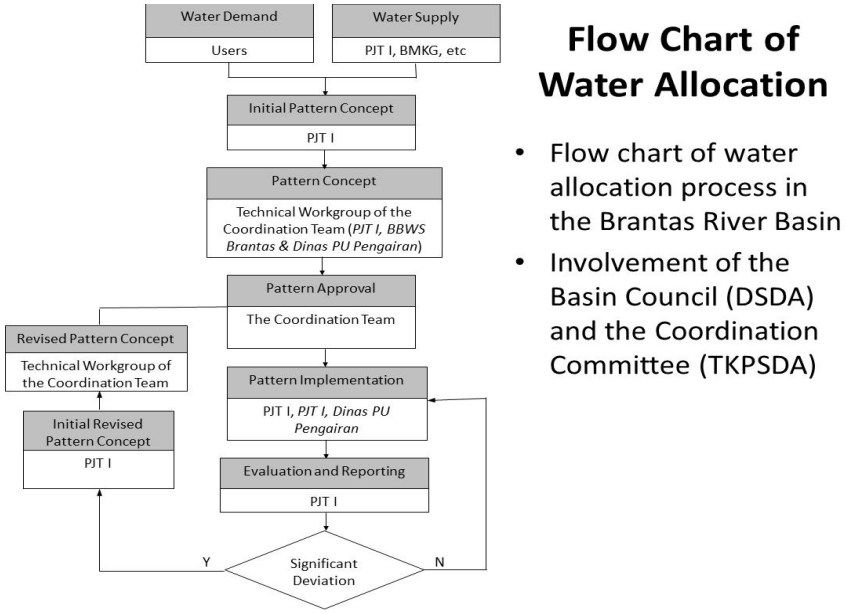
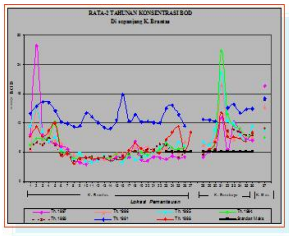


Figure 10 – Water allocation flowchart

c. **Water quality management**, that consists of four basic activities: (1) *control on effluents* based on an allowable limit of concentration and amount of pollution load in waste water discharged by a certain activity; (2) *effluent discharge licensing* as a basis for controlling water pollution through law enforcement; (3) *water quality monitoring* that is carried out and reported periodically, both for river water and for effluent discharge of dominant industries; and (4) *pollution control* either *in-stream* and *off-stream* (pollution source) through command and control approach.

SAMPLING

LABORATORY TEST



REPORTING RESULTS

RAISING PUBLIC AWARENESS

FIELD STUDY

Action to increase water quality gradually to meet standard

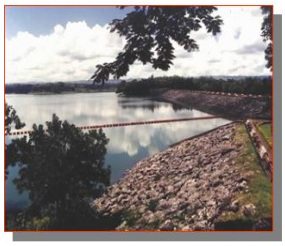
Figure 11 – Water quality management

d. **Flood control** as an attempt to regulate flood discharge and minimizing its destructive effects can be done by: performing hydrological observation (using telemetric and non-telemetric equipment), preparing flood prediction, as well as discharge regulation using the related infrastructures (reservoirs, barrage and gates). The RBO prepares a flood control plan and undertakes control of the flood distribution by operating the infrastructures along the main river.

MASTER STATION

WATER LEVEL GAUGING

RAINFALL GAUGING



CONTROL DAM

MITIGATION

Action to control and mitigate flood in cooperation with related agencies

Figure 12 – Flood control

e. **River environment management** is a form of regulating the river corridor land use to keep the function of the river safety area and to increase the benefit of the river for tourism and water sport.

Figure 13 – River environment management

f. **Water resources infrastructure management** is an important activity, of any given institution responsible for water resources management in a river basin. This is mainly related to the maintenance activity (preventive, corrective and emergency), either *routine maintenance* and small repair to prevent from serious damage; or *corrective maintenance* in forms of large-scale repair, rehabilitation and rectification in the frame of restoring/increasing the function of the water resources infrastructure; as well as *emergency maintenance* as a temporary repair due to emergency condition (like floods).

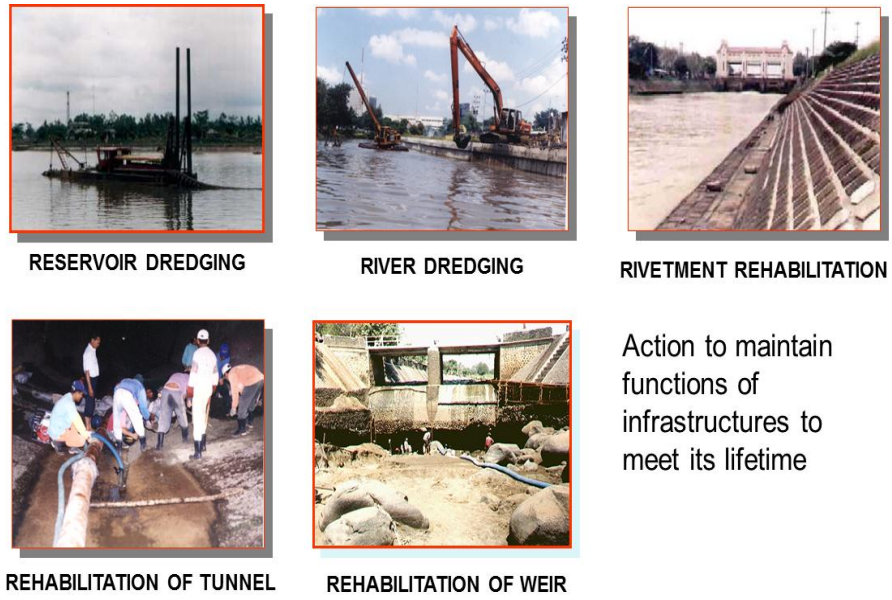


Figure 14 – Water resources infrastructure management

g. **Research and development** in water resources management activities are necessary to implement both in advances of technology and management approaches, in order to secure water services within the basin.

h. **Hydro-data network and information management system** are parts of any given institution with a responsibility of water resources management.

III. Jasa Tirta I Public Corporation

3.1 Legal Basis of Establishment

Jasa Tirta Public Corporation was established as a state-owned company with a specified concensus in rendering water services and performing O&M activities based on water service fee abstracted from the users. The corporation was established under the Government Regulation No. 5 of 1990.

To adapt further to the responsibilites and assignments, the regulating basis of Jasa Tirta I Public Corporation was twice ammended. Firstly, in 1999, by the Government Regulation No. 93 of 1999, in order to strengthen the organization and permit its jurisdiction to extend to other basins; and recently by the Government Regulation No. 46 of 2010, to adapt to the Law No 7 of 2004 on Water Resources.

3.2 Objectives and goals of establishment

The objective and goal of Jasa Tirta I Public Corporation is take part and support the Government policy and program on economic sector and national development in general, and particularly on business of water resources and water resources management, as well as optimization of Jasa Tirta I Public Corporation resources to produce goods and services based on healthy corporation management principles.

3.3 Business Activities

In order to achieve the objective and goal, Jasa Tirta I Public Corporation conducts main business activities: (1) services to provide bulk water for drinking water, industry, agriculture, flushing, port, electric power generation and others; (2) provide water power to generate electricity for the State Electricity Company; (3) generate and distribute electric power and drinking water, perform consulting in water resources fields, heavy equipment rental and water quality laboratory services, and (4) develop other water-related services including piped domestic supply at specified scales.

Besides the above activities, Jasa Tirta I Public Corporation also conducts optimization of resources owned by the corporation for office estates, warehousing, tourism, hotel and resort, sport and recreation, hospital, telecommunication infrastructures, energy resources, consulting services, construction services, eco-business, training center,

agriculture, leasing, and business of infrastructures owned and controlled by the corporation.

3.4 Tasks and Responsibilities

Jasa Tirta I Public Corporation in-charged in managing the water resources in 40 rivers (including the Brantas River) of the basin and to operate, maintaining, and managing the major infrastructure in these rivers. In 2000, the corporation was authorized to undertake water resources management activities within 25 rivers of the Bengawan Solo River Basin (an inter-provincial river basin lying in Central Java and East Java Provinces). Table 4 summarizes the rivers in the Brantas and Bengawan Solo Rivers Basin managed by the corporation.

Table 4 – Assigned rivers to the corporation within the Brantas and Bengawan Solo

Brantas River Basin (40 rivers)	Bengawan Solo River Basin (25 rivers)
Brantas, Amprong, Lesti, Metro, Lahor, Bambang, Lekso, Semut, Jari, Putih, Ewuh, Dawir, Parit Agung, Parit Raya, Ngrowo, Ngasinan, Tawing, Tugu, Bodeng, Song, Badak, Serinjing, Konto, Kedak, Widas, Kedungsoko, Ulo, Kuncir, Bening, Beng, Watudakon, Brangkal, Sadar, Kambing, Porong, Marmoyo, Surabaya, Kedurus, Wonokromo, Mas	Bengawan Solo, Tirtomoyo, Keduwang, Walikan, Dengkeng, Blora, Ceper, Ujung, Lohgede, Siwaluh, Grompol, Tempuran, Mungkung, Gambiran, Madiun, Ketegan, Cemer, Catur, Brangkal, Gandong, Kukur, Jungke, Ketongo, Trinil, Foodway Plangwot-Sedayulawas

Therefore, tasks and responsibilities of Jasa Tirta I Public Corporation are defined to: (1) rendering water services at the basin-scale, and (2) conducting certain activities of water resources management at 40 assigned-rivers in the Brantas River Basin and 25 assigned rivers in the Bengawan Solo River Basin.

Water services within at the basin scale are stipulated in Article 4 of the Government Regulation No 46 of 2010;[5] whilst certain activities of water resources management within the assigned rivers in the basin is stipultated in Article 5 of the same regulation.[6]

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[5] The tasks and responsibilities are: (a) delivering services for water utilization by the users; (b) guarantee the water services for the users through the implementation of operation and maintenance works, including construction of water resources infrastructure which give direct benefits; and (c) provide technical consideration and advice to the government regulatory body in the basin, on water usage.

[6] The tasks and responsibilities are to perform: (a) operation of water resources infrastructures which are already transferred to corporation; (b) perform preventive maintenance which consists of routine and periodic maintenance and minor repair of water resources infrastructures which are already transferred to the corporation; (c) perform preventive maintenance which consists of routine and periodic maintenance and minor repair of water resources which are already transferred to corporation; (d) assist the Government to protect and safe water resources and the infrastructures in order to maintain its preservation, based on the (financial) abilities of the corporation; (e) emergency maintenance of water resources and the infrastructures which are already transferred to corporation in consideration to the financial ability of the corporation; (f) assist the Government to perform water resources conservation

Besides the tasks and responsibilities mentioned above, Jasa Tirta I Public Corporation also conducts excellent and adequate public utilization of water resources to fulfill people needs for social services, welfare and safety of the public within the working area of the corporation. Those includes providing surface water supply to fulfill daily basic needs, providing irrigation water for public agriculture within the existing irrigation system, controlling flood hazards, conducting water resources conservation and performing the development of Drinking Water Supply System and sanitation for domestic.

The corporation is not responsible for irrigation system management but provides bulk water. In cases where water supply is made from the irrigation system for non-irrigation functions (water supply to industry), the corporation coordinates with the concerned irrigation agency. Thus, much of the management decisions are based on a consultative process through a proactive approach. The corporation is authorized to make most of the technical policy decisions and some policy decisions related to WRM, such as release of reservoir water for flushing, changes in water allocation during times of shortage, reservoir operation, awareness campaign etc.

Jasa Tirta I Public Corporation however has no policy power in areas of enforcement, basin planning, basin infrastructure development and investment for public services, off-stream water quality improvement, tariff fixing. In these areas where it is not permitted to make policy decisions, the corporation works through the administrative and consultative channel to influence decisions. As a river basin organization, Jasa Tirta I Public Corporation has to be an accountable and effective organization in most aspects of the water resources management process, coordination, improving resource base, and working with other agencies and stakeholders by adopting a proactive management style and having a good working relationship with both formal and informal institutions.

3.5 Collaboration with Stakeholders

Water resources management covers across sector and across area of interest which require cohesiveness of action to maintain sustainability of function and benefit of water resources. As a platform for stakeholder liaison, cohesiveness of action and advisory mechanism for water-related basin-level development and management, it requires a coordination and consultative mechanism to integrate the interests of various sector, territory and stakeholders in water resources. According to the Water Resources Law No.7 of 2004, coordination of water resources management must be established at the national level (National Water Resources Council), at the provincial level (Water Resources Council or other name) and in basin level (Water Resources Management

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and controlling of water resources destructive forces; (g) flushing for river maintenance; (h) monitoring and evaluation of water quantity and quality of water resources; (i) disseminate results of the monitoring and evaluation of water quantity and quality to users, community and other stakeholders; (j) in cooperation with the Government regulating body within the river basin: provide guidance and counseling to the community to improve their empowerment; (k) technical consideration and advice for the utilization of water resources.

Coordination Team – WRMCT or *Tim Koordinasi Pengelolaan Sumber daya Air – TKPSDA*). Establishment of coordination body of water resources management in regency are optional, depend on the local necessity of this coordination body.

A team called the Brantas Basin Water Resources Management Coordination Team (BWRMCT) was established based on Ministry of Public Works Decree No. 248/KPTS/M/2009 on February 9, 2009. The membership of Brantas Basin WRMCT comes from the stakeholders of the basin with equal percentage from government organizations and non-governmental organizations. Membership of the Coordination Team consists of river basin organizations – both the corporate-type Jasa Tirta I Public Corporation and the quasi-river-basin-organization namely Brantas River Basin Public Utility Type Basin Organization (or in Indonesian: Balai Besar Wilayah Sungai Brantas), Provincial and Regency/Municipal Government Agencies (Agencies related to regional planning, water resources, agriculture, environment, health, forestry, transportation, industry, energy and natural resources, coastal and fishery, education, etc.) and non-governmental organizations (water users organizations/associations for irrigation, drinking water, industries, tourism, forestry pressure groups, etc).

The Coordination Team consists of Chairman, Vice Chairman, and Members. Total members are 44 (forty four) members compost 22 (twenty two) members come from Government Organizations and the other 22 (twenty two) members come from Non-Government Organizations. The Coordination Team is supported by 4 (four) Commissions, namely: (1) Commissions on Water Resources Utilization; (2) Commissions on Conservation; (3) Commissions on Water Hazard, and 4) Commissions on Institution and Information System.

The team identifies development needs and opportunities, provides policy guidance, and undertakes strategic development planning and implementation planning. The main responsibility according to the Law on Water Resources (2004) is to formulate water resources policies and strategies based on predefined national guidelines. The Coordination Team reports to the Minister of Public Works and to the Governors of Central Java and East Java Provinces.

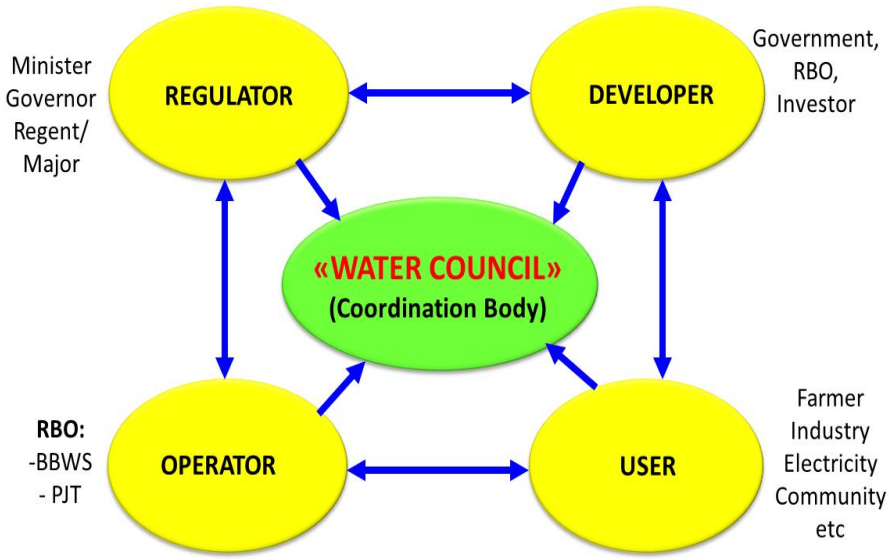


Figure 15 – Water resources coordination scheme within the Brantas River

Prior to the establishment of the Coordination Team, in order to avoid conflict among water users in the Brantas River basin, a Provincial Water Resources Management Committee (in Indonesian: Panitia Tata Pengaturan Air) that was established based on the East Java Governor's Decree No. 59 of 1994. The committee, responsible to the Governor, was supposed to be a coordination body where decision on all management aspects in water resources (planning, implementing, supervising, controlling and funding) in its respective area was made.

3.6 Organizational Setup

Jasa Tirta I Public Corporation is supervised by a supervisory board composed of central and provincial government representatives and is managed by a board of directors headed by a president director. Being a national corporation, the authority to oversee the management and functioning of PJT-I lies with the center through the MPW, with the Ministry of State-owned Corporation (MoSC) exercising a fiscal oversight role.

The Minister, who draws his powers from the water law, has supervisory control. The supervisory board has five members representing the MPW, MoSC, other Ministry concern (nowadays from the Ministry of Research and Technology) and provincial government (East Java and Central Java) who undertakes general supervision of the corporation's program, work plan, and budget. This is the only institutional setting in which the Provincial Government of East Java (for Brantas basin) and Central Java and East Java (for Bengawan Solo basin) can directly interact with the work of the corporation and influence the WRM in the basin, apart from the authority it exercises through other agencies in the basin. To a large extent the central ministries' (MPW and MoSC) role overshadows the supervisory board's functions in the operation of the corporation.

The day-to-day management of the corporation is with an executive board director. Based on the recent Minister of SoC Decree (Nov. 2012), the board of director composed of a President Director, a Director for Technical Affairs, a Directors of Business Development, a Director of WR Management, and a Director of Financial and General Affairs. Three regional units (division) in the Brantas basin and two regional units in the Bengawan Solo, manage the field operations and maintenance of the water resources system.

3.7 Financing and Funding

In order to support the sustainability of Water Resources Management, a consistence and continuous funding support are required. The Water Resources Law No.7 of 2004 has mandated that funding source for water resources management can be derived from: (i) government budget; (ii) private budget; and (iii) Income from water resources management services fee (WRMSF).

Based on the Government Regulation No 46 of 2010, Jasa Tirta I Public Corporation has been given the authority to collect, receive and use the revenue from WRMSF to finance all activities based on its tasks and responsibilities. The tariffs of WRMSF for business activities, i.e. domestic water supply, industry and hydroelectric power generation are set by the Ministry of Public Works (MPW) based on the proposal of corporation after consultation performed by an evaluation committee established by the MPW.

3.8 Quality Assurance System

Under Jasa Tirta I Public Corporation I, the Brantas River Basin was the first river basin in Indonesia that applies the Quality Management System (based on the ISO 9001-2000 approach) for design, operation and maintenance of water resources and infrastructure; this quality system was implemented since 1997 under the motto Identity by Quality.

Besides to anticipate stakeholders and beneficiaries' request and to enhance stakeholders' satisfaction by meeting their requirements, the reasons to adopt this Quality Management System is as an instrument to meet better and effective system of water resources management according to the global standards; to improve the company's performance; efficient, effective and consistent corporate management; to improve employee's integrity; optimum time and resources usage; to improve employee's capacity and responsibility; and to create better communication and improvement in information quality.

After having experience in applying Quality Management System of ISO 9001 for water resources management in the Brantas River basin, PJT-I has benefits as follows:

- Operational aspect of the company is not affected by change of the employed workforce (better working methods);
- Improvement in the company's performance;

- Stakeholders' complaints are better handled and anticipated;
- Main tasks are undertaken more efficient and effectively;
- Better relationship between stakeholders and beneficiaries, and
- Easier to implement Good Corporate Governance (GCG) principles.
- Appreciation from external parties to the company's existence increases;
- Pilot concept for water resources management at the basin-wide perspective in Indonesia;

3.9 Corporatization Achievement

After operating for several years, Jasa Tirta I Public Corporation has been able to pilot the developing management system and technology for advanced water resources management. The corporation has performed in either technical, financial, management aspect.

a. Technical Aspect

The following technical aspects were utilized:

- The fourth master plan of the Brantas River Basin, as inter-sectoral approach for water management and conservation in the basin since 1998.
- Brantas river flood control plan has been established during the setting up of the master plan, with flood control management carried out through coordination with local government agencies. The flood forecasting and warning system is operated to support data collecting and information management for flood control purposes.
- Brantas river pollution control master plan was set up in 1998 for river pollution control and effluent regulations. The water quality shows improvement although the standard values have not been achieved.
- Water resources conservation is carried out in coordination and cooperation with related agencies in various departments, local governments and the population in general of the Brantas River Basin.
- Water allocation is carried out through coordination with Coordination Committee as explained before. The operational patterns are prepared by Jasa Tirta I Public Corporation.
- Effluent discharge standard is currently stated in the Governor Decree No. 136 of 1994, however, it is being updated involving all agencies concerned under coordination of related agency at the provincial level.

b. Financial Aspect

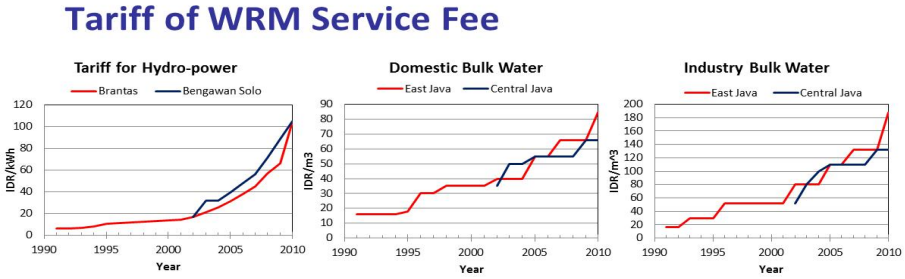
Ever since its establishment, Jasa Tirta I Public Corporation has been carrying out the O&M of water resources infrastructures funded by the beneficiaries. Although it has not

been fully funded by the water users, the step-wisely attempt to apply the principle of cost recovery in O&M activities is being applied basin-widely.

Tariff of the rendered water service fee is decided by the MoPW, based on the result of consultation to thecostumers done by Specific Team established by the MPW. The service is conducted also on a contract basis that provides security for both parties. In the future, it is expected that the Basin Water Resources Management Committee will act as consultation forum for having an agreement on this tariff.

Tariff of water service fee increased significantly in the last decade. Tariff applied in 2012 was Rp 149.37/kWh (for water power use for electricity generation), Rp 112/m^3 (for domestic water use) and Rp 221.07 /m^3 (for industrial water use, progressive approach), in other words, it has increases for 10.5 times, 3.2 times and 4.2 times respectively compared to the same tariffs of 2001.

Progressive block system tariff policy for industrial water users has shown a good example for promoting efficiency use of water. Many big industrial costumers (such as sugar can factories) apply recycling technologies to reduce their water abstractions.



Hydro Electric Power	Brantas River Basin					Bengawan Solo River Basin		
Year	1991	1995	2000	2005	2010	2002	2005	2010
Tariff (IDR/kWh)	6.00	10.20	13.61	31.17	104.03	16.67	39.22	104.66
%	100%	170%	227%	520%	1734%	100%	235%	628%

Domestic drinking water supply	East Java Province					Central Java Province		
Year	1991	1995	2000	2005	2010	2002	2005	2010
Tariff (IDR/m³)	16.00	18.00	35.00	55.00	84.50	35.00	55.00	66.00
%	100%	113%	219%	344%	528%	100%	157%	189%

Industry	East Java Province					Central Java Province		
Year	1991	1995	2000	2005	2010	2002	2005	2010
Tariff (IDR/m³)	16.00	30.00	52.00	110.00	188.10	52.00	110.00	132.00
%	100%	188%	325%	688%	1176%	100%	212%	254%

Figure 16 – Tariff of water service fee

As shown in the following Figure, water service fee revenue has increased by 8.8 times from Rp 29.1 billion in 2001 to Rp 256.1 billion in 2012. Budget allocation for O&M activities goes up from Rp 27.9 billion in 2001 to Rp 206.8 billion in 2012 or has increased 7.4 times.

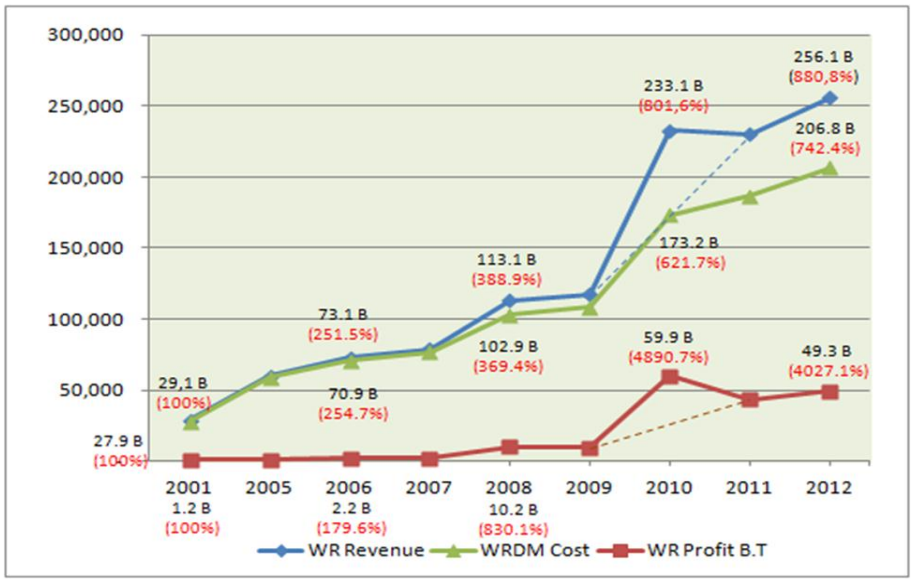


Figure 17 – Water service revenue for the Brantas River Basin

Various details on the WMSF expenditures and in its relation to the need of basic O&M degree can be seen at

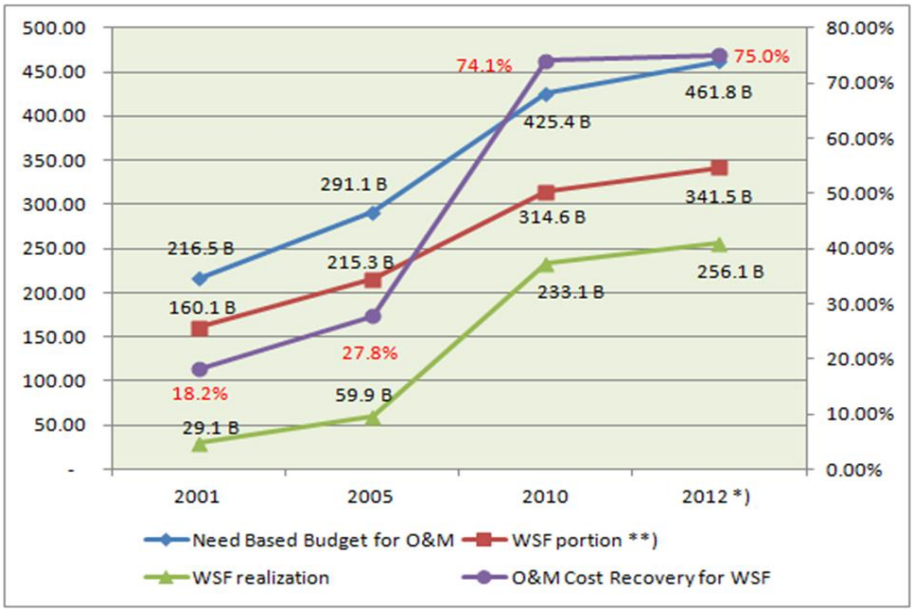


Figure 18 – Degree of O&M cost recovery from WRMSF revenue

Other than the O&M fee, Jasa Tirta I Public Corporation also raises fund from non-water services, such as consultancy, construction, equipment rental, land rental, tourism, and joint venture in resource utilization. Private sectors' desire to participate also in investment for water resources development such as hydropower project, drinking water supply, tourism etc. by establishing joint venture or joint operation.

c. Management Aspect

As a state-owned company, the managing corporate body is subject to various management audit and control. Management performance of the corporation is judged

based on financial criteria's as well as good-corporate performance or best common practice in managing a company.

During the last 10 years, the corporation is positioning itself better, in form of a consolidated water resources management system that is supported by regional legislation for the operational basis of the management. The corporation also implements a quality assurance system that ensures good performance of the management body.

Jasa Tirta I Public Corporation was established to solve managerial, personnel and financial problems that loom over the completed water resources infrastructure in the Brantas River Basin. This task was achieved, not in a perfect sense, but as a role model for other river basins in Indonesia. This corporate body is an example of what proper management can do to extend the development benefits to its beneficiaries.

Triple bottom line of key success areas is adopted by the management to realize the corporate vision 2025: «to be one of worldwide class basin water resources management agency» as described in the following figure.

Figure 19 – Three key success area in water resources institutional approach

After 20 years, the corporation has develop its management capacity, whereas some areas should be maintained continuously:

- Consolidated water resources management system supported by regional legislation for the operational basis of the management.
- Better river basin organization role in the integrated activity implementation related to water resources.
- Improved coordination, increase awareness and stakeholder's participation in decision making process based on agreed mechanism in BWRMC.

- International acknowledgment on quality management system of the Brantas water resources management presented by ISO-9001 Certificate from SGS International Certification Services in May 1997 (Certificate No. Q9755).
- Active participation in NARBO – the Network of Asian River Basin Organization since its establishment at Batu – Malang, the home of Jasa Tirta I Public Corporation. Nowadays the former President Director of the corporation enacts as the Vice President of NARBO.
- Satisfactorily score using the NARBO's RBO performance benchmarking, as result of peer reviewing by other RBOs in 2009.

On the financial and management aspect, the following achievements were obtained, based on the audited financial report of the corporation in accordance to the financial indicators given by the MoSC.

- The company health performance score of PJT I (2001 – 2010)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Score	93,9	91,5	90,0	91,0	93,0	92,3	94,6	95,0	95,6	97,3
Health Level	Sehat AA	Sehat AA	Sehat AA	Sehat AA	Sehat AA	Sehat AA	Sehat AA	Sehat AA	Sehat AA	Sehat AA

Note: Sehat = Healthy

- The assessment of management performance, Key Performance Indicator (KPI) of PJT I start by the letter of State Owned Company Minister No. 676/MBU/2004 on 22 December 2004, the performance of the year 2005 – 2010 as follow:

	2005	2006	2007	2008	2009	2010
Score	120,0	134,4	111,4	118,4	122,5	122,6
Performance	Baik ~ A2	Baik ~ A3	Baik ~ A2	Baik ~ A2	Baik ~ A2	Baik ~ A2

Note: Baik = Good

Figure 20 – Financial and managerial performance indicators of the corporation

The benefits from water resources development and management in the Brantas River basin gives very significant supports to the economic development in the basin, in the region (East Java Province) and National which raise economic welfare of the area as measured in the gross domestic product (GDP). Data from the Indonesian Central Bureau of Statistics shows that gross regional domestic product (GRDP) of the Brantas River Basin in 2003 amounted to Rp 150.63 billion (approximately US$ 17.66 billion), which accounted for 59% of GRDP in East Java (Rp 254.38 billion) and 8% of the national GDP (Rp 1,786.7 trillion).

Benefit	Unit	Before managed (1990)	After managed (2000)	After managed (2010)
Flood control	Inundation	Controlled	More Controlled	More Controlled
Irrigation	Harvest intensity	1.8 times / year	2.2 times / year	2.2 times / year (122 %)
Electricity	Million kWh	910	1,024	1,315 (145 %)
Domestic water supply	Million m^3	125	204	315 (252 %)
Industrial water supply	Million m^3	115	144	181 (157 %)
Water quality	Average BOD/year	12 – 16 mg/lt	3 - 14 mg/lt	3 ,2 – 7,5 mg/lt
Infrastructures	Condition	Less maintained	Maintained	Maintained

Brantas River Basin = **25%** area of East Java Province
GRDP Brantas River Basin = **59%** GRDP in the East Java Province (as of 2005)

Figure 21 – Infrastructure and water-related indicators of the Brantas Basin

As it could be seen, flood control in the mainstream is maintained with a designated capability to control 50-years return period flood. Agricultural cropping intensity in the basin has increases from 1.8 to 2.2 annually. Higher than before, hydroelectric power generation in the basin is optimized from 910 kWh annually to an amount of 1,300 million kWh annually. While, domestic and industrial water supply increase from 240 m^3 to 496 m^3annually. In matter of water quality, the average water quality in the basin is approaching to designated standard eventually it has not yet fully achieved its target.

3.10 Brantas IWRM Spiral Model

Modern water resources development and management in Brantas river basin has a long history (almost 50 years since 1960's) and having wide spectrums of lesson learnt could be shared. It is an practical example of UNESCO (1992) basic concept as presented in **a spiral model of integrated water resources management**.

The spiral evolutionary model reflects progressivepositive changes in historical waterresources development and managementand offers the following advantages: it allows IWRM actions to be started at anypoint of the evolutionary process; builds capacity over time; promotes cooperation and integration, as well as pursuit for better solutions that adapt to changing circumstances andvalues.

The spiral of integrated water resources management illustrates the process as an incremental, step by-step process, and therefore provides apractical framework for looking ahead andplanning for successive turns of the spiral.

The following figure illustrate the evolutionary step of water resources development and management in the Brantas River Basin since the modern WRDM has applied in the basin.

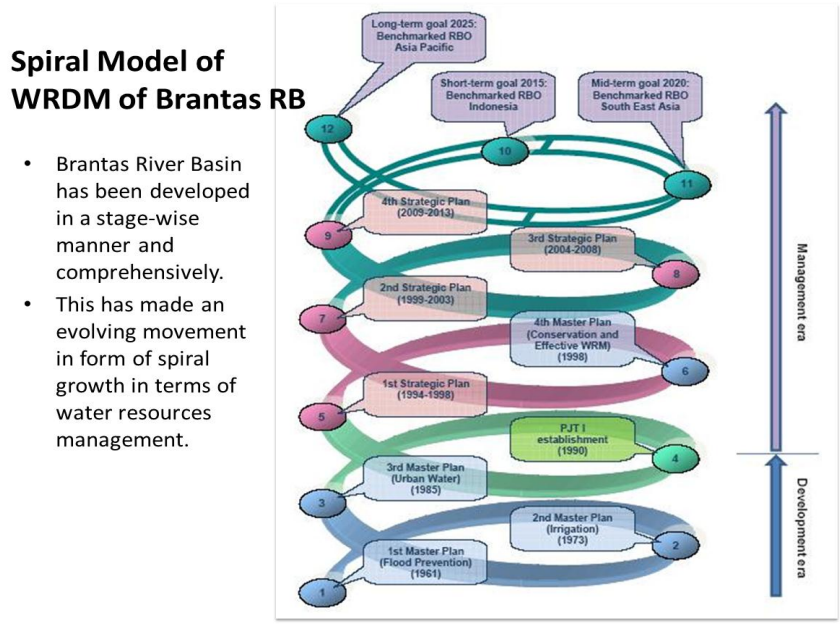


Figure 22 – The spiral of integrated water resources management of the Brantas

IV. Main Challenges in the Brantas River Basin

Some issues are identified as the most likely to have significant impacts on future water management in the Brantas Basin. The issues and challenges will give impact to water security in the basin, since water resources in the basin is very important input of agriculture production, water quality degradation has occurred in the basin and threaten the health and welfare of the poor and the water related hazards such as extreme floods and landslides etc. happen frequently.

4.1 Water scarcity

The first main issue and challenge is related to water scarcity in the Brantas River basin in the near future that will cause the difficulties to allocate water due to increasing water demand and limited supply capacity. Growing populations need more food and their increasing wealth spurs demand for fruits and vegetables as well as animal products, whose feed requires more land and water resources to produce.In case of serious drought and unexpected drought year, shortage of water would become more serious for meeting the expanded water demand.

This situation will lead to conflict of interest among users. The limited supply capacity is caused by the decrease of effective storage capacity of the reservoirs in the basin due to severe land erosion and sedimentation. Watershed degradation has become an important constrain, since erosion (related to land use and spatial management) and natural forces (volcanic debris) enhances sedimentation that shortens economic life of major dams in the basin and natural base flow degradation during dry spells.

The Brantas River basin has eight reservoirs with a total initial gross storage capacity of 647.0 million m^3 and effective storage capacity of 479.6 million m^3. Because of sedimentation, the gross and effective storage are now decreasing to 390 million m^3 (60%) and 341 million m^3 (71%) respectively. The remaining effective storage of Sutami reservoir is only 56.1% of its original.

4.2 Water quality degradation

The second main issue and challenge is related to water quality deterioration in the Brantas River Basin. Increase of population at the Brantas River Basin and various economic activities, has direct impact on water quality in the basin, and could be foreseen in the following facts:

- Domestic bulk water supply for Surabaya City is provided mainly from Brantas surface water. As a matter of pollution accumulation, the river's water has a low dissolved oxygen (DO) level, thus creating water purification difficulties and rises the cost of water treatment.
- Increased water pollution are frequently worsen by shock loadings, especially in the dry season when natural flows in the rivers are at the minimum.
- The occurrence of increased turbidity during the rainy season inflicts the increase of sediment contents caused by degradation of the upstream catchments area.
- Eutrophication symptoms at the Sutami Reservoir caused by the accumulation of nitrates (N) and phosphates (P) elements. This symptoms creates significant problems, like: algae blooming, deterioration of freshwater fauna and organic depravement.

4.3 Water Related Hazards

The third main issue and challenge is related to water related hazards in the Brantas River basin.

The land development for farming and illegal logging in the mountainous area has brought about increase of flood magnitude in the downstream, land erosion, landslides and thus debris discharge increase. Flood control works such as the construction of dikes, revetment and other facilities has brought about accumulation of people and properties in surrounding area of river. This means increase of flood damage potential. The more safety is required to protect the people and properties from flood.

The water related hazards such as extreme floods and landslides etc. happen frequently in the Brantas River basin. Extreme flood usually happen in some small tributaries e.g. Amprong, Bogel, Sadar, Batan, Gunting Rivers etc. The flood occurrence in the tributaries couldn't be avoided due to lack of flood control structures.

4.4 Climate Change

Water resources faces more delicate problems caused by climate change. Rainfall will increase in some areas and decrease in others. Changes – both increases and decreases - in average rainfall of up to 20% are predicted in many cases. The size of extreme water events such as floods and droughtswill be more powerful, intense, and longer.It is predicted thatextreme events will occur more often; floods and droughts that previously occurred once in a lifetime, every 50 years, may now occur every 5 or 10 years.

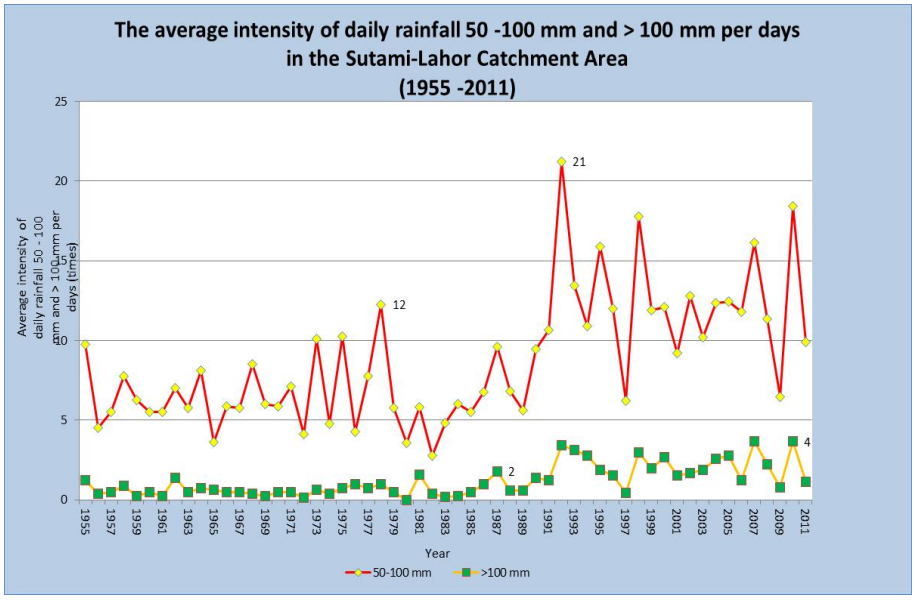


Figure 23 – Average intensity daily rainfall (Sutami-Lahor Catchment Area)

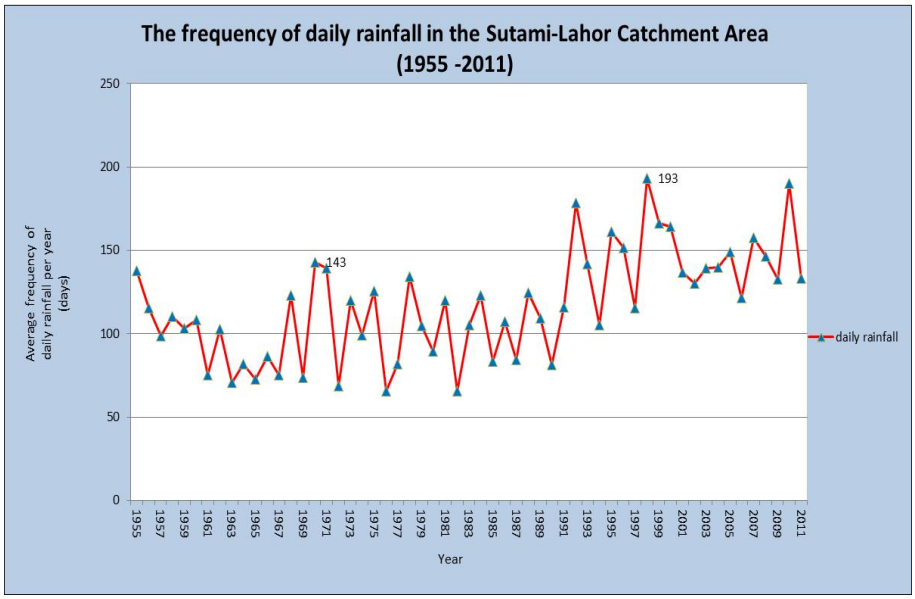


Figure 24 – Frequency of daily rainfall (Sutami-Lahor Catchment Area)

The average intensity of 50-100 mm daily rainfall in the Sutami-Lahor Catchment Area during 1955 – 1989 is 6.5 times, with maximum of 12 in 1970. During 1990 – 2011, the average daily rainfall increase 12.5 times with maximum of 21 in 1998. For average intensity of daily rainfall > 100 mm during 1955 – 1989 is 0.6, with maximum of 2 in 1987, during 1990 – 2011, is 2.1 with maximum of 4 in 2007.The average frequency of daily rainfall per year during 1955 – 1989 is 100 days with maximum of 143 days in 1970. During 1990 – 2011, the average become increase with 146 days daily rainfall per year, with maximum of 193 days in 1998. Therefore, it can be concluded there is a significant changing of hydrological pattern in Brantas River Basin. It is preliminary concluded that the impact of climate change has occur in the basin.

V. Conclusions

Water resources in the Brantas River Basin has been developed stage-wisely since the 1960s; by this mean, the developed infrastructures has secured water service in the basin and provide a spiral-like effect in the terms of water management.

Present water uses in the Brantas River and its main tributaries i.e. for electricity generation, irrigation, brackish water fishponds, domestic water supply, industrial water supply and river maintenance flow will cause potential conflict among water users due to water shortage in the basin.

As a the responsible partaking agent in the basin, the Government of Indonesia has established Jasa Tirta I Public Corporation (1990) to undertake water resources management in the Brantas River Basin.

Water allocation in the Brantas River basin is based on a water allocation plan, which is made upon concensus by representative of various water users in Water Resources

Management Coordination Team, whereas Jasa Tirta I Public Corporation acts as the operator of water services.

The main issue and challenge related to water security in Brantas River basin due to increasing water demand and limited supply capacity, water resources degradation in term of water quality and water quantity as well as environment, especially in the watershed area, more bigger size and frequent of water related hazard. These challenges are aggravated by climate change that requires effective implementation of adaptation measures.

After a long periods and wide-span of experiences in developing and managing water resources, the Government of Indonesia got the intention to scaling-up Jasa Tirta Public Corporation to be national wide water resources management body to manage national strategic river basins.