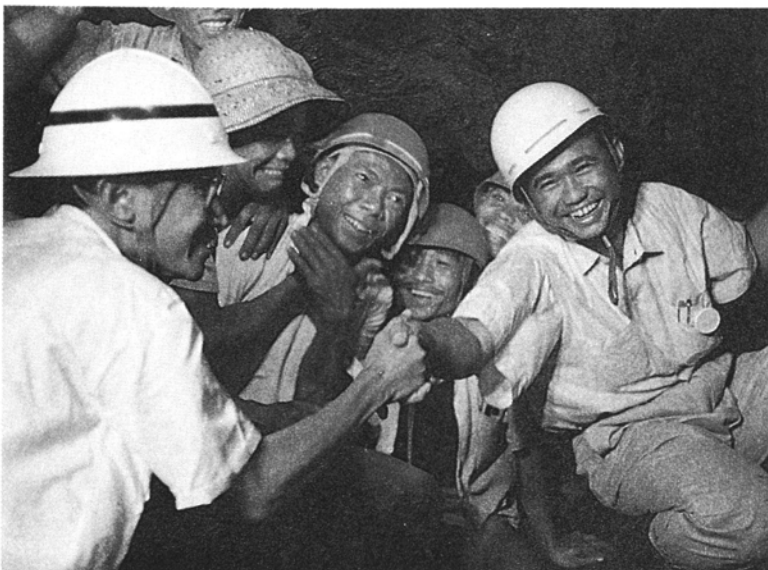


Chapter 2

History of Brantas River Basin Development Project



The first General Manager of the Brantas River Basin Development Executing Office, Mr. Suryono, observing the Karangates Dam site. (1963)



Elated engineers after breaking through the diversion tunnel of Selorejo Dam (1966)

1. Brantas Project Development

(1) Overview

(a) Background

Full scale development of the Brantas River probably began around the late 1840's during the Dutch colonial days. Development in those days covered flood control and water utilization projects such as the construction of Wonokromo Discharge Channel (branching from the Surabaya), Gunungsari Dam, Boezem Regulation Pond (at the mouth of the Mas), and Porong Flood Diversion Channel (branching from the Brantas main stream), Lengkong Dam, and small-scale hydroelectric power stations. Included in these advancements were the development of irrigation facilities and the construction of roads and bridges.



Jagir Water Gate across Wonokromo Discharge Channel

Those flood control and water facilities built under the Dutch Administration were totally handed over. But they were found dilapidated in the late 1950's. This poor state of repair was partly caused by a lack of maintenance due to the shortage of funds, resulting from Indonesia's financial problems following its independence, and partly because of the great floods that hit the basin in 1954 and 1955.

After attaining independence the Indonesian government directed strenuous efforts, as a state objective, toward the development of electricity which in turn would reinforce food

production and industrialization. They laid out a development plan in 1959 for the Citarum River (basin area of 5,970 km²) running to the East of Jakarta in West Java and had already initiated the Jatiluhur Multi-purpose Dam Project (completed in 1964). Following these projects, their next goal was the development of the Brantas River, with its abundant water power potential, running through the key granary of Java. It was around 1957 that the government embarked on the project (Nejama Diversion Tunnel) of reclaiming the marsh in the middle reaches of the Ngrowo, a Brantas tributary, independent of outside assistance. The tunnel was completed with Japan's assistance, the process of which will be described later.

The government had also started on the survey, single-handedly, for the planned flood control dam at Pohgajih on the upper reaches of the Brantas main stream. Excerpts from the survey report completed by local specialists are included in the following:

The point of Pohgajih was initially considered as the prospective dam site, which is right downstream of the junction of the Lahor and the Brantas, located 3 km downstream of the current Karangates Dam. The feasibility study for the dam site was conducted at Pohgajih on June 20, 1956 at the request of the Doctor of Engineering Ir. Agus Prawiranata (the then Director General of the Directorate of Water Resources, Ministry of Public Works) The greatest authority, at that time, on dams in Indonesia, Doctor of Engineering Sedijatmo (the then Director General of the Directorate of Energy, Ministry of Public Works & Energy) headed the survey team consisting of four specialists on water supply and construction. The reported results were as follows:

- 1) A trunk road is in close proximity to the site, providing good access for the transport of construction materials and equipment.
- 2) The site meets the minimum height requirements for dam construction of 100 m, to secure the required storage capacity.
- 3) Although the foundation of the site is made of porous limestone, the fine pores would become blocked with the sediment carried down river, thus not making leakage a big problem. This is a critical issue for the construction, so we have made a request for geological inspection.
- 4) Concrete, a material still under development, poses the problem of deterioration over time while earth material is suited to dam structure.
- 5) The planned dam is intended exclusively for flood control since the potential generating capacity of 20,000 kW would be less feasible.

Furthermore, the report mentioned the flow rate of the Brantas and advised establishing flow gauging stations.

Later this work was succeeded by Japanese consultant, and Karangates, farther up the river, was eventually selected as the site since the foundation earth at Pohgajih turned out to be inappropriate for a high dam. It is interesting to see from the process described above how very enthusiastic the Public Works Ministry of that era was about flood control measures for the Brantas.

(b) Implementation of development

Although a French consultant company wished to join the Brantas Project, Nippon Koei was awarded a majority of the projects after their involvement in the South Tulungagung Drainage Project.

The Brantas River Basin Development Project was launched with flood control and water use development as their major goals, followed by agricultural development, river improvement, volcanic disaster prevention work, urban development, and other various development projects step-by-step. The master plan was subjected to review about once every decade in response to situational changes in the basin along with the progress of the project development to satisfy regional needs. The Brantas Project can be divided into the following three development phases:

- Phase I: The South Tulungagung Drainage Plan and its construction work was initiated in 1958 through means of the Japanese government's war reparations. Emphasis was placed on the construction of large-scale dams on the upper reaches and the provision of flood control measures on the lower ones, based on the first master plan of 1962 that focused on the development of the Brantas main stream.
- Phase II: Before the implementation of subsequent projects, the Overseas Technical Cooperation Agency (OTCA) formulated the second master plan in 1972 under the basic policy of the continuation and expansion of previous phases. The plan focussed on the construction of multi-purpose dams on the upper reaches, which was part of the Brantas main stream comprehensive development; and flood control measures and agricultural development on the middle reaches the Brantas main stream.
- Phase III: The Japan International Cooperation Agency (JICA) elaborated the third master plan in 1985 aimed at the balanced development of the entire basin with stress placed on the development of tributaries area.

Each development plan was carried out by fund cooperation including yen loans. For the purpose of sustaining and expanding the effects of these projects, the Overseas Economic Cooperation Fund (OECF) conducted post evaluation surveys in 1987 and 1992.

Along with the Brantas Project, an agent other than the Brantas River Basin Development Executing Office drew up the Surabaya urban development plan in 1982, which lead to the acceleration of urban area development.

As of 1995, projects under way in the Brantas Basin included construction of the Wonorejo Dam across the Ngrowo (scheduled for 1995-99), an urban drainage project as part of Surabaya urban development; and road network development. (See Appendix 3 Reference Materials - List of work schedules for projects.)

As shown in Table 2-1, there were a total 21 projects executed under the Brantas Project through foreign assistance, including that from Japan. Aid ranged from Japan's reparations, yen loans, and grants (by OTCA, OECF, and JICA) as well as loans by ADB (Asian Development Bank) and IBRD (International Bank for Reconstruction and Development, more generally called the World Bank), including other bilateral assistance.

Table 2-1 Projects by assistance source (1995)

(Brantas Basin excluding Surabaya City)

| | Source | Number of projects | Total assistance (x ¥10 ⁶) | Remarks |
|------------------|-------------|--------------------|--|--|
| Japan | Reparations | 3 | 8,874 | South Tulungagung Drainage Project: 710 x ¥10 ⁶ Karangkates, Selorejo Dams (initial phase): 8,164 x ¥10 ⁶ |
| | JICA | 5 | 600* | 2nd, 3rd master plans |
| | OECF | 14 | 66,190 | Assistance by loan |
| Other than Japan | ADB | 3 | 11,202 | Assistance by loan |
| | IBRD | 1 | 790 | Assistance by loan |
| | Others | 2 | 16,018 | Assistance by loan and/or grant |
| | Total | 26 (21) | 103,674 (103,074) | |

- Remarks: 1) OTCA: Overseas Technical Cooperation Agency, JICA: Japan International Cooperation Agency, OECF: Overseas Economic Cooperation Fund, ADB: Asian Development Bank, IBRD: International Bank for Reconstruction and Development (World Bank)
 2) The number of projects was calculated by assistance source and since some projects relied on multiple sources, a discrepancy resulted in the actual total number.
 3) The parenthesized totals are those excluding master plans.
 4) The asterisked figure represents a rough estimate.
 5) Groundwater surveys are not included, because they covered not only the Brantas Basin, but the entire island of East Java.

The major Japanese consultant companies involved in the Brantas Project were: Nippon Koei, Co. Ltd. which was involved in most of the survey, planning, and design work of the basin's development; Nikken Consultants Inc. which undertook the urban river improvement project; and Pacific Consultants International in charge of establishing

Surabaya's urban development plan. Canadian and French consultants had partial involvement. Kajima Corporation was a major force in offering construction guidance on the projects run by the Indonesian government. Engineers from many manufacturers were engaged in the fabrication of hydraulic turbine generators, high pressure gates, penstocks, etc.

(2) Phase I Development

(a) Nejama Diversion Tunnel

The Nejama Diversion Tunnel (official name: South Tulungagung Drainage) Project was the first project funded through economic cooperation between Indonesia and Japan. Nippon Koei entered into a consulting contract for the Nejama Diversion Tunnel project with Indonesia and that seven specialists in the fields of geology, civil, and river engineering left for the site as the first team.

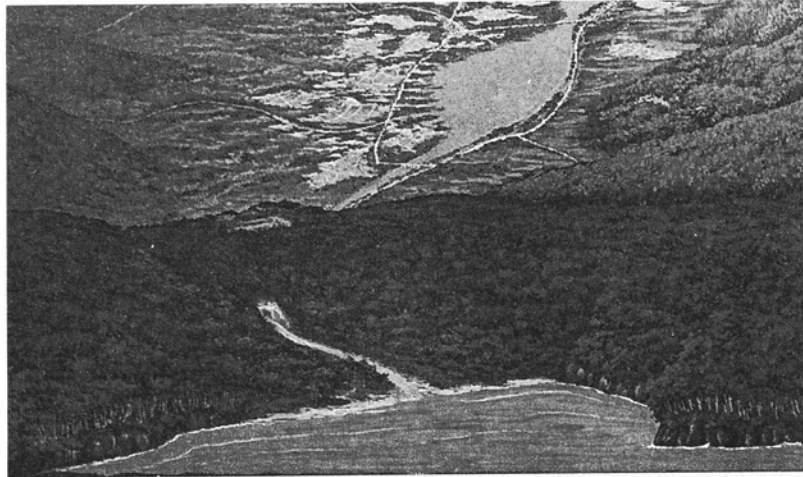
In those days the 3,000 ha marsh in the Ngrowo middle reaches used to increase in size in the rainy season, stretching up to 28,000 ha. The Consultant presented a proposal to the Indonesian government to construct a tunnel (7.2 m in dia. x 1,000 m in length) in the mountainous area to the South of the Ngrowo River for draining the marsh. This was intended to allow the flood waters that flowed into the marsh from the Ngrowo to be discharged directly into the Indian Ocean rather than allowing it to run into the Brantas. Following the government's immediate acceptance, the Consultant undertook the survey and design for this South Tulungagung Drainage Project and Kajima Corporation commenced construction work in 1959 as the contractor. The Consultant was also responsible for supervising the construction. The now well-known Nejama Diversion Tunnel was thus finished in 1961.



The marsh (top, 1959) turned into fertile farming land (bottom, 1993), as a result of Nejama Diversion Tunnel



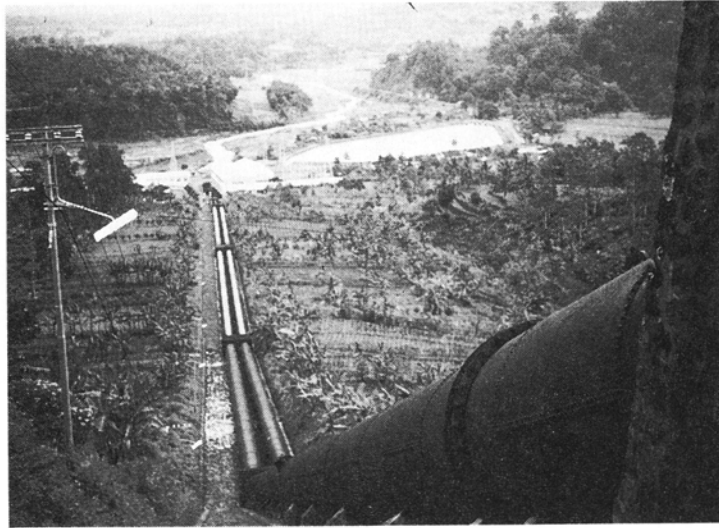
Inlet of Nejama Diversion Tunnel



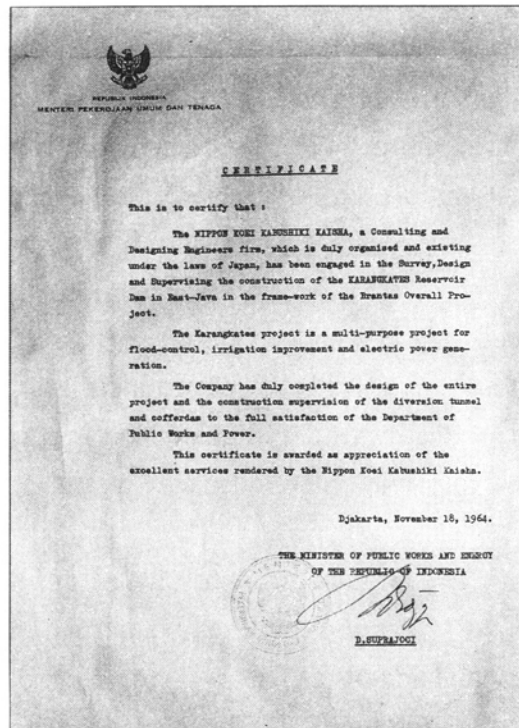
Panoramic view of Nejama Diversion Tunnel Project

Memorial picture postcard for the completion of Nejama Diversion Tunnel

There is a long story about the Nejama Diversion Tunnel dating back to Japan's occupation during WWII. There is a record (but the details are unknown) that the Japanese army developed, executed, and completed the marsh drainage plan through a diversion tunnel at that time. However since it remained a hand dug tunnel and lacked maintenance and repair for many years, the finished tunnel collapsed over the course of time and ended up being buried, leaving only part of the mucking tunnel behind, which was subsequently used in the present construction. In 1956 the Indonesian government worked out and implemented the tunnel plan in the form of an open channel, producing a tremendous amount of excavated earth. Since there was a shortage of earth moving equipment, and what they had was old and poorly operated, they had no choice but to rely on manual-oriented excavation. This method considerably delayed the work schedule, requiring an extended period of some odd ten years until completion. The Consultant immediately started on the survey and decided that a tunnel, not a channel, was the best suited solution for handling the marsh drainage, and the project was at last realized through Japan's reparations. One of Japan's national newspapers (*Asahi Shimbun*) ran the story under the title of "Successful Reparations Work in Indonesia" dated August 31, 1960. It said that the tunnel heading was penetrated on August 3, 1960; then the lining was begun using concrete; and that the project was scheduled for completion in March 1961. It also added that the price of land in Indonesia's most productive rice-growing region tripled.



Mendalan Power Station of Dutch era construction



Certificate of completion for Karangates Dam issued by the Minister of Public Works

The Nejama Diversion Tunnel brought about great effects. After its completion floods rarely occurred in the 28,000 ha where it was not possible to grow rice before, and the 3,000 ha marsh was now reduced by half. The proceeds from farming products

increased by US\$2 million the year after completion, which meant that the construction cost of US\$2 million could be repaid in one year. Further, unlike the pre-tunnel days, malaria hardly ever broke out in the region, greatly increasing the quality of residents' lives.

High officials of the Indonesian government were very impressed with the level of technology used on the Nejama Diversion Tunnel Project. It can be said that the philosophy, one plan for one river, was the driving force in naturally and efficiently pursuing subsequent Brantas projects.

(b) Implementation of priority projects

Along with the South Tulungagung Drainage Project, Nippon Koei was commissioned, in October 1958, to prepare a plan for comprehensive development of the Brantas River Basin. Upon this request, the Consultant recognized the following issues as those needing to be addressed at that time in the Brantas Basin:

- 1) Ejecta from Mt. Kelud's eruptions had accumulated as sediment in the Brantas main stream raising the riverbed level, thus lowering the ability of flood runoff and increasing the danger of flood occurrence.
- 2) Irrigation and water utilization facilities are now old, which makes it difficult to appropriately distribute irrigation water.
- 3) The increase in agricultural yield (due to irrigation) and the construction of hydroelectric power stations are to be promoted under government established policies.

The Consultant prepared interim reports of the survey in October 1959 and September 1960 and had repeated consultations with the government prior to submitting the first master plan for development to the Ministry of Public Works in April 1961. After this, the six projects listed below were implemented as those with highest priority:

- 1) Karangates Dam: The Brantas droughty water discharge was nearly 100% utilized and its flood protection facilities were near satisfaction. But further expansion of arable land and the efficient enhancement of safety factors for flood control necessitated a large multi-purpose dam across the Brantas main stream. For this purpose, the Karangates Multi-purpose Dam Project was planned and executed on the upper reaches.
- 2) Selorejo Dam: The Konto, a branch of the Brantas, has a plentiful water volume and a steep bed slope, providing good conditions for the run-of-river type power station that was built in the Dutch era and equipped with a 29,000 kW regulation pond. Irrigation is also provided for the Konto lower reaches and the area

stretching over 30,000 ha to the right bank of its junction with the main stream. The Selorejo multi-purpose dam was constructed upstream of the existing power station with the aim of power generation, flood protection, and supplemental irrigation water supply.

- 3) New Lengkong Dam (reconstruction of the old Lengkong Dam): Located at the point where the Surabaya branches off the Brantas. Since the water gate facilities of the Lengkong Dam were old, it was difficult to safely direct the flood waters from the Brantas into the Porong, or to adjust water levels for a secured supplemental supply of irrigation water to the delta. The New Lengkong Dam was constructed to solve these problems.
- 4) River improvement project: This was carried out to provide increased flood control safety on the Porong, which serves as a flood diversion channel.
- 5) Restoration work of irrigation canals: This was performed in the Sidoarjo Delta, having the largest irrigation area in the basin.
- 6) Mt. Kelud debris control project: The construction of checkdams was started on the mountainsides of Mt. Kelud. This project is to be continued as long as there are people living in the basin.

(3) Phase II Development

After the period of confusion in Indonesia subsequent to the 1965 coup d'état, development of the Brantas Basin was pushed forward more actively based on the first 5-year development plan established in 1969.

The 1966 eruption of Mt. Kelud fortunately resulted in only slight personal damages, but produced about 90,000,000 m³ of ejecta which caused the river bed to rise again. In the ten years after the first master plan was developed the basin situation was continuously undergoing change.

In the early 1970's, several years after the founding of the Brantas Office in 1965, the Office was gaining more experience in project implementation and was strengthening its structure with staff reinforcement. With the dams of Karangates and Selorejo successfully completed, the Office has now gained confidence in construction techniques and owned a considerable amount of construction equipment. Against this backdrop, the Office had strong intentions to embark on the next project, which led to their own survey, design, and construction of large-scale checkdams such as Tokol and Mendalan and the Sengguruh Dam project (where Nippon Koei came on board later as a consultant). Also after seeing the two completed dams, basin residents' expectations for further development

grew. It is our understanding that the Brantas Office and Nippon Koei gained increased mutual trust and confidence through the process of the Phase I Development.

Contributing to the establishment of friendship between Indonesia and Japan and recognizing anew the significance that the Brantas Project had on producing remarkable economic cooperation effects, the Japanese government had OTCA (Overseas Technical Cooperation Agency) send the Brantas Basin development survey team in 1971 and 1972. The team, under the basic principle of continuing the priority projects of the first master plan, conducted various activities: the collection of materials on the current situation of hydrology, floods, volcanic disaster prevention, and water utilization; the understanding of the current status of agriculture and irrigation; and surveys of the flood damage situation, hydroelectric power development points, etc. Based on the survey results, the following represents the basic concept for the second master plan worked out in consideration of the principles presented by the Indonesian government in the first 5-year development plan:

- 1) The total arable land area is 730,000 ha, accounting for 60% of the basin area. No further large-scale development of farming land is desirable from the viewpoint of volcanic prevention control, soil conservation, and water resource development and conservation.
- 2) The basin population density is high at 850 people/km² and farm villages have surplus labor. An increase in agricultural unit yield is to be continuously aimed at for stabilized economy of farming households until such time as when industry has reached a level of development that can absorb these latent unemployed.
- 3) Mount Kelud eruptions have caused a large amount of ejecta to flow out into the river channel, which raised the level of the river bed leading to a remarkable reduction in flood discharge capacity. Flood control measures are to be examined from comprehensive viewpoints such as debris control, flood control using dam reservoirs, build-up of embankments, and an increase in channel sections.

The second master plan was formed in May 1973 aimed at more active development of the Brantas Basin. It dealt with many projects related to hydroelectric power development including Wlingi Multi-purpose Dam, Lodoyo Irrigation, Middle Reaches River Improvement for enhanced safety of flood control, and others.

(4) Phase III Development

The fourth 5-year development plan was launched in April 1984 and the following year, 1985, saw the accomplishment of self-sufficient rice production, a long hoped for objective

of Indonesia. With the economy improving after the slow down of the early 1980's, exports began to increase steadily and per capita national income exceeded US\$500, boosting Indonesia to a middle income country. Along with the improvement of living standards, the call for environmental development was rising.

In the Brantas Basin, thanks to Phase I and II developments, the flood control safety in the Brantas main stream was enhanced with a resulting sharp drop in flood damage. The economy, including Surabaya City, achieved remarkable growth. This was realized against the backdrop of a considerable increase in unit yields of agricultural products resulting from various factors including secured irrigation water in the dry season, developed water supply systems, and assured industrial and domestic water supplies.

Both Phase I and II developments were mainly intended for and resulted in the overall development of the Brantas main stream. Tributary development, on the other hand, was limited to projects that were expected to bring especially great economic effects. The flood protection measures indeed enhanced the flood control safety in the main stream as mentioned earlier whereas many tributaries remained exposed to the danger of flooding. Naturally the residents in such tributary basins began to demand the enhancement of flood control safety up to the same level as that of the main stream. In addition, the progress of basin development, along with social and economic growth were creating new problems, which are listed below:

- 1) In Surabaya and surrounding areas, population is growing at a remarkable rate with the advance of industrialization, consequently increasing the demand for industrial and domestic water. The Brantas droughty water discharge is however almost depleted.
- 2) The quality of tap water is deteriorating.
- 3) Basin development has brought about an increase in basin assets, from which more possible flood damage is expected. Especially due to the low flood control safety of the tributaries.
- 4) For structures within the basin including dams, reservoirs, canals, and improved river channels, comprehensive management and maintenance are required in view of the effects of Mt. Kelud eruptions.
- 5) Water management is now under the supervision of multiple bodies, the establishment of an integrated management system for the entire basin is preferred.

Toward the end of the Phase II Development, JICA (Japan International Cooperation Agency) embarked on the formulation of the third master plan in June 1984. The surveys in connection with it were carried out on two occasions as described below:

The first survey (June 1984): With the purpose of preparing the third master plan for the basin development up to the year of 2000. The survey covered a wide range from the formulation of basin development plans anticipating expected future growth of Surabaya City, through surveys for flood damage to tributaries and water management systems of the basin, including environmental assessment.

The second survey (March 1985): This produced plans for flood protection, dam and irrigation development for the Widas River, a Brantas branch, which was given high priority as a result of the first survey.

The reports of the above surveys were prepared in July 1985 and March 1986 respectively.

Phase III Development was marked by the construction of Bening Dam and Wonorejo Multi-purpose Dam (currently under construction), Widas River improvement project, and Lesti debris control project that was part of basin management.

(5) Sustaining and expanding project effects

The Brantas Project, now 30 years after its inception, has made great contributions in the social and economic sectors at the basin, regional, and state levels. Not only direct, but indirect and far-reaching benefits deserve attention: The total population of the Brantas Basin including Surabaya City was 13,500,000 as of 1993, 1.6 times that in 1960 at the time of the project's initiation. The basin has undergone substantial changes due to developed and enhanced irrigation facilities, and the industrialized urban area of Surabaya enjoys about three times as much industrial output as it did in 1960. In the meantime, there has been an increasing need for appropriate maintenance of already established facilities.

The droughty water discharge of the Brantas River has already been distributed to existing water demands, leaving no surplus for future needs. Accordingly the shortage of water to newly created demands has been a concern for quite some time. This situation has required further approaches to more efficient use of the limited water resources within the basin, and towards this purpose Nippon Koei was commissioned by OECF (Overseas Economic Cooperation Fund) to conduct surveys in 1987 and 1992. Those survey results are summarized below:

- 1) For the current needs, the operating system of the Karangates reservoir, having the largest capacity in the basin, is to be reviewed to create surplus water;
- 2) For future demands, many multi-purpose dams, small and medium scale, are to be constructed across tributaries. This would be more cost effective from the viewpoints of flood control and water utilization;

- 3) Pumped storage power stations are to be constructed on appropriate, existing sites in the Brantas Basin. Peak power supply through economical hydroelectric power generation is to be provided to meet future power demands; and
- 4) A legal system is to be established and a public water management company founded (the Public Water Management Corporation was founded in Feb. 1990) for sustainable and furthered effects of projects executed.

The major targets of the sixth 5-year development plan which started in April 1994 were the promotion of industrialization and the stabilization and enhancement of public welfare. This will also require the Brantas Project to employ more detailed, advanced technologies in the future. The Indonesian government has the intention of implementing their project plans with foreign technical assistance. Especially the Brantas Project, since it has been so successful, is considered a good example for developing countries' comprehensive river development at home and abroad. It is hoped that foreign assistance, technical and economic, will be continuously rendered to the Project.