COMPREHENSIVE DEVELOPMENT OF THE BRANTAS RIVER BASIN THE REPUBLIC OF INDONESIA

By

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ABSTRACT : The Brantas river is the second largest river in Java Island, Indonesia.The length of the river is about 320 km and catchment area of about 12,000 sq km. Average annual rainfall is about 2,000 mm and annual surface run off is about 12 billion m3 Population in the basin is around 14 million people (1998)

In the past, the problems in the basin were annual floods that suffered the people living in the flood plain and villages, shortage of water availability during dry season caused reduction of food production, inbalance of water allocation among consumers, low water quality and shortage of electricity (hydropower).

Development of the Brantas river basin was started in 1961 . A series of Master Plan had been formulated to overcome the problems in the basin. Basic concept of the development was comprehensive and integrated development, that was **" one river, one plan, one coordinated management"** , because of water is a dynamic resources, that flowing from upstream down to the estuary as an unity. Even though the river was flowing across the boundary of districs, prefectures or countries, it has to be managed as an unity to avoid conflict of interest

Up to year 2000, benefits of the Brantas river basin development were : **Flood control** (protected of about 56,000 ha of land), **Irrigation** (supply water for about 345,000 ha pady field), **Electricity** (producing electricity of about 900 million kWh / year), **Drinking water** (supply raw water of about 200 million m3/year), **Industrial water** (supply raw water of about 120 million m3 / year), **Fishery**, **Recreation**, etc The Brantas river basin has supported around 25 % of national stock of rice. Development of the Brantas river basin has raised up social life prosperity in economy, social and culture within the river basin.

The main problems after project completed were (1) lack of institution responsible to manage finished structures, (2) lack of qualified staffs, because most of project`s staffs moved to another new project and (3) lack of budget to manage river basin

In the case of the Brantas river basin, a state own company (public corporation) was establihed in 1990, to manage the finished structures.The corporation has an authority to collect money from beneficiaries.to cover budget requirement of management activities.

KEYWORDS : Brantas river, river basin, catchment area, master plan, prosperity.

1 BACKGROUND OF THE BRANTAS RIVER BASIN DEVELOPMENT

Since long time ago the Brantas river basin suffered caused by eruption of Mt.Kelud, the active volcano located in the middle reaches of the basin. Mt. Kelud erupted 11 times in the period of year 1811-1990. The volume of erupted material amount to 100-300 million m3 was extruded in one eruption. On the time of eruption, hot mud flow called " primary lahar ", rushed down and destroy everything. Some of " lahar " deposited in the mountain slopes, called " secondary lahar" and flowing down together with rain water to the plain area.and to the mainstream of the Brantas river. Raising up of the Brantas riverbed during 1951 – 1970 was around 1,50 m in on average, caused floods along the Brantas river almost every year.

2 OBJECTIVES OF THE DEVELOPMENT

In general, objectives of the Brantas river basin development is to raise up social life prosperity in economy, social and culture of the society within the basin. Comprehensive development plan has been formulated in the Brantas river basin to control flood, to increase food production, water supply, electricity, etc. .

3 STAGE OF DEVELOPMENT

Based on the development cycle and budget availability, development of the Brantas river was implemented stages, and as long as possible follows of a series of Master Plan as follows : **Master Plan I**- (1961)- priority flood control, **Master Plan II** 1973)- priority food production, **Master Plan III** (1985) – priority water supply for drinking water and industry, **Master Plan IV** (1998) – priority water resources management. The comprehensive development plan is shown in the Figure below.

4 FLOOD CONTROL MANAGEMENT IN THE BRANTAS RIVER BASIN.

Around 1958, when the Brantas river basin was initiated, erupted material produced by the eruption of Mt.Kelud (secondary lahar), caused the riverbed of the Brantas river mainstream and it`s tributaries were heightened. This sediment deposition decreased the river discharge capacity for carrying floods. This incurred flooding almost every year, resulting in personal injury, loss of life, crop damage and loss of asset. Accordingly, flood prevention was given the first priority in the initial stage of the Brantas river basin development. In light of such situation, basic concept for the entire Brantas River Basin Flood Control Plan was **" one river, one plan, one coordinated management "** consists of technical aspects and administartive aspects and was formulated as follows.

Technical Aspects

A **Structures to be constructed**

- Brantas (mainstream) : Karangkates Dam, Lahor Dam,Wlingi Dam
- Konto river (tributary) : Selorejo Dam
- Widas river (tributary : Bening Dam
- Ngrowo river (tributary) : Wonorejo Dam

B **Flood diversion and flood way**

- Flood water in Ngrowo river (tributary of the Brantas river), in the middle reaches of the Brantas river to be diverted to Indonesian Ocean through Tulungagung Drainage Tunnel I + II, with the capacity of 1000 m3 / second.

- Part of the flood water of the Brantas mainstream to be diverted to Indonesian Ocean through diversion tunnel, located at southern part of Blitar city.
- Improvement of Porong river. The main function of Porong river is as flood way to control flood discharge entering Surabaya city area, the second largerst city in the country.

C **Natural retarding basin**

Natural retarding basin in the middle reaches of the Brantas river to be improved for more efficient reduction of flood run off.

D **Riverbed channel**

Riverbed channel of the Brantas river mainstream and it`s tributaries to be improved by excavation (dredging works) to remove sediment and diking system to increase flood discharge capacity

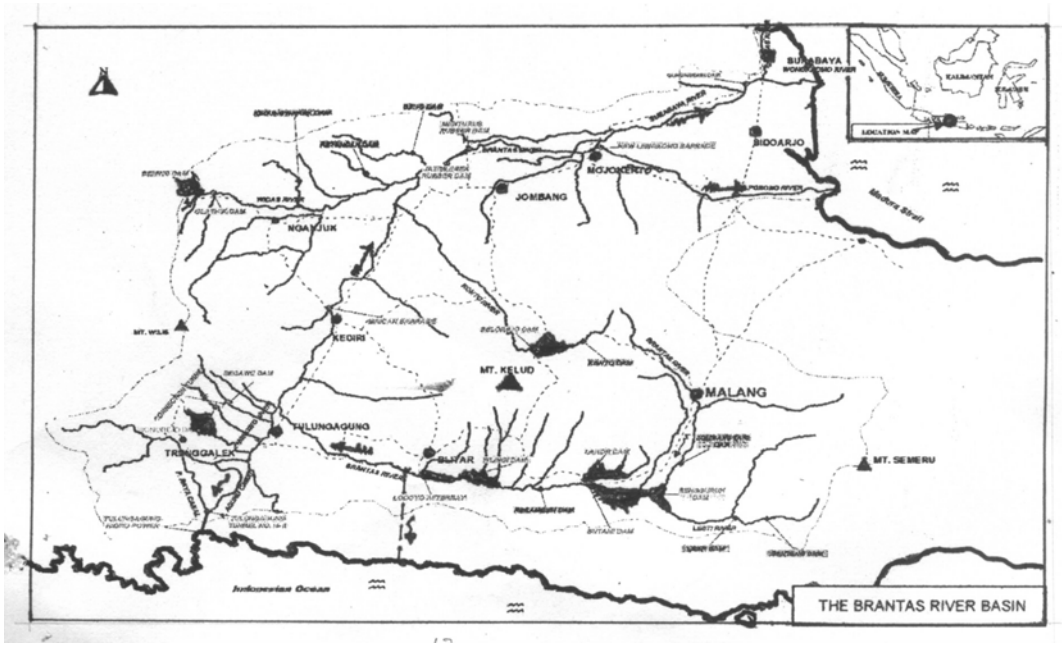

Figure – Comprehensive development plan of the Brantas river basin.

Administrative Aspects

In order to get optimum benefits of the above structures, flood management is very important. The Management has an obligation to manage the structures and has an authority to collect money from the beneficiaries. In case of the Brantas river basin, flood forecasting and warning system (FFWS) has already been installed since the year 1990 to control and allocate flood discharge

5 RIVER BASIN MANAGEMENT

In Indonesia, the problems after project had been completed were lack of institution responsible in managing finished structures , lack of qualified staffs and lack of budget to manage the structures Budget allocation from the Government was very limited and less than standard requirement, caused decresae of function of the structures

For example, there was an irrigation project.. The cost of the project was supported by donor agencies through soft loan. Economic life time of the project was 50 years. The project was designed to irrigate 10,000 ha of irrigation area. In fact after about 5 years completion, because of lack of management, capacity of the project decreased to 5,000 ha. Looking from economic view point, when the project was re-evaluated, probably the benefits will less than the costs. It means the project can be said " the suffer loss project " and the objectives of the development can not be achieved. On the other hand, the borrower (all the people in the country) has an obligation to pay back the loan. As a result the poor country (poor people) will become more poor. This illustration was not rare occurred in many projects. International understanding and cooperation is important to overcome these problems.

The alternatives solution proposed by the author are : (1) Establising of state own company to manage the finished structures. The cost of preparation is included in the project cost, (2) The cost to manage the finished structures is supported by donor agencies (fore instance up to 5 years after project completion). Amount of O&M cost per year is about 1 % of construction cost , (3) Periodical evaluation (every 5 years) of finished structures has to be done to overcome the problems, if any.

In the case of the Brantas river basin, a state own company (Jasa Tirta Public Corporation) had been established in 1990. The Corporation has an obligation to manage the Brantas river basin and has an authority to collect money from beneficiaries (industry, drinking water company and electricity / power company). Farmers are free from obligation to pay contribution.

6 WATER QUANTITY MANAGEMENT

a. Licensing

Taking water from the Brantas river is not allow without licence issued by the Local Government and supported by technical recommendation by Jasa Tirta Public Corporation (PJT).

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

b. Dry Season Operation Rule (OR)

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

Procedure for preparing OR is as follows. In the month of May (for the dry season OR) users submited water demand to PJT. Then by computer simulation and weather forecasting, PJT prepared draft of dry season OR. On the end of May the draft of OR was discussed in the forum of EJPWB and if all parties agreed, then approved by Vice Governor for implementation. If during the monitoring time, there was deviation of prediction to OR or conflict of interest between users, limited members of EJPWB sitting together to solve the problem or to review OR , if needed.

c. **Rainy season Operation Rules (OR)**

Preparation of the rainy season OR is the same procedure as for dry season, Focus of rainy season OR is to control flood, because from average annual disharge of 12 billion m3 surface run off, only about 4.5 billion m3 was utilized. The rest is flowing into the ocean, mostly during rainy season. Management of flood control in the Brantas river basin was done by a State Own Company, namely Jasa Tirta Public Corporation. Water management was operated using equipment Flood Forecasting and Warning System, by time interval of 1 hour, on line.A yearly guide line books were prepared as a guide line of flood forecasting, flood warning and flood fighting.

The guide line book mentioned the critical locations of levee along the river (about 600 km length of l3evees, both sides of river bank), protection methods, numbers of material and equipment available for flood fighting in the warehouse along the river, information of the staff involved (names , addresses, telephone numbers , hierarchy of information to be submitted from the chief of district up to the Governor) , etc.

7 WATER QUALITY MANAGEMENT

Water quality control in the Brantas river (including its tributaries), plays an important role in sustaining the benefits of the development. It should consider the available legal aspect from the 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 to support the Central and Provincial Government. One of the continuous participation of PJT is working out for the water quality monitoring, 50 sampling points, along the Brantas river and in 41 outlets of industrial pollution sources. After that, the samples are tested by PJT's Laboratory. These data are reported to the Local Government of East Java for further action. By using computer simulation, these datas can be used also for preparing a strategic action plan in pollution control abatement program in short, middle and long term period to achieve the river water quality objective.

Based on the study in 1989 , main pollutant source in the Brantas river , came from industrial, domestic and agricultural waste..

In order to reduce pollutant coming from industriy, regulation had been issued by Local Government that all industriy has to install waste water treatment plant (WWTP). Because of type of industries are varies, for small industries (home industries) had difficulties to follow the regulation. Actually , in the field also some large industriy did not operate WWTP continuously.

It was more difficult to control pollutant from domestic waste. The people used river water for many purposes. Because of low income and less education they did not care the environmental protection . It takes some more time to educate them.

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

8 WATERSHED MANAGEMENT

Watershed management played an vital role to minimize sediment entering the reservoirs. Sediment yield in the middle reaches of the Brantas river, mainly result from eruption of an active volcano, namely Mt. Kelud. According to the datas since the year 1000, Mt. Kelud erupted every about 15 to 30 years in on average. Around 100 –200 million m3 of lava flowing out in one eruption, caused raising up the riverbed of the Brantas river The last eruption was in 1990. As a result, Wlingi reservoir located at the middle reaches of the Brantas river was almost fully covered by sediment deposition, coming from southern slopes of Mt. Kelud . In order to settle this problem, a sediment by pass channel in the Putih river was committed. The sabo dams in Konto and Lesti river basins, located in the upstream of the Brantas river, was planned to be rehabilitated or constructed to trap sediment discharge**.**

According to the field investigation , there were 2 dams (Sengguruh and Wlingi) out of 7 dams, suffered from sediment caused by volcanic eruption (Mt. Semeru and Mt. Kelud). To overcome the problem, beside construction of check dams as mentioned in Master Plan, periodical excavation (dredging) have been done by PJT for both dams. Reforestation and regreening are also underway leaded by PJT to control erosion and sedimentation

9 WATER RESOURCES MANAGEMENT

Management system of the Brantas river basin was operated in line with the concept of sustainability. The sustainability should be coordinated and integrated 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 was not just limited to save the resources. It must became the guiding principle for all future planning and development. Future prospect of the entire Brantas river basin would be essential as the key to success in achieving the economic development for East Java Province as well as national economy, in the long run.

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

10 THE RESULTS OF DEVELOPMENT

(1) Flood control (protected of about 56,000 ha of land and to secure up to 50 year return period flood in the mainstream of the Brantas river), **(2) Irrigation** (supply water for about 345,000 ha of pady field),**(3) Electricity** (producing electricity of about 900 million kWh / year),(**4) Drinking water** (supply raw water of about 200 million m3 / year), **(5) Industrial water** (supply raw water for about 120 million m3 / year), **(6) Fishery, (7) Recreation, etc**. Datas of the benefits of structures are as follows.

Table – I Pady (rice) production in the Brantas river basin (ton / ha)

	1965	1970	1980	1990	1993	1999
All Indonesia	3.48	3.95	3.29	4.30	4.38	4.25
Brantas River Basin	3.69	4.55	4.62	5.43	5.67	5.22

Source of data : Statistical Year Book 1971-1999, Central Bureau of Statistic Indonesia

Table – II Performance of the structures in the Brantas river basin

Year	1991	92	93	94	95	96	97	98	99	`00
Irrigation (1.000 ha)	345	345	345	345	345	345	345	345	345	345
Electricity (1000,000 kWh)	324	845	907	828	948	883	554	1023	1014	945
Drinking Water (1,000,000 m^3)	20	138	124	128	144	152	177	199	207	205
Industrial Water (1,000,000 m^3)	23	132	145	127	135	133	134	123	123	125
Flood Control	*)	*)	*)	*)	*)	*)	*)	*)	*)	*)

*) 50 year return period flood can be managed

- Source of data : Yearly Program of Jasa Tirta I Public Corporation (2001)
- The datas shown that up to the present, performance of structures can be sustained.

11 CONCLUSIONS

(1) In order to get optimum benefits, development of river basin likely to be done integrated, looking water resources as an unity from upstream down to the estuary. Basic concept of the development was **" one river, one plan, one coordinated management "**

(2) Management of river basin, after project had been constructed was very important to get benefits of the structures. Many of structures damaged shortly after the project completed, caused by lack of budget for O&M, lack of professional staff and lack of institution responsible to manage the structures. In the Brantas river basin state own company had been established in 1990, to manage the Brantas river basin.

(3) Increasing of agricultural development and economic activity as a result of development , has positive effect to the people living in the basin.

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