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Integrated Management in the Brantas River Basin

ABSTRACT: *Development area of river basin consists of area as a unit of ecosystem, economic development and area as administration unit. By this conception, river basin is not only area based on hydrological boundary, but also area surrounding that affected by the river basin itself. This conception is because development of the river basin may affect the area surrounding. The optimum development in the river basin, should be followed by development of surrounding area, otherwise the optimum tends to decrease.*

River basin development should be implemented in proportional, well balance and totally by estimating existing water resources and contributed requirement and the observing existing condition in the related region which can influence water resources and that requirement.

The main objective of river basin development is to raise up the social life prosperity in economy, social and culture within that watershed. To reach the target the project activity should be shown to develop and distribute the national and local ability to make a plan and provide it with program management of comprehensive approached step which cover three activities, that are water resources conservation, water resources development and river basin management.

KEYWORDS: *Watershed, BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand).*

A. INTRODUCTION

Life on earth depends upon water, which maintains and correlates all ecosystems within the planet earth by continually moving on and in the ground surface. Water characterizes the river resources on which mankind and their livelihood are largely dependent. A steady increase in the population growth and both agricultural and industrial activities have called upon the concept that water has been always unlimited and intangible commodity is an erroneous foundation. Excessive use of water resources as a logical consequences of national economic development has induced a range of national problems. Not only has the shortage of clean water supply become an obstacle for economic development, but also an increase in waste deposits has become the pollutants of water bodies which reduce natural purification. This has made worst with the reduction of forested lands and conversion of agricultural areas to settlements which have in turn change the hydrological cycle remarkably.

B. THE BRANTAS RIVER BASIN

Indonesia, straddling the equator, is an archipelago nation with over 17,000 islands-of which about 6,000 are inhabited-covering and area of 1,940 million km² and with a coastline of over 84,000 km. Much of the nation's population lives in the four main islands of Java, Sumatera, Sulawesi and Bali/Nusa Tenggara. Although the average population density of Indonesia is currently about 104/ km², Java-the most densely populated island, in area only 6.9% of the country have a population density of 926/ km², or 110 million in 1997.

The Brantas River Basin located on East Java Province, as a whole has been one of the most productive and advanced granaries in Indonesia, because of ample water resources, tropical climate and fertile soil

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(Figure-1). Yet, this basin holds possibilities for further agricultural development. Also the industry in the basin located in the lowest reaches around Surabaya harbour city is promising for future growth supported by the market in East Java, Indonesia.

As a whole the characteristic of the Brantas River Basin can be summarized as follows. The length of the river is about 320 km, with the catchment area of about 12,000 km². Average annual rainfall is 2,000 mm equivalent to the volume of surface water about 12 billion m³ per year. The total population in the basin is about 14 million people (1990).

Brantas river basin development is carried out as an integrated development based on the master plan which is reviewed every 12 years projecting the future socio economic conditions and based on the goals of national guide line. The plan is based on the philosophy of: one river, one plan, one coordination management.

Up to 1998, 4 (four) Master Plans have been worked out and water resources that already built as follows:

MASTER PLAN	OBJECTIVES	STRUCTURES FINISHED
MASTER PLAN I (1961)	Flood Control Irrigation Hydropower Development Water Supply (Domestic & Industries)	Sutami Dam (1970) Selorejo Dam (1973) New Lengkong Dam (1973) Porong river improvement (1977) Lahor Dam (1977)
MASTER PLAN II (1973)	Irrigation Flood Control Hydropower Development Water Supply (Domestic & Industries)	Brantas middle reaches river improvement (1977) Wlingi Dam (1977) New Gunungsari Dam (1981) Bening Dam (1982) Lodoyo Dam (1983) Tulungagung Drainage (1987) Sengguruh Dam (1989)
MASTER PLAN III (1985)	Water Supply (Domestic & Industries) Irrigation Hydropower Flood Control	Brantas middle reaches rehabilitation (1990) Tulungagung hydropower (1990) Jatimlerek rubber dam (1992) Wlingi dam rehabilitation (1993) Menturus rubber dam (1993) Porong river rehabilitation (1993) Surabaya flood control (1995) Wonorejo Dam (2000)
MASTER PLAN IV (1998)	Water resources conservation & Management	Integrated Watershed Management

C. BENEFIT OF THE DEVELOPMENT

The benefit achieved due to water resources development in the Brantas river basin such as:

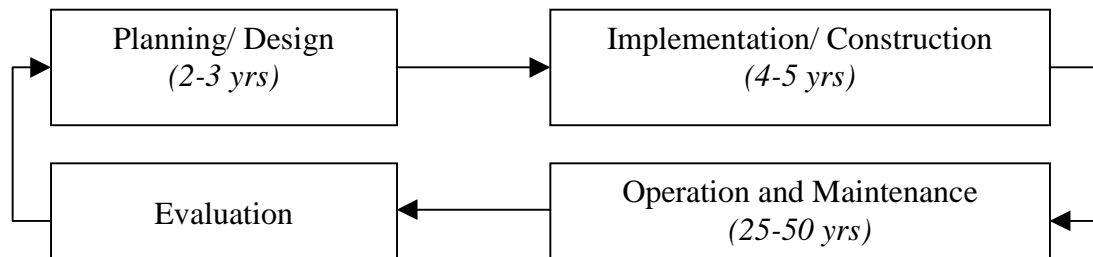
1. Safety due to flood of 50 year return period for the Brantas main stream.
2. The 233 mW capacity of hydropower plant was installed in the basin, producing around 1.0 billion kWh of energy per year.
3. Total area of paddy field irrigated from the Brantas river system is around 345.000 ha. In the dry season irrigated agriculture consumes approximately 80% of the available water in the Brantas river. East Java Province, since 1989 can supply more than 30% of national stock on food production.
4. Supply raw water for drinking water and industries is around 300 million m³ per year.
5. The fresh water requirement for brackish aqua-culture was estimated at 13.5 m³/ sec for 11,000 ha in Brantas delta area, but due to the limited of water, the water supply of brackish aqua-culture depends on the returning flow of the irrigation water usage.

D. PERUM JASA TIRTA (JASA TIRTA PUBLIC CORPORATION)

According to the laws and regulations, beneficiaries of water resources facilities are asked to contribute to operation and maintenance (O & M) of the facilities. Contribution from water users other than farmers is not collected owing to a reason that the Brantas Office as a Project Organization is not authorized to collect the contribution. It is necessary to transfer the O & M of the dams and reservoirs to a body who is duly authorized to collect contribution.

After about 30 years of development, several river structures have been constructed along the Brantas river. The next step will be O & M activities. According to development cycle O & M is the main role for the success of development.

Development Cycle



Problem in the Brantas river (1990) is that no institution responsible to manage O & M activities, besides lack of budget for O & M and less of skill labour.

The Jasa Tirta Public Corporation was established on February 12, 1990, by the government regulation No. 5/ Th 1990. The main objective of establishing the corporation is to manage operation and maintenance activities of the facilities in the Brantas river basin.

The cost for operation and maintenance activities will be collected by the Corporation from the beneficiaries. For the time being, the main source of fund is from electricity, drinking water and industries. No obligation for the farmers to pay water charge, even though more than 80% of water in the Brantas river is for irrigation purposes. The government now is introducing the pilot project of Irrigation Service Fee in several provinces around Indonesia. The purpose of the pilot project is to show the farmers, the important of the operation and maintenance of the irrigation facilities.

E. PROBLEMS FORMULATION AND WATER RESOURCES MANAGEMENT

Land and water resources development had been implemented for long years in the Brantas river basin. The development covers some important aspect such as irrigation, flood control, water supply, industry, electric power, fishery, tourism, water pollution, river transportation etc.

Problems arise on the development and management of the Brantas river basin are as follows:

1. Land compensation

Several ha of land is to be compensated on the dam and or reservoir site. The process of land compensation related to the removal of the people and always there is a problem as mention below, based on the experiences in the development of the Brantas river.

a. Problem of land compensation

During the construction of Tulungagung drainage channel (24 km length, $Q=1,000 \text{ m}^3/\text{sec}$) to the Indian Ocean in the middle reaches of Brantas river (1983), around 10 people out of 150 people did not agree with the price of land compensation decided by Government (the project).

Several step had been done to solve the problem in order to get win-win solution, that are:

Problem identification (transparency of process, market price, land owner/ private/ communal)
Discuss with the government official, informal leader, religion leader (moslem leader), politician leader (if necessary)
Discuss with the people, what is the real requirement

b. Problem of removal of people from project site

In the 1985, during preparation of Wonorejo Dam (95 m height, 105 million cum reservoir capacity), in the middle reaches of Brantas river, around 1,500 people have to be removed to Sumatra island (transmigration).

The process of removal was as follows:

The people selected 5 person as their representative consists of government official, informal leader, religion leader (moslem leader), school teacher and chief of the village to visit a new land in Sumatera island. After that they explained to the people about the condition of a new land and discuss with the people which a new land they are selected.

2. Problem during construction

Problem during construction is mainly caused by the strong request from donor countries and poor position of the borrower. Regulation from some donor countries tend to recommended to borrower to use equipment, consultant and contractor from the certain countries.

Experience in the Brantas river indicated that project manager has to have strong authority to manage the project included to consultants and contractors (assistance concept basis). The example is during construction of Tulungagung drainage tunnel (1,000 m length, \varnothing 7.00 m, $Q = 1,000 \text{ m}^3/\text{dt}$), in the middle reaches of Brantas river in 1983, project manager rejected the proposed consultant team leader from abroad because of low capability. The same condition is for the construction of Sengguruh Dam, in the upper reaches of Brantas river, in 1986.

3. Water Quantity Management

a. Licensing

Licensing of water utilization issued by Local Government supported by the Technical Recommendation from Perum Jasa Tirta (PJT).

Technical Recommendation from PJT is important to meet the balance of water supply and demand. Water in the Brantas river used for various purposes. The main consumers are = irrigation (80%), raw water for drinking water, industries, fishpond, city flushing (20%) and electricity (not consume the water). Water allocation from PJT to the users is based on contract basis. Users have to pay fee to PJT, except farmers, for covering O & M cost. The tariff is decided by the Government upon pre discussion between PJT and users.

b. Dry Season Operation Rules

Water management in the Brantas river coordinated by a body called Panitia Tata Pengaturan Air (East Java Provincial Water Board/ EJPWB) headed by Vice Governor of East Java Province. Water allocation pattern consist of two kind of Operation Rules (OR) that are for dry season (June-November) and rainy season (December-May).

The procedure of preparing OR is in the month of May (for dry season OR) users submit water demand to PJT. By simulation and weather forecasting, PJT prepared draft of dry season OR. In the end of May draft OR discussed in the forum of EJPWB and if all already agreed, then signed by Vice Governor. Implementation of OR done by PJT by 10 days monitoring.

If there is deviation of prediction or conflict of interest in the field, limited members of EJPWB discuss to review OR if needed.

c. Rainy Season Operation Rules

Preparing rainy season OR is the same procedure as for dry season. The important of rainy season OR is flood control. In the Brantas river, PJT prepared a guideline book called Guideline for Flood Forecasting, Flood Warning and Flood Fighting.

Mentioned in the guideline about critical location along the river (levees), protection method, number of material and equipment available for flood fighting in the warehouse along the river, name of staff involved (address, telephone number hierarchy of information to be submitted, etc).

To monitor rainfall intensity in the basin and water discharge along the Brantas river had been installed, Telemetering System called Flood Forecasting and Warning System (FFWS) located in the Operation Room on the main office of PJT. FFWS consist of 26 nos of Rainfall station, 31 nos of Water level station, covering 12,000 sq. km of catchment area. The data's transferred to Operation Room every 30 minutes (real time). The basic concept of flood control is one river, one plan, one coordination management (Figure-2).

The purpose of establishing a flood forecasting and warning system is to prevent or mitigate the damage due to flood and to ensure safety of inhabitants. The flood-fighting activities are performed by flood defense teams. The people living near the river can take necessary actions for flood protection by giving them information about flood with enough time allowance. The information on coming flood such as scale of flood, arrival time of peak flood, etc. is to be given to inhabitants well in advance, in case that occurrence of flood is judged to be inevitable.

4. Water Quality Management

Water quality control in the Brantas river (including its tributaries), plays an important role in sustaining the benefit. It should consider the available legal aspect from Central and Provincial Government. That legal aspect confirm that PJT should have an active participation in supervising and controlling the Brantas river water quality. It means that the task of PJT on water quality control is supporting the Central and Provincial Government. One of the continuous participation of PJT is working out for the water quality monitoring along the Brantas river stream in 50 sampling points and in 41 industrial pollution sources. After that, the samples are tested by PJT's Laboratory. These data can be used by the Local Government of East Java to control pollution activities. By using simulation computer programming, it can also develop a strategic action plan in pollution control abatement program in short, middle and long term period to achieve the river water quality objective (Figure-3).

The main pollutant source in the Brantas river, based on the study in 1989, comes from Industry, Domestic and Agriculture.

In order to reduce pollutant from industries the Government issued regulation that all industries have to installed Waste Water Treatment Plant (WWTP). Because of type of industries are varies, for small industries (home industries), it is difficult to follow the regulation. For some large industries the WWTP are not always operated.

More difficult to control is pollutant comes from domestic waste. The people use the river water for may purposes. Because of low income and less awareness of environment protection it takes time to educate the people.

Pollutant comes from agriculture is not significant factor to deteriorate water quality. Agriculture activity is done during rainy season that the flow of water in the river is big enough to neutralize pollution.

5. Clean River Program

To minimize pollution discharge into the river, Government issued the program called Clean River Program (CRP) in 1989. PJT and other parties promote the CRP through several activities as mention below.

a. CRP Campaign

Educate the people about the important of environment protection for life of people at present and for the next generation. Objective of campaign is that people have to have same perception of environment protection starting from young people, student, industries, government official, NGO, etc. (Figure-4). In practice PJT collaborate with academic, NGO, informal leaders (moslem leaders), government organizations, etc.

Campaign activities is focused to reduce pollution from domestic, agriculture and small industries.

b. Law enforcement

Law enforcement is focused to large industries. Many large industries do not operate their WWTP continuously. Difficulties of law enforcement are poor regulation, poor staff and difficult to get evidence.

The other way, maybe, it is needed a global cooperation between developed and developing countries. In fact that large industries came from developed countries. What is their responsibility to protect environment?

After several years of hard works, now the people along Brantas river come to step **understand**, but **not to do yet** environment protection. Some of industries already asked for court of justice. It needs some more time before environmental condition completely protected.

6. Maintenance of Infrastructure

Maintenance activity is primarily to protect water resources infrastructure (dam, reservoir, weir, check-dam, dike, sluice, conduit, etc.) (Figure-5).

The management of Brantas river basin needs the participatory of beneficiaries. For example, the farmers play the role in operation and maintenance the irrigation infrastructure including pays irrigation service fee (ISF), and the other beneficiaries pay water abstraction fee. The fees would be used to manage the river basin.

7. Watershed Conservation

The category and percentage of land use in the whole basin as of 1990 were farm land: 57%, forest: 26%, homestead area: 14% and others: 3%, respectively. On the other hand, according to land use map prepared by East Java Province, in the year 2008, farm land will be decreased and forest and homestead areas will be increased by 10.2% and 21.8% compared with those in 1990 respectively.

Sediment yield in the Mt. Kelud basin mainly result from eruption of volcano (Mt. Kelud). As the result, Wlingi dam reservoir located at the lower reaches of the basin was damaged by sediment deposition coming from southern slopes of Mt. Kelud after eruption in 1990. In order to settle this problem, a sediment bypass channel in the Putih river and sabo works are being constructed.

The sabo works in Konto and Lesti basins are also being rehabilitated or constructed, to trap sediment discharge. The sabo works in Ngrowo basin seem to delay or not to commence, because of no serious sedimentation.

According to the field investigation 2 dams (Sengguruh and Wlingi), out of 6 dams, suffered from sediment caused by volcano eruption (Mt. Semeru and Mt. Kelud). To overcome the problem, besides construction of check dams as mention in Master Plan, periodical excavation (dredging) have been done by PJT for both dams. Reforestation and greening also underway leaded by PJT (Figure-6).

8. Water Resources Management

The management of Brantas river basin will follow the concept of sustainability: Sustainability is maintaining the resources. The sustainability should coordinate and integrate the river basin activities and environment. The concept of sustainability will be applied to all phase of the development, i.e.: planning, design, construction, operation & maintenance. However, sustainable development cannot just be limited to save the resources. It must become the guiding principle for all future planning and development. Future prospect of the entire Brantas river basin would be essential as the key of success in achieving the economic development for East Java Province in the long run.

To get the nations development aims for lifting-up the prosperity of the people, it is also necessary to prepare the sustainable development program and management the Brantas river basin in an effective and efficient manner for sustaining the water resources in the basin.

In the other side, based on the equity principles, the water management shall be done by the neutral institution.

F. CONCLUSION

- 1.** Brantas river basin has been a valuable natural resource for many years. It was essential for food production, to support national economic development. Water is considered as a strategic commodity.
- 2.** The development of Brantas river basin is carried out as an integrated development by philosophy of one river, one plan, one coordination management, based on the hydrologic cycle.
- 3.** The management of water resources in Brantas river basin is carried out as an integrated management operated by PJT state own corporation. Scope of activities of PJT are: water quantity management, water quality management, maintenance of water resources infrastructure. PJT has implemented Quality Assurance System ISO-9001, issued by Yarsley International Certification Services Limited, London, No. Q.9755 on May 12, 1997.
- 4.** To operate the above activities, PJT was supported by the related agencies, such as: East Java Provincial of Water Resources Committee (Panitia Tata Pengaturan Air) for water allocation, Commission for Environmental Pollution Control and Abatement (KPPLH) for pollution control.
- 5.** The funding for O & M of water resources in the Brantas river basin mainly come from the contribution of beneficiaries, that are: State Electric Power Company, Regional Drinking Water Supply Company and Industries.

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EXPLANATION OF TRANSPARENT PAPER

1. **P – 1:**
The Republic of Indonesia consist of about 17000 islands, total population (1999) around 210 million people and will be 280 million people in 2020.

The Brantas river basin located on East Java Province. The length of the main river is about 320 km with catchment area of about 12000 km². Average annual rainfall is about 2000 mm, equivalent to the surface water about 12 billion m³ per year.

2. **P – 2 :**
Development of Brantas river is carried out as an integrated based on series of Master Plan, started in 1961. The Master Plan reviewed every about 12 years, that are : Master Plan I, flood control (1961), Master Plan II, irrigation (1973), Master Plan III, water supply (1985) and Master Plan IV, water resources management (1998).

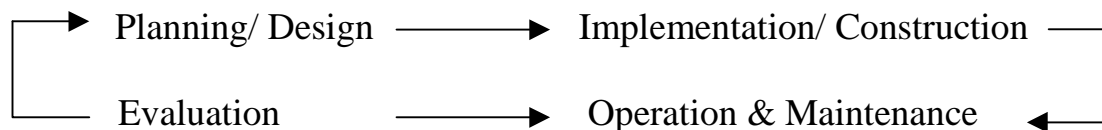
3. **P – 3 :**
After about 30 years of development (1961 – 1990), several infrastructure have been constructed, such as dams, barrages, hydropower station, flood control facilities, levees, short cut, etc.

Benefit of infrastructure are : flood control for 50 year flood in the main river stream, electricity production about 1.00 billion kWh per year, irrigation for 340000 ha of land, raw water supply around 300 million m³ per year for drinking water and industries, tourism, etc.

4. **P – 4 :**
Problen arises after construction (1990) are : WHO will manage the infrastructure, WHAT is the quality of staff and HOW to get funding for the management activities.

Because of shortage of Government budget, beneficiaries have to contribute O&M cost required.

The need of O&M activities can be summarized as follow :



5. **P – 5 :**
Based on law and regulation, on 12 February 1990, JASA TIRTA – PUBLIC CORPORATION (PJT) was established by government regulation No. 5/ 1990

The main task of PJT are :

- a. O & M of infratructure
- b. Water management by the economic view point
- c. Watershed conservation
- d. Rehabilitation of infrastructure

6. **P – 6 :**
Problem on the water resources management, such as :

- a. Land compensation process
- b. Removal of people from project site
- c. Loan process

7. P – 7 :

Water allocation/ Operation Rules

Operation Rules is prepared in the beginning of dry season (June) and the beginning of rainy season (December) every year, based on the predicted water balance between supply and demand.

8. P – 8 :

Flood control/ FFWS

To control flood during rainy season has been installed Flood Forecasting and Warning System (FFWS).

9. P – 9 :

Water quality management/ CRP campaign and sedimentation.

The source of pollutant in Brantas river comes from industry, domestic and agriculture. Public campaign to get the same perception of environment protection is very important.

Most of sediment enter into reservoirs is from volcanoes (Mt. Semeru and Mt. Kelud). It is needed excavation by dredger.

10. P – 10 :

Use of water by public. This is the actual condition in the Brantas river . So that, the problem is very complex.

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