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Yayasan Air Adhi Eka



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River Management in Indonesia
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Director General of Water Resources

Foreword



Water, as a renewable resource, is a gift from God for all mankind. Water is a necessity of life for creatures in this world. No water, no life. The existence of water, other than according to the hydrological cycle, at a particular place, at a particular time, and in particular quality as well as quantity is greatly influenced by a variety of natural phenomena and also by human behavior. Properly managed water and its resources will provide sustainable benefits for life. However, on the other hand, water can also lead to disasters, when it is not managed wisely. Therefore, it is highly necessary to conduct comprehensive and integrated water resources management efforts, or widely known as “Integrated Water Resources Management”.

In the same way, river management efforts as part of the river basin integrated water resources management, include efforts on river utilization, development, protection, conservation and control, in an integrated river basin with cross-jurisdiction, cross-regional and cross-sectoral approach.

This book outlines how water resources development and management in several river basins are carried out from time to time according to the existing situations and conditions. Besides, it covers various challenges and obstacles faced by the policy makers and the implementers in the field. The existing sets of laws and regulations and the various uses and benefits are also discussed. Therefore, this book is able to describe the experience and understanding of river management, so as to enhance our appreciation and wisdom in treating and managing water resources as well as in conducting better river management in the future.

We would like to express our gratitude and appreciation to. Ir. Suyono Sosrodarsono, Dr.h.c.(Delft) who has taken initiative in writing this book, and also to Mr. Hisaya SAWANO from Japan International Cooperation Agency (JICA), as well as our seniors in Yayasan Air Adhi Eka for their support in completing the writing of this book.

We hope this book on River Management in Indonesia may bring benefits to all of us.

Dr. Ir. Mohamad Hasan, Dipl.HE



Chairman, Board of Trustees of Yayasan Air Adhi Eka



Foreword

As we all know, water is an indispensable requirement for the survival of living beings (humans, fauna and flora) in this world. There is not one living creature in this world that can live without water, though the requirement of water for each living thing is not the same in the same unit of time.

A river is a natural water body or resource in the form of drainage network along with the water in it, from upstream to the estuary, with banks on its right and left sides.

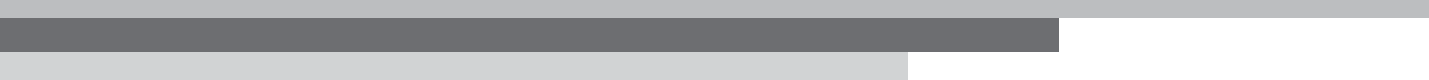
River management is a part of a river basin-based comprehensive and integrated water resources management. A river's condition is especially influenced by the condition of the watershed at its upstream area. Therefore, efforts to improve the upper watershed should be given serious attention by river managers.

This book is written as the result of the cooperation among the Directorate General of Water Resources, Japan International Cooperation Agency (JICA) and Yayasan Air Adhi Eka, and is one of the realizations of the Memorandum of Understanding among the Directorate General of Water Resources, Japan International Cooperation Agency (JICA) and Yayasan Air Adhi Eka. It is the hope of the writers that this book will provide information to people interested in river management.

On this occasion, I would like to express my gratitude and appreciation to DR. Ir. Mohammad Hasan, Dipl.HE for his support and also to Mr. Hisaya SAWANO from Japan International Cooperation Agency (JICA) for his support, as well as to the authors from Yayasan Air ADHI EKA, and resource persons from River Basin Working Unit (Balai Besar Wilayah Sungai).

May this book on River Management in Indonesia will be beneficial as information material for river managers.

Ir. Suyono Sosrodarsono, Dr. h.c. (Delft)





Japan International Cooperation Agency

Foreword



Since water is a fundamental resource for socio-economic development, people seek for the place where the water is available and most case it is in the flood plain. On the other hand, living in the flood plain to utilize water resources means that people also should accept the risk of disasters. Too much water causes flood and debris flow that threaten the human's life and property, while shortage of water causes draught, which affects human activities that depend on the anticipated water. Therefore people try to work on rivers to reduce the risk caused by natural hazard and develop strategies to live with residual risk.

Japan International Cooperation Agency (JICA) has been supporting the efforts made by the Government of Indonesia in managing rivers and river basins through Japanese Official Development Assistance (ODA). Assistance from Japan in the water resources management sector by ODA started from 1962 when the first Japanese Experts dispatched to Indonesia. Since then it continues in a form of Technical Cooperation, ODA Loan and Grant Aid to formulate and implement strategies for the water resources management, water related disaster management and capacity development, which also creates firm foundation of cooperation between Indonesia and Japan.

Accumulated knowledge and experiences concerning river and its management are valuable assets for the practice in the field, which improve the efficiency of administration, promote the understanding of stakeholders and facilitate public participation; therefore they should be transmitted, disseminated and appreciated. In this regard, this book provides precious opportunities not only for the officers in charge but also for all the people concerned to acquaint themselves with the activities and achievement of river management.

Finally I would express my sincere appreciation for the efforts in compiling this book made by Yayasan Air Adhi Eka and Ministry of Public Works, Indonesia. I believe this book will contribute to the further development of river and river basin management in Indonesia.

A handwritten signature in black ink, which appears to read 'Motofumi Kohara'. The signature is fluid and cursive, written over a light blue background.

Motofumi Kohara
Chief Representative, JICA Indonesia Office

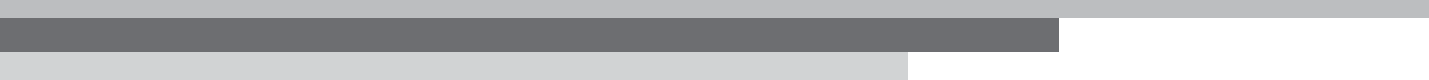


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I. INTRODUCTION

1.1. General

Water is a primal requirement of every creature, including human beings. Therefore, the history and development of water resources management in general and river management in particular, have actually started and grown along with the existence and development of culture and civilization of human beings. Historical heritage in the form of remains of buildings, inscriptions and writings related to the issue of river and water resources management have been found at various places in this world.

The Harinjing Inscriptions in Kediri recorded the construction of river diversion and dam to overcome the lava of Mount Kelud. They are the oldest inscriptions regarding water resource management.

The front part is called the Harinjing A Inscription, which mentions that on the eleventh day of Shukla Paksha of Chaitra in Saka 726 or 25 March 804 AD, the priests in Culangi had obtained the *sima* (protected land) right over their area from king because of their service in making a river diversion called Harinjing.

The rear part, Harinjing B Inscription, line 1 to 23 mention that Sri Maharaja Rake Layang Dyah Tulodhong, on the fifteenth day of Shukla Paksha of Asuji in Saka 843 or 19 September 921 AD, acknowledged the rights of the priests in Culangi since they were still required to maintain the Harinjing channel.

The next line, which is called the Harinjing C Inscription, mentions that a similar right was also acknowledged on the first day of Shukla Paksha of Chaitrain Saka 849 or 7 March 927 AD.



Other inscription are for example, the Kamalagean (1037) in Kediri, which tells about the construction of Wringin Sapta dam to protect sacred buildings such as temples, residential areas and rice fields in the surrounding area from the threat of flooding and lahar flooding from Brantas River, as well as the utilization of river water to irrigate rice fields. It also tells about the improvement of Brantas River's estuary for shipping purposes.

Figure 1: Kamalagean Inscription

The Kraton Taman Sari (Water Castle), built in 1758 within the area of Kraton Yogyakarta, served as a bathhouse for royal princesses and until today its waterworks still look intact.

In 1905, the construction of sand pockets in Badak River (known as "Kelud Zak") was started to hold the lahar flow or volcanic debris flow from Mount Kelud. The tunnel for draining the water of Mount Kelud's crater was built in 1919.

Meanwhile, to overcome the flooding caused by the overflowing of Ciliwung River in Jakarta, the West Flood Canal was started to built in 1918.

In 1919, the Cileunca Dam was built in Cisangkuy River, in the Citarum River Basin. The dam was built for the hydroelectric power (PLTA), drinking water for the city of Bandung, irrigation and tourism.

The construction of water resources continues and grows along with the development of human culture and civilization, including the development of demands and the development of technology in various fields.

1.2. Rivers in Indonesia

The Republic of Indonesia Government Regulation (PP) Number 38 of 2011 regarding Rivers defines river as a natural and/or artificial waterway or watercourse in the form of water drainage network from upstream to estuary, and it is limited its right and left sides by demarcation lines.

Furthermore, “river functions” are the benefits brought by the existence of a river for:

- Human life, such as the benefits from the existence of a river as water provider and water container to meet the requirements for households, environmental sanitation, agriculture, industries, tourism, sports, defense, fisheries, power plants, transportation, and other requirements;
- Natural life, such as the benefits from the existence of a river in restoring water quality, flood channel, and as the main provider of flora and fauna ecosystems.

River management includes several activities, namely:

- River conservation;
- River development; and
- Control of the destructive power of river water

Table 1: Number of River Basins and Watersheds

No	Regulation of Minister of Public Works		Regulation of Minister of Public Works Number 11A of 2006		Presidential Decree Number 12 of 2012	
	Total River Basins	Total Watersheds	River Basin Classification	Total River Basins	Total River Basins	Total Watersheds
1	90	668	Cross-country	5	5	304
2			Cross-provincial	27	29	859
3			National Strategic	37	29	3,137
4			Cross-Regency/ Municipal	51	53	3,168
5			Within One Regency/ Municipality	13	15	504
	90	668	TOTAL	133	131	7,972

Based on the Regulation of Minister of Public Works Number 11A/PRT/M/2006, there are five classifications of river basin with a total of 133 river basins and 850 watersheds as seen in Table 1 above. However, there have been expansions of regency/municipal and provincial areas, causing several rivers, which were previously within one province, regency/municipality, to become rivers that cross several provinces or regency/municipalities. In accordance with this condition, the Presidential Decree Number 12/2012 was issued in order to rearrange the classification of River Basin as seen in Table 1 above.

Based on the results of river inventory survey carried out in 1990, there are not less than 5,187 main or first order rivers and there are more than 66,028 tributaries ranging from the second order to fifth order.

Table 2: Large River Basin Organizations (Balai Besar Wilayah Sungai/BBWS)

NO.	TYPE	NAME OF ORGANIZATION	LOCATION	WORK AREA
1	A	BBWS Brantas	Surabaya	Brantas River Basin
2	A	BBWS B. Solo	Surakarta	Bengawan Solo River Basin
3	A	BBWS Pemali-Juana	Semarang	Pemali-Comal River Basin and Jratunseluna River Basin
4	A	BBWS Serayu-Opak	Yogyakarta	Serayu-Bogowonto River Basin and Progo-Opak River Basin
5	A	BBWS Cimanuk-Cisanggarung	Cirebon	Cimanuk-Cisanggarung River Basin
6	A	BBWS Pompengan-Jeneberang	Makasar	Pompengan-Larona River Basin, Sadang River Basin, Walanae-Cenranae River Basin and Jeneberang River Basin
7	A	BBWS Citarum	Bandung	Citarum River Basin
8	A	BBWS Mesuji-Sekampung	Bandar Lampung	Mesuji-Tulang Bawang River Basin and Way Seputih-Way Sekampung River Basin
9	A	BBWS Sumatera VIII	Palembang	Musi River Basin, Sugihan River Basin, Banyuasin River Basin
10	B	BBWS Citanduy	Banjar	Citanduy River Basin
11	B	BBWS Ciliwung-Cisadane	Jakarta	Ciliwung-Cisadane River Basin and Kepulauan Seribu River Basin
12	B	BBWS Cidanau-Ciujung-Cidurian	Serang	Cidanau-Ciujung-Cidurian River Basin

The Regulation of Minister of Public Works Number 23/PRT/M/2008 in conjunction with Regulation of Minister of Public Works Number 12 and 13/PRT/M/2006 stipulates that cross-country, cross-provincial and national strategic river basins are managed by the Central Government. Meanwhile, cross-regency/municipal river basins are managed by provincial governments and river basins within one regency/municipality are managed by regency/municipal governments.

The management of river basins which are under the authority of the Central Government is carried out by 12 Large River Basin Organizations or *Balai Besar Wilayah Sungai* (BBWS) and 19 River Basin Organizations or *Balai Wilayah Sungai* (BWS), as seen in Table 2 and Table 3. Large River Basin Organizations consist of two types, which are Type A, with a total of 9 organizations, and Type B, with a total of 3 organizations. River Basin Organizations consist of 11 type-A organizations and 8 type-B organizations. The difference of Type A and Type B is shown in Table 4.

Table 3: River Basin Organizations (Balai Wilayah Sungai/BWS)

NO.	TYPE	NAME OF ORGANIZATION	LOCATION	WORK AREA
1	A	BWS Sumatera I	Banda Aceh	WS Meureudu-Baro River Basin, Woyla-Seunagan River Basin, Alas-Singkil River Basin
2	A	BWS Sumatera II	Medan	Belawan-Ular-Pandang River Basin, Toba-Asahan River Basin, Batang Angkola-Batang Gadis River Basin, Batang Natal River Basin

NO.	TYPE	NAME OF ORGANIZATION	LOCATION	WORK AREA
3	A	BWS Sumatera III	Pekanbaru	Rokan River Basin, Siak River Basin, Kampar River Basin, Indragiri River Basin
4	A	BWS Sumatera V	Padang	Anai-Kuranji-Arau-Mangau-Antokan River Basin
5	A	BWS Sumatera VI	Jambi	Batanghari River Basin
6	A	BWS Sumatera VII	Bengkulu	Majunto-Sebelat River Basin
7	A	BWS Bali-Penida	Denpasar	Bali-Penida River Basin
8	A	BWS Nusa Tenggara I	Mataram	P Lombok River Basin
9	A	BWS Kalimantan II	Kuala Kapuas	Seruyan River Basin, Kahayan River Basin, Barito-Kapuas River Basin
10	A	BWS Kalimantan III	Samarinda	Sesayap River Basin, Mahakam River Basin
11	A	BWS Sulawesi III	Palu	Palu-Lariang River Basin, Parigo-Poso River Basin, Laa-Tambalako River Basin, Kaluku-Karama River Basin
12	B	BWS Sumatera IV	Batam	P Batam-P Bintan River Basin
13	B	BWS Nusa Tenggara II	Kupang	Aesesa River Basin, Benanain River Basin, Neo-Mina River Basin
14	B	BWS Kalimantan I	Pontianak	Kapuas River Basin, Pawan River Basin, Jelai-Kendawangan River Basin
15	B	BWS Sulawesi I	Manado	Sangihe-Talaud River Basin, Tondano-Likupang-Dumoga-Sangkup River Basin
16	B	BWS Sulawesi II	Gorontalo	Limboto-Bolango-Bone River Basin, Paguyaman River Basin, Randangan River Basin
17	B	BWS Sulawesi IV	Kendari	Lasolo River Basin, Sampara River Basin
18	B	BWS Maluku	Ambon	P Buru River Basin, P Ambon-Seram River Basin, Kep. Kei-Aru River Basin, Kep. Yamdena-Wetar River Basin
19	B	BWS Papua	Jayapura	Memberamo-Tami-Apauvar River Basin, Einlanden-Digul-Bikuma River Basin and Omba River Basin

Furthermore, the management of river basins which are under the authority of provincial governments is carried out by Water Resources Management Centers or Balai Pengelolaan Sumber Daya Air (Balai PSDA), which serve as Regional Technical Implementation Unit (UPTD) and they are a part of the Provincial Office of Water Resources. The Water Resources Management Centers are established by Regional Government Regulation or Governor Regulation based on the Government Regulation Number 7 of 2008 concerning Deconcentration and Co-Administration. There are 52 Water Resources Management Centers throughout Indonesia.

The management of river basins which are under the authority of regency or municipal governments is carried out by the concerned Regency or Municipal Office of Water Resources.

The differences between Large River Basin Organization and River Basin Organization are as follows.

Table 4: LargeRiver Basin Organization (BBWS) and River Basin Organization (BWS)

LargeRiver Basin Organization (BBWS)	River Basin organizations (BWS)
A Large River Basin Organization is a technical implementation unit in the areas of water resource conservation, water resource development, water resource utilization, and control of water destructive power in a river basin.	A River Basin Organization is a technical implementation unit in the areas of water resource conservation, water resource utilization and control of water destructive power in a river basin.
A Large River Basin Organization is under the authority of and is responsible to the Director General of Water Resources.	A River Basin Organization is under the authority of and is responsible to the Director General of Water Resources through the relevant Director.
A Large River Basin Organization has the task to carry out the management of water resources which includes planning, construction, operation and maintenance in order for water resource conservation, water resource development, water resource utilization, and control of water destructive power in a river basin.	A River Basin Organization has the task to carry out the management of water resources which includes planning, construction, operation and maintenance in order for water resource conservation, water resource utilization, and control of water destructive power in a river basin.
Type A Large River Basin Organization consists of: a. Administration Division; b. Program and Evaluation Division; c. Water Resource Network Implementation Division; d. Water Utilization Network Implementation Division; e. Operation and Maintenance Division; and f. Functionaries.	Type A River Basin Organization consists of: a. Administration Sub-division; b. Maintenance Planning and Operation Section; c. Water Resource Network Implementation Section; d. Water Utilization Network Implementation Section; and e. Functionaries.
Type B Large River Basin Organization consists of: a. Administration Division; b. Maintenance Planning and Operation Division; c. Water Resource Network Implementation Division; d. Water Utilization Network Implementation Division; and e. Functionaries.	Type B River Basin Organization consists of: a. Administration Sub-division; b. Maintenance Planning and Operation Section; c. Water Resource Network Implementation and Water Utilization Network Section; and d. Functionaries.

1.3. Types of Rivers

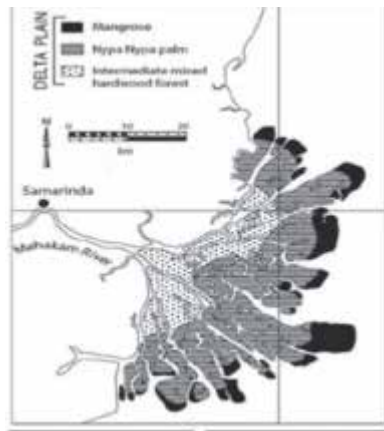
River channels are formed naturally according to the topographical, geological and hydrological conditions of the local area. In their development, demographic, social and cultural influences from the local inhabitants often bring impacts to the rivers' physical condition.

Indonesia has several topographical, geological and hydrological conditions throughout its territory. Such condition results in several types of rivers, with their features and characteristics are different from one another.

a) Tidal Rivers.

Rivers that flow into alluvial lowlands are in general strongly influenced by tides (alluvial-tidal river). This tidal influence may extend to only a few kilometers, but some may reach tens of kilometers, such as the rivers in Kalimantan. The positive impact is that the river channel can be utilized as ship channel. Another advantage is that the tides affect the water surface level and this can be utilized for tidal irrigation. The negative impact is that it can lead to an overflow of seawater out of the river and create inundation, or commonly known as *rob*.

Vast alluvial lowland makes rivers meandering before they reach the mouth.



River with low gradient at lowland area causes sedimentation in river channel, and therefore reduces its capacity. In Jakarta, for example, sedimentation including waste sediment, requires channel dredging in order to prevent an overflow. In Cimanuk River in Indramayu and Pemali River in the city of Brebes, river channel silting forces to rise the embankment, so now the elevation of the riverbed is higher than the elevation of land on the left and right sides (ceiling river).

Figure 2: Delta at the Mahakam River mouth

High level of sedimentation at the estuary causes frequent river channel blockage, which leads to the displacement of river mouth and river mouth branching (distributary). This sedimentation results in the forming of delta or sandbar at the river mouth.

Many of these tide-influenced rivers are found on the east coast of Sumatera, north coast of Java, south coast and some of the east coast of Kalimantan and some of the south coast of Papua.

b) Non-tidal Rivers

River that flows at the plain where the elevation is higher than sea level are not influenced by tides. The sediment in the flow will easily flow into the sea and therefore will not cause any blockage at the river mouth.

Rivers of this type are found in several places on the west coast of Sumatera, some of the south coast of Java, some of Sulawesi and Papua. In general, these rivers are not utilized for shipping channel.

c) Dry Rivers

In areas with small rainfall or in semi-arid areas such as East Nusa Tenggara, especially in Timor Island, water flows in the river channels only during rains or during rainy season. Rivers of this type are known as *wadi* or creeks.

In volcanic areas and in areas where the material is in the form of sand, river channels are often found dry at their upstream part. Water is absorbed and stay under the river channel, then it appears at the bottom of the river channel in downstream. In Mount Semeru area, this type of river is called *besuk*, such as Sat *besuk*, Bang *besuk*, and so on. The local people have to dig the riverbed as deep as 20 to 40 cm to find relatively clear water.

d) Debris Flow Rivers

When it rains, the flow of rivers with their upper reaches in volcanic areas brings sediments created by eruptions. At the upstream area with steep slope, there is torrential flow that carry large amount of sediments, which is known as mudflow, lahar flow or debris flow.

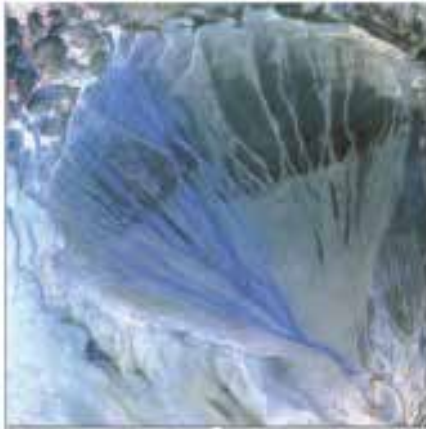


Figure 3: Alluvial Fan

Part of the material in the alluvial fan area will be transported to the downstream in the form of mudflow.

This flow still has a high destructive power that can erode the dykes of the river channel and overflow the dyke, which causes disaster at the right and left sides of the river.

e) Underground Rivers

Underground rivers or subterranean rivers are rivers which some or all water flows beneath the ground surface. These underground rivers are common in karst regions such as Mount Kidul and Wonogiri.

At Mount Kidul, those rivers are known because they are connected to the ground surface through several caves such as the Seropan Cave, Grubug Cave, Ngreneng Cave, Jurangjero Cave and Bribin Cave. In this area, underground rivers are found at a depth of around 360 meters. Among them, Baron River is well-known that flows discharge into the Baron beach. In 1983, MacDonald and partners compiled the mapping of waterflow in Mount Kidul's underground cave with assistance from the Regional Development Planning Agency (Bappeda) of Gunung Kidul.



Figure 4: Underground River

Media Indonesia (Tuesday, 4 August 2009) informed that the discharge of the underground river in Bribin reached 1,000 m³/hour at a depth of 104 meters below the ground surface. The width of the river is 10 meters and the flow is one meter deep.

In Sindon village, a microhydro power plant was built in 2004 with aid from the University of Karlsruhe, Germany.



Metrotv News (Thursday, 8 March 2012) informed that three underground rivers in Pracimantoro, Wonogiri, overflowed through a cavern and flooded the settlements in the District of Pracimantoro, leading to an evacuation of at least 45 people.

Figure 5: Turbine in Underground River

1.4. General Condition of the River

a) Floods and Droughts



Figure 6: Jakarta Flood in 2007
Source: Kompas, 2007

All creatures including human beings instinctively have chosen to live near water sources, especially rivers. Civilization has been developed by making good use of the rivers and the contained nutrient in the river water. In the beginning, rivers are always able to fulfill all of the needs of human beings. When the population grows, requirements for water also increase and in the dry season, not all of these requirements can be fulfilled. The higher the population is, the more residential areas are required at watersheds and riversides. This changes land use and causes an increase of the discharge from the land during rainy season because of the covering of land surface and decrease of discharge during dry season.



Figure 7: Cilutung River in dry season
Source: Kompas,
3 September 2001
Photographer: Hers Suganda

Riverside residential areas also dangerous to residents during floods. When urbanization increases, in metropolitan area, floods and droughts also increase in their frequency and intensity. In addition to flooding resulted from overflowing rivers, rivers that have volcanic area at their upper reaches have the potential to carry sediments from the volcanoes' eruption materials which can cause disasters at the downstream area.

b) Waste

Run-off that enters into the river channel carries soil particles resulted from erosion as well as all forms of waste such as leaves, twigs, branches or even tree trunks, and also household waste. At up-stream area in West Sumatera, Lampung, Papua and other places, the entering of waste into the river channel combined with sediment from river bank erosion causes blockage in the flow and results in damming effect. When this blockage is unable to hold the increased stored water, the blockage will break and flash flood will occur.



Figure 8: Waste in the River

At the estuaries, the river waste that enters into the river channel will get stuck on bridge pillars or floodgates impede river flow and causes overflow. Waste that is carried to the estuaries will pile up and cause river channel siltation.

c) Pollution



Figure 9: Pollution in the River

River pollution occurs due to the entering of various dirt, garbage, waste, and other pollutants into the river channel. The dirt can come from many sources such as farming areas, households, urban/market garbage, as well as from industrial areas.

This pollution causes not only lowers the quality of river water, but also causes damages the surrounding ecosystem and environment. The pollution at the upstream part of Citarum River for instance, which not only creates very bad appearance and smell, but also causes the loss of river biota including fish of the river. River water that is polluted by industrial waste and flows into rice fields causes damages plants and causes skin diseases for the people living around the areas.

d) Occupation of Riparian Areas



Figure 10: Settlement in the River

The urbanization that takes place in several major cities has resulted in a need for residential land. The increase of this need makes land prices to be very expensive. Migrants who cannot find settlement eventually occupy riparian areas, riverbanks, and even areas above river channels.

In many settlement place of urban areas, there often exist permanent constructions in the river channel.

This condition obviously lowers the river channel's capacity, makes water to overflow from the channel many times and causes inundation at the surrounding area.

These river dwellers generally make use of the river water to meet their household requirements, and also dispose their household garbage and waste into the river, which causes pollution and narrowing of the river channel. They also become the victims when the water level of river rises high or when there is flooding. But they all still remain living there because they have no other option.

2. KEY ISSUES

The general conditions of rivers as described in 1.4 above shows the various problems of river management such as the conditions of critical watersheds, social and environmental issues and law enforcement issue. River segments whose conditions are quite good can be found, at the upstream part where there are still no or little human activities exist at the watershed. But at the downstream part, where human intervention no longer follows environmentally-friendly rules, the river segments are generally not as good as the ones at the upstream part.

2.1. Conditions of Watersheds

The conditions and problems in rivers means the conditions and problems in watersheds, including the impact by human behavior.

The conditions of watersheds in Indonesia show a tendency of decreasing their quality and increasing critical areas, as shown in Table 5.

Critical limit of quality degradation means that when the condition reaches this point, the watersheds have been damaged as such that they have lost and/or been reduced their function as the natural ecosystem that plays a role in maintaining hydrological cycle.

Table 5: Number and Areas of Critical Watersheds

No.	Year	Number of Critical Watersheds	Area (Ha.)
1	1984	22	9,7 million
2	1994	39	23,2 million
3	1998	62	58 million
4	2009	108	n.a.

Source: Joko Legono, UGM on PAT HATHI 2005, and Decree of Minister of Forestry Number 328/Menhut-II/2009

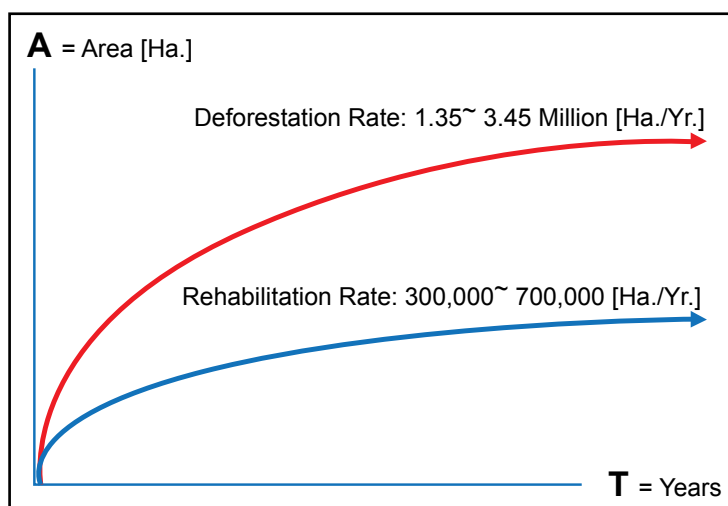


Figure 11: Deforestation and Rehabilitation

Table 5 shows that there has been a great increase in the number and areas of critical watersheds, especially during the period between 1994 and 1998, where the number of critical watersheds increased by 59% during 4 years, or by an average of 15% per year. Meanwhile, the areas increased by 150% during 4 years or by an average of 37,50% per year.

Figure 11 shows that great efforts are required in order to reduce deforestation rate and at the same time increase rehabilitation rate to prevent the growing number and areas of critical watersheds.

Furthermore, Djoko Legono (2005) states that there are at least 600 main rivers that experience flooding.

These critical watersheds' conditions cause not only floods and droughts, but also erosion and sedimentation. This erosion increasingly lowers soil fertility level, and sedimentation causes siltation in reservoirs, irrigation networks, river channels and estuary blockage.



Considering the increasing widespread of these critical watersheds, in 2007, the Minister of Forestry, Minister of Public Works and the Minister of Agriculture issued a Joint Agreement Number PKS.10/MenHut.V/2007; 06/PKS/M/2007; and 100/TU.210/M/S/2007 regarding Watershed Rehabilitation for Land and Water Resources Conservation. This joint decision was the follow up of the declaration of the National Movement for Water Safeguard Partnership (GNKPA) by President Bambang Susilo Yudhoyono on 28 April 2005, together with the celebration of World Water Day.

The National Movement for Water Safeguard Partnership (GNKPA) contains six components of water safeguard, namely:

- 1) Spatial planning, physical construction, land, and demography,
- 2) Forest and land rehabilitation as well as water resource conservation,
- 3) Control of water destructive power,
- 4) Water quality management and pollution control,
- 5) Water saving and water demand management,
- 6) Fair, efficient and sustainable water resource utilization

2.2. Social and Environmental Issues

Based on the results of the 2010 census, the total population of Indonesia amounts to 237,641,326 persons. This number increased by 15% from the results of the census conducted in 2000. If compared to the 1971 census results, the total population in 2010 has increased almost twice the total in 1971, which is by 99%, as seen from the following Table 6.

Table 6: Population Based on the Census Results of Badan Pusat Statistik (Statistics Indonesia)

Year of Census	1971	1980	1990	1995	2000	2010*)
Population	119,208,229	147,490,298	179,378,946	194,754,808	206,264,595	237,641,326
Increase		24%	22%	9%	6%	15%
Average increase/year		2.64%	2.16%	1.71%	1.18%	1.52%
Increase in 1980 against 1971	24%					
Increase in 1990 against 1971	50%					
Increase in 1995 against 1971	63%					
Increase in 2000 against 1971	73%					
Increase in 2010 against 1971	99%					

Source: www.bps.go.id

As many as 57.49% or more than half of the total population live in the island of Java, while the size of which is only 6.83% of the total land area of Indonesia. In the Special Capital Region of Jakarta, almost ten million people or 4.04% of total population reside in areas which extend to only 0.03% of the total area of Indonesia.

Some of the population occupies at the upstream area and others reside in urban areas. Villagers in upstream area mostly make a living as farmers and clear up forests to make dry rice fields or farms. In Sumatera and Kalimantan, this forest clearing is carried out by cutting down forest and burning bush to make dry rice fields under the concept of shifting cultivation, which often cause problems of forest fires and smoke.

In cities, especially major cities such as capital cities of provinces, population density keeps on increasing with the urbanization of rural areas. Many of the settlers occupy vacant lands, especially along existing rivers.

Increased number of population bring about damages in the upper and lower parts of rivers, which eventually causes greater deterioration of environment.

Table 7: Population by Province

No.	Province	Population		
		1971	2010	%
1	Aceh	2,008,595	4,494,410	1.89%
2	North Sumatera	6,621,831	12,982,204	5.46%
3	West Sumatera	2,793,196	4,846,909	2.04%
4	Riau	1,641,545	5,538,367	2.33%
5	Jambi	1,006,084	3,092,265	1.30%
6	South Sumatera	3,440,573	7,450,394	3.14%
7	Bengkulu	519,316	1,715,518	0.72%
8	Lampung	2,777,008	7,608,405	3.20%
9	Bangka-Belitung Islands	-	1,223,296	0.51%
10	Riau Islands	-	1,679,163	0.71%
11	Special Capital Region of Jakarta	4,579,303	9,607,787	4.04%
12	West Java	21,623,529	43,053,732	18.12%
13	Central Java	21,877,136	32,382,657	13.63%
14	Special Region of Yogyakarta	2,489,360	3,457,491	1.45%
15	East Java	25,516,999	37,476,757	15.77%
16	Banten	-	10,632,166	4.47%
17	Bali	2,120,322	3,890,757	1.64%
18	West Nusa Tenggara	2,203,465	4,500,212	1.89%
19	East Nusa Tenggara	2,295,287	4,683,827	1.97%
20	West Kalimantan	2,019,936	4,395,983	1.85%
21	Central Kalimantan	701,936	2,212,089	0.93%
22	South Kalimantan	1,699,105	3,626,616	1.53%
23	East Kalimantan	733,797	3,553,143	1.50%
24	North Sulawesi	1,718,543	2,270,596	0.96%
25	Central Sulawesi	913,662	2,635,009	1.11%
26	South Sulawesi	5,180,576	8,034,776	3.38%

27	Southeast Sulawesi	714,120	2,232,586	0.94%
28	Gorontalo	-	1,040,164	0.44%
29	West Sulawesi	-	1,158,651	0.49%
30	Maluku	1,089,565	1,533,506	0.65%
31	North Maluku	-	1,038,087	0.44%
32	West Papua	-	760,422	0.32%
33	Papua	923,440	2,833,381	1.19%
	INDONESIA	119,208,229	237,641,326	100.00%

Environmental condition degrades increasingly due to inappropriate forest management, including illegal logging, forest fires, mining in forest areas as well as licensing for exploration and exploitation in forest areas and so on.

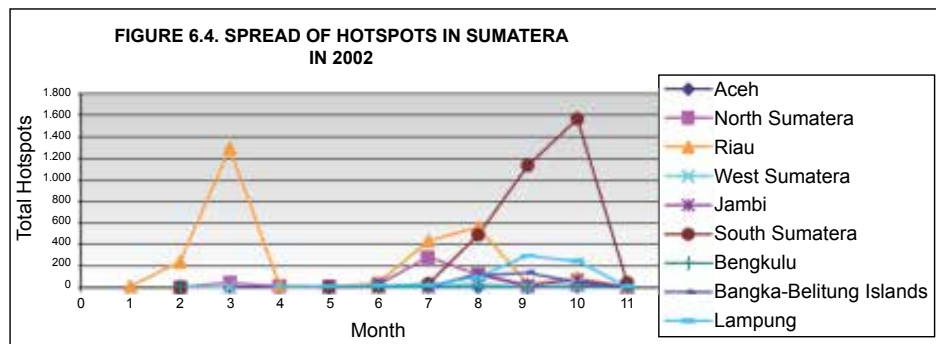


Figure 12: Spread of Hotspots in Sumatera in 2002

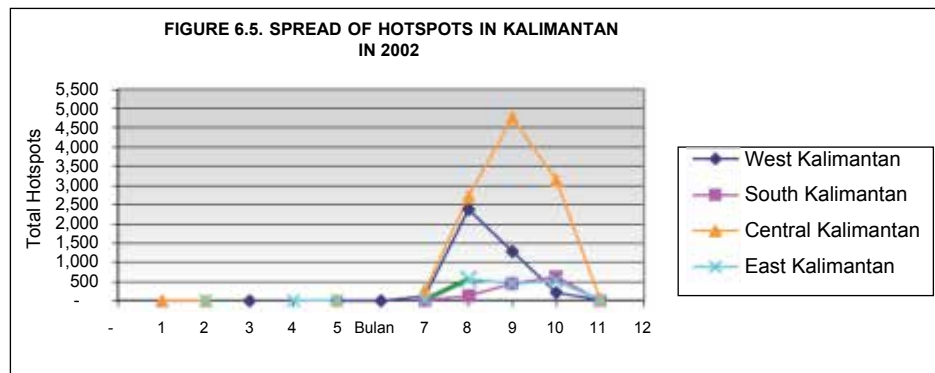


Figure 13: Spread of Hotspots in Kalimantan in 2002

Source: Ministry of Environment, 2002



Figure 14: Forest Clearing
Source: Kompas, 2002

In addition to human factors as described above, deterioration of environment can also be occurred by nature itself, for example:

1) Deterioration of environment due to a force that comes from within the earth itself (endogenous), such as the movement of tectonic plates that causes tectonic earthquakes and their derivative impacts such as tsunamis and landslides.

Included also are volcanic eruptions, along with the products of the eruptions such aspyroclastic flows (nueeardente), glowing lava and othereruption materials. Volcanic mud flows, such as the one in Sidoarjo, also cause terrible deterioration of the environment which is also very difficult and costly to manage.

2) Deterioration of environment due to forces that originate from outside (exogenous) such as thunderstorms, which can lead to floods or flash floods, *galodo* (mudslide and flood from a volcanic eruption), landslides, rock falls and so on.

2.3. Focus and Paradigm of Development

Since the reformation era, the development carried out by the government and the private sector has been growing rapidly in all sectors and regions, such as the expansion of residential areas, industrial areas, recreational areas, expansion of urban areas along with the development of their infrastructures. This development certainly requires land as its basis. In line with this rapid pace of development, the government has immediately prepared various laws and regulations to set up the implementation as well as reduce the negative impacts.

Among those regulations are:

- a) Law Number 7 of 2004 regarding Water Resources, along with:
 - Government Regulation Number 42 of 2008 regarding Water Resources Management;
 - Presidential Decree Number 6 of 2009 regarding the Establishment of National Water Resources Council, including Water Resources Management Coordinating Teams (TKPSDA);
 - Presidential Regulation Number 33 of 2011 regarding National Policies on Water Resources;
 - Government Regulation Number 38 of 2011 regarding Rivers;
 - Including Presidential Declaration as well as Joint Agreement between the Minister of Forestry, Minister of Public Works and Minister of Agriculture on National Movement for Water Conservation Partnership (GN-KPA).
- b) Law Number 32 of 2004 regarding Regional Governance, along with:
 - Presidential Regulation Number 7 of 2008 regarding Deconcentration and Assistance Task.
- c) Law Number 26 of 2007 regarding Spatial Planning, along with:
 - Presidential Regulation Number 26 of 2008 regarding National Spatial Plan;
 - Presidential Regulation Number 54 of 2008 regarding Spatial Plan of Jakarta, Bogor, Depok, Tangerang, Bekasi and Cianjur (Jabodetabekjur); and
 - Presidential Regulation Number 15 of 2010 regarding Implementation of Spatial Planning.
 - Several Decree of Minister of Public Works, Provincial Government Regulations, and Regency/Municipal Government Regulations on Regional Spatial Plan

From all the laws and regulations mentioned above, it is explicitly clear that there is a spirit that intends to build together for the management of water resources, which is the cooperation between the central and local governments as well as the cooperation among various related sectors.

Furthermore, it is mandated to have a focus on the development of water resources through National Policies on Water Resources, which serve as one of the references in the compiling of Regional Plans and Regional Long Term Development Plans/Short Term Development Plans. Based on a study conducted by the JCFM Project (2011) on the Regional Spatial Plan of a province and the Regional Spatial Plans of 3 regencies/municipalities, it appears that the land use changes projected in the concerned Regional Spatial Plans will result in an increase of flood volume by 49 to 57% at the downstream area of river channels. Due to this, efforts are required from many parties in order to ensure that the impacts of such land use changes can be compensated according to the mandate stated in the Government Regulation Number 38 of 2011 so that they will not lead to increase flood discharge.

The Water Resources Management Plans are produced by several Water Resources Management Coordinating Teams (TKPSDA), which are derived from the plans compiled before the issuance of the laws and regulations mentioned above. Those plans need to be refined and adapted to the existing laws and regulations.

Good and proper efforts of water resources management should be reflected in Regional Government Work Plans (RKPD) and Strategic Plans along with the Ministerial Budget Implementation Documents (DIPA).

2.4. Law Enforcement

In order to ensure that development activities can be planned, implemented and controlled well and properly, the Central Government has issued many laws and regulations, among them are those specified in 2.3. Regional Governments, both at provincial and regency/municipal levels, have conduct follow-ups through various regional regulations such as the regional government regulations on garbage, establishment of development areas or zones, licensing issue, and so on.

The controlling of Puncak area, for example, has often been carried out, but the number of new buildings is still far greater than the number of buildings that had been demolished. In Jakarta, which has had a regional government regulation on garbage for quite a long time, tens of tons of garbage are taken out from the rivers every day, but there has been no sanction to residents for the violation of throwing garbage into the river.

The following Figure 15 clearly shows that in all islands of Indonesia, especially in Sumatera, Kalimantan and Sulawesi, the activity of illegal mining at hinterlands still continues even though the locations and the miners have been identified.



Figure 15: Spread of Illegal Mining Locations
Source: Ministry of Environment

The same things happen for wood theft in forests. Even though the locations and culprits had been identified, and evidences had been found, the main actors were never revealed and captured. Only the laborers and workers were captured. This is due to the many constraints faced in combating illegal logging. Among those constraints are (Source: Indonesian Environmental Status Report of 2002, Ministry of Environment):

- (1) There are 11 agencies which are involved in the process of criminal law enforcement in the area of forestry to eradicate illegal logging, namely the Coordinating Ministry for Political and Security Affairs, Indonesian National Army/Department of Defense and Security, Indonesian Navy, Indonesian National Police, Department of Forestry, Department of Trade and Industry, Department of Transportation, Customs and Excise, Attorney General's Office, Courts, and Provincial/Regency Governments;
- (2) Law enforcement is still weak and therefore wood mafia is able to act freely;
- (3) Illegal logging is prohibited but it has been done at several places with the connivances of government officers;

- (4) The moral, social and cultural conditions of the people and state organization which tend to no longer be concerned about forest preservation and law enforcement;
- (5) The awareness of people is still low and they are easy to be manipulated by wood mafia;
- (6) There still exist wood processing industries that accept and process illegal timber;
- (7) The Management of illegal logging at present has not achieved maximum results since it is carried out in a discontinuous manner due to the cost;
- (8) The complexity of social and moral issues at various levels of community;
- (9) Data and information concerning illegal logging management are still limited;
- (10) The implementation of regional autonomy is more oriented towards increasing Regionally-generated Income (PAD) without regard to forest sustainability.

Based on the description above, great efforts are still required to enforce the laws in areas along rivers as well as all watersheds throughout Indonesia. Without definite law enforcement, deterioration and destruction that occur will always be greater than the efforts for improvement carried out, and therefore development will seem to be useless.

3. RIVER MANAGEMENT IN INDONESIA

Based on the inscriptions found in various places, it is known that river management in Indonesia has been carried out since pre-historic time. The oldest inscription that has been found is known to date back to the fourth century. In the beginning, it was conducted primarily to manage floods and volcanic mudflows (Harinjing Inscription, Kamalagean) and to utilize water for irrigation and shipping (Tugu Inscription). (Note: The word “prasasti” or “inscription” in English derived from the Sanskrit language which actually means “praise”. However, the word was then considered to have the meaning of “charter, edict, decree, statute or writing”. Among archaeologists, “prasasti” is called “inscription”, while among laymen, it is called written stone or inscribed stone).

Since then, management of the river continued, but it was still only for meeting or responding local requirements, and it had not brought wider impacts. The existing rules and regulations that underlay the management were also still local in nature.

The first regulation that was issued and applied nationally in the area of river management was Law Number 11 of 1974 concerning water, which was then renewed by Law Number 7 of 2004 concerning Water Resources.

Therefore, river management in Indonesia can be categorized into three phases, namely:

- a) Management in the period before Law Number 11 of 1974
- b) Management in the period between Law Number 11 of 1974 and Law Number 7 of 2004
- c) Management in the period after Law Number 7 of 2004

3.1. Management in the period before Law Number 11 of 1974

3.1.1. Legal Framework

Introduction of this book mentioned the existence of the Harinjing A Inscription (804) and the Kamalagean Inscription (1037) related to the construction of Wringin Sapta dam. The inscriptions consist of 23 statements which include a statement on the establishment of areas around dams as fiefs where people had resided to construct dams, and these areas receive relief of the tax that had to be paid to the king, or the kingdom, as compensation from the king for the participation of the dam construction work.

The case with the Tugu Inscription found at the downstream of Ciliwung River in Koja, Jakarta (5th century AD), which tells the story of the excavation of Candrabaga River by Rajadirajaguru and the excavation of Gomati River by Raja Purnawarman in the twenty second year of his reign. The excavations was originally from the idea to avoid natural disasters in the form of flooding which occurred frequently during the reign of Purnawarman, and drought that occurred during the dry season.



Figure 16: Tugu Inscription

It is believed that the two inscriptions are historical evidences of the establishment of rules that are equivalent to laws related to irrigation or water resources issues.

In addition to those two inscriptions, many heritages were also found in Brantas valley such as the Penataran Temple, Tikus Temple in Trowulan, Jago Temple in Tumpang, Singosari Temple, and so on. The same period, there also produced high-value literature works such as the story of Arjunawiwaha and Calon Arang. Then, King Jayabaya of the Kediri Kingdom (1117 ~ 1222) is famous for his prophecy about Ratu Adil (King/Queen of Justice). King Kartanegara of the Singosari Kingdom (1222 ~ 1292) had an idea which then became famously known as *Gagasan Nusantara*, which intended to unite Indonesia primarily to deal with external threats. During the reign of King Hayam Wuruk and Prime Minister Gajah Mada in the period of Majapahit Kingdom (1293 ~ 1521), *Gagasan Nusantara*

was followed by the famous oath known as *Sumpah Palapa* (Palapa Oath).

The description above has been presented simply to provide an overview on the existence of an advanced civilization that had produced a beneficial water resources management. Beside the construction engineering in the making of temples, literature works, and political configuration that unite the country beyond geological distance are still relevant to the condition today.

In 1925, the agency in charge of irrigation, which is Burgerlijke Openbare Werken (BOW) began compiling the General Irrigation Regulation for Java and Madura (Algemeen Water Reglement Voor Java en Madura) under the direction of Ir. J. Blastone. On 1 January 1930, the irrigation management regulation was compiled and applied to all areas in Java and Madura, except at the Yogyakarta and Surakarta Residencies (Vorstenland). In 1936, the Algemeen Water Reglement (AWR) obtained approval from the People's Council (Volksraad).



After the proclamation of independence, several provinces such as West Java, Central Java, and East Java, renewed the regulation on irrigation. Among the new regulations was the *Peraturan Perairan Daerah Djawa Timur* (Water Regulation of East Java) or abbreviated as PWR, which was issued by the Public Works of East Java Province in 1964.

Figure 17: Water Regulation of East Java

In this period, there were still no laws and regulations governing the issue of river development or management. However, as part of the national development, water resources were developed based on the following policies formulated by the Central Government :

- 1) In 1947: The several economic sectors formulated plan as the Republic of Indonesia Three-year Production Plan for 1948, 1949 and 1950; the plan was intended for the areas of agriculture, animal husbandry, industries and forestry.
- 2) In 1952: A comprehensive plan was formulated, although the core remained to be public sectors.

- 3) In 1956-1960: The Five-year Development Plan was successfully compiled.
- 4) In 1961-1969: The National Development Plan (Rencana Pembangunan Nasional Semesta Berencana) was successfully compiled, which covered an eight-year period divided into 3-year and 5-year phase plans.

3.1.2. Managing Agencies

During this period, development management and implementing agencies, including in the area of water resources, were still not well-defined. In general, projects were established and carried out as the special activities of local, and were not yet regionally-oriented (development unit area) or nationally-oriented, except for case of flood management project (Komando Proyek Pentjegahan Banjir (Kopro Banjir) Djakarta Raja 1964) and the Djatiluhur Multipurpose National Project (Proyek Nasional Serbaguna Djatiluhur) in 1957. Both projects were organizationally under the direct supervision of the Central Government.

3.1.3. Budgeting

Efforts were made to ensure that the Development Expenditure Budget (Anggaran Belandja Pembangunan) of 1969/1970 and 1970/1971 reflected the policy plans, priorities and programs of the Five-year Development Plan. As already noted, the classification of development expenditure budget provision was done by function, which was according to the programs that were to be carried out and the provision was no longer classified by state institution/department/non-departmental government institution. Therefore, development budget was a budget oriented toward programs. These fundamental changes were intended to ensure that budget provision planning was more directly toward the implementation of a business program. Continuous changes were also conducted in the method of budget provision implementation. Improvements in the area of supervision had been conducted to the extent possible in order to reduce leaks and inefficiency.

The cost for development was generally borne by the State Budget (APBN). For large-scale development projects, such as dam construction, the financing was obtained not only from the State Budget but also from loans or Foreign Aids (BLN).

The development cost was allocated as Development Expenditure Budget and broken down into various fields, sectors, sub-sectors, programs and projects.

3.1.4. Implementation

Before 1945, water resource development had been mainly to deal with local problems and requirements, such as floods, droughts, drinking water requirement, irrigation, power plants and so on. There were at least 29 large structures constructed since 1857, such as canals, tunnels, weirs and dams, as seen in the Table 8.

Table 8: Construction of Water Resource Structures until 1945

No	Year	Structure	Location of River Basin	Main Benefit
1	1857	Lengkong Weir	Brantas	Irrigation
2	1910-1917	Prijetan Dam	Bengawan Solo	Irrigation
3	1911-1914	Nglangon Dam	Jratunseluna	Irrigation
4	1916	Tempuran Dam	Jratunseluna	Irrigation
5	1918-1923	West Flood Canal	Ciliwung-Cisadane	Flood Management
6	1919	Greneng Dam	Jratunseluna	Irrigation
7	1919-1923	Cileunca Dam	Citarum	Hydroelectric Power Plant, Drinking Water
8	1921-1925	Setupatok Dam	Cimanuk-Cisanggarung	Irrigation

9	1923	Delingan Dam	Bengawan Solo	Irrigation
10	1925	Gn. Rowo Dam	Jratunseluna	Irrigation
11	1925	Walahar Weir	Citarum	Irrigation
12	1926	Mendalan Dam	Brantas	Hydroelectric Power Plant (PLTA)
13	1927-1933	Pacal Dam	Bengawan Solo	Irrigation
14	1928	Plumbon Dam	Bengawan Solo	Irrigation
15	1929-1932	Garung Dam	SerayuBogowonto	Hydroelectric Power Plant (PLTA)
16	1929-1939	Cipanunjang Dam	Citarum	Suppletion of Cileunca
17	1930	Ngebel Dam	Bengawan Solo/ Madiun	Irrigation/Hydroelectric Power Plant (PLTA)
18	1930-1934	Penjalin Dam	Pemali-Comal	Irrigation
19	1931	Cengklik Dam	Bengawan Solo	Irrigation
20	1932	Siman Dam	Brantas	Hydroelectric Power Plant (PLTA)
21	1933-1940	Malahayu Dam	Pemali-Comal	Irrigation
22	1933	Gembong Dam	Jratunseluna	Irrigation
23	1939	TlogoNgebel Dam	Bengawan Solo	Irrigation & Electricity
24	1940	Sengguruh Dam	Brantas	Irrigation & Electricity
25	1942-1945	South TulungAgung Tunnel	Brantas	Flood Management
26	1943	Klego Dam	Jratunseluna	Irrigation
27	1943	Krisak Dam	Bengawan Solo	Irrigation
28	t.a.d	Beringen Dam/ <i>Embung</i>	Lombok	Irrigation
29	t.a.d	Gn. Paok Dam/ <i>Embung</i>	Lombok	Irrigation

Source: *Menyimak Bendungan di Indonesia 1910-2006*, KNIBB, 2007 and *Bendungan Besar di Indonesia*, Directorate General of Irrigation, 1995. (Note: According to Ir. Suyono Sosrodarsono, Nglangon, Tempuran, Greneng, Gn. Rowo and Walahar are weirs, not dams).

After 1945, national development strategies were based on a development planning approach that put more emphasis on political development efforts, in which this corresponded to the situation at the time.

The National Development Plan (Rencana Pembangunan Nasional Semesta Berencana) mandated that development should focus on a balance among the agricultural, drinking water requirement and industrial sectors. Due to this, dams that had begun to be constructed in the sixties were planned to serve as multi-purpose dams, as seen in the Table 9.

Table 9: Construction of Water Resource Structures in 1945 - 1974

No	Year	Structure	Location of River Basin	Main Benefit
1	1946	Ngancar Dam	Bengawan Solo	Irrigation
2	1952-1959	Cacaban Dam	Pemali-Comal	Irrigation
3	1958-1962	Darma Dam	CimanukCisanggarung	Irrigation, Cane, Sugar Factory
4	1959-(1974-1978)	Sempor Dam	SerayuBogowonto	Irrigation & Electricity
5	1963-1970	Selorejo Dam	Brantas	Irrigation & Electricity
6	1964	Way Rarem Dam	Mesuji - TulangBawang	Irrigation
7	1967	Jatiluhur Dam	Citarum	Irrigation, Electricity, Raw Water
8	1973	Karangates Dam	Brantas	Irrigation& Electricity
9	1973	RiamKanan Dam	Barito	Irrigation

Source: *Menyimak Bendungan di Indonesia 1910-2006*, KNIBB, 2007 and *Bendungan Besar di Indonesia*, Directorate General of Irrigation, 1995.

Construction of large structures during this period faced several problems such as:

- 1) Limited trained human resources in the government, consultants and contractors, especially for planning and implementing as well as supervising large projects such as dam construction.
- 2) Limited fund for financing, related to the country's economic condition at the time. In certain cases, this problem could be solved by the willingness of the structures' main beneficiaries to contribute to the financing, such as in the construction of Garung Dam (the main contributor was ANIEM: *Algemeene Nederlanch Indische Electriciteit Maatschappij*) and the financing for the research and planning of Darma Dam by cane factories.
- 3) Political situation that was not yet stable, accompanied with wars and security disturbances by the separatist movement of DI/TII, especially in West Java and Central Java. This resulted in a delayed completion of work and reduced quality in the compaction of Darma Dam's core, which led to a leakage that affected the dam's safety. This leakage was finally repaired in 1976.

It should be noted that the Cacaban Dam was the first large dam built in the early days of independence, and its construction, starting from the planning to the implementation, was done entirely by Indonesian experts. This dam is often described as a 'sick' dam due to various problems that have occurred such as leakage, cracks in the dike's body, silting, operational problems and so on. Repair and rehabilitation works, including the replacement of the floodgates have frequently been done, and gratefully, until today it can be said that the dam is functioning well.

This dam serves as a place for learning by doing and a training ground for officers from the Central Government and regional governments about large dams. The next dam that serves as the second place for learning and training ground after the Cacaban Dam is the Darma Dam.

Recognizing the obstacles encountered in implementing water resources development as described above, the government began a partnership with several countries through the Colombo Plan. To finance the projects, the government is working with several world financial organizations such as Asia Development Bank (ADB), International Bank for Reconstruction and Development (IBRD) or also known as the World Bank, and Overseas Economic Cooperation Fund (OECF) that is a Japanese financial institution. OECF was

established in 1961 and was then reformed and became Japanese Bank for International Cooperation (JBIC) in 1999, and then the unit of JBIC was merged with Japan International Cooperation Agency (JICA) to establish new JICA in 2008.

The government also request technical cooperation from Japan through Japanese Official Development Assistance (ODA) under the scheme of Colombo Plan for managing water resources and controlling water's destructive power. The first technical cooperation by the Japanese ODA was the support for the Water Research Institution or *Lembaga Penelitian Masalah Air* (now Center for Water Resource Research and Development or *Pusat Penelitian dan Pengembangan Sumber Daya Air*) in Bandung, by assigning two Japanese experts in 1962. Since then, the technical cooperation has been continued in a form of individual experts, technical cooperation projects and technical trainings carried out by Japan International Cooperation Agency (JICA), which was established in 1974.

In 1958, a technical and financial support for Brantas Project from Japan was started by the fund of war compensation, which was then taken over by Japanese ODA loan financed project by OECF in 1968.

The government commissioned a Japanese consultant, namely, Nippon Koei Co., Ltd., to formulate a design for the multipurpose dams of Kali Konto and Karangates, while the supervision of the project implementation was undertaken by a Japanese contractor, namely, Kajima Co., Ltd.

In 1967, the government established the Multipurpose Master Project Executing Agency for Brantas River (BP-PIS Kali Brantas), with tasks as follows:

- 1) To execute the development of Karangates, Seloreji (Konto River), Wlingi, South Tulungagung projects and other projects (which were parts of Master Plan I).
- 2) To create experts in the area of water resource development, both in technical field as well as administration and financial field. The implementation of project serves as an effective training ground through transfer of skill, knowledge and know-how.
- 3) To conduct researches on Cost Analysis and Cost Accounting systems, particularly for large project development.

Furthermore, a decision was made to change the projects' development system from an outsourcing system to On Force Account. The position of the experts from the consultant Nippon Koei Co., Ltd. changed into assistance providers for planning and supervision officers and from full contractors to guidance engineers for the field officers of project owners and advisers for project executing experts.

After development in accordance with the Master Plan I to IV had been completed, the development experts were assigned to assist the implementation of various projects such as the Klaral irrigation Project, Tajum Irrigation Project, Progo Irrigation Project, Batujai Project and so on, especially for the implementation of tunnel construction.

Many of the workers from the Brantas Project were also deployed to projects of Public Works/Irrigation and PT PLN. Among the projects were the Garung Hydroelectric Power Plant Project, ICCI Project in the Middle East, Tenggari Hydroelectric Power Plant Project, South Kedu Project, Jratunseluna Project, Luwu Irrigation Project, Way Rarem Irrigation Project, Krueng Jrue Irrigation Project, Bengawan Solo Project, PLN Master Project of West Java Hydro Generator, PLN Project of Power Plant in North Sumatera, PLN Development VI in East Java, Jaya Flood Project, Krueng Aceh Project, Bakarua Hydroelectric Power Plant Project and Jeneberang Project.

In addition, there were many alumni of Brantas who occupied core positions in PT PLN and Ministry of Public Works, such as Dr. Ir. Soenarno, Dipl.HE., who was the Minister of Settlement and Regional Infrastructure at the time, Prof. Ir. Suryono who became the President Director of PT PLN, and so on.

Once the development as described above had been completed, a re-organization was done on the Multipurpose Master Project Executing Agency for Brantas River (BP-PIS Kali Brantas). The unit that experienced implementation work became PT Brantas Abipraya. The Planning Unit was put into PT Indra Karya to strengthen the state-owned enterprise, while the task to further handle the river management and the operation and maintenance of constructed infrastructures was assigned to PT Jasa Tirta I, which was specially established for the task.

The development model implemented in Brantas was considered successful in improving the capacity of Indonesian experts, which means that development is not just about dam construction alone but also the transfer of technology and skills to enhance the capacity of Indonesian experts. Since then, the planning and construction of dams in other places have been carried out with focus on improving knowledge and experience, such as:

- 1) Saguling Dam, Citarum, 1980-1986
 - Consultant : NEWJEC Inc. (Japan)
PT IndraKarya (state-owned enterprise)
 - Contractor : Dummertravaux Publics (France)
Raya Contractor (private)
- 2) Cirata Dam, Citarum, 1984-1988
 - Consultant : NEWJEC Inc. (Japan)
PT IndraKarya (state-owned enterprise)
 - Contractor : Taisei Co., Ltd. (Japan)
PT PP (state-owned enterprise)
- 3) Wadaslintang Dam, Serayu, 1982-1987
 - Consultant : PRC-ECI (United States)
NEDECO (The Netherlands)
 - Contractor : HECC (The Philippines)
PT Brantas Abipraya (state-owned enterprise)

Afterwards, constructions of several dams, such as the ones in Bengawan Solo River Basin (except Wonogiri Dam, which was designed by Nippon Koei Co., Ltd.) were done by Indonesian experts from the designing to the implementation, such as:

- 1) Nawangan Dam, Bengawan Solo, 1974-1976
 - Consultant : PWS Bengawan Solo (force account)
 - Contractor : PT Waskita Karya (state-owned enterprise)
- 2) Song Putri Dam, Bengawan Solo, 1977-1984
 - Consultant : PWS Bengawan Solo (force account)
 - Contractor : PT Wijaya Karya (state-owned enterprise)
- 3) Parangjoho Dam, Bengawan Solo, 1973-1980
 - Consultant : PWS Bengawan Solo (force account)
 - Contractor : PT PP (state-owned enterprise)

In the previous period, dam constructions, starting from design to implementation, were fully managed by foreign consultants and contractors without involving Indonesian experts in the process, such as Jatiluhur Dam, which was designed by Coyneet Bellier (France) and the implementation was done by Francaise d'Enterprise (France).

After that, more foreign consultants and contractors were involved in dam construction, such as Hazama Co., Kajima Co., Kumagai Gumi Co., Maeda Co., Obayashi Co., Shimizu Co., Taisei Co., and Zenitaka Co., as contractors and CTI Engineering International, IDEA Consultants (NIKKEN Consultants), NEWJEC, Nippon Koei, Oriental Consultants (PCI) and Yachiyo Engineering, Synotec, SMEC and others as consultants. In practice, all of

them were required to work with local consultants or contractors.

In the early days of the New Order, the government established the Long-Term Development (PJP) I, which consisted of five-year development stages, and were known as the Five-Year Development Plans (Repelita). Repelita I was carried out from 1969/1970 to 1973/1974.

By taking into account the limited capabilities at that time, the prioritized development targets set in Repelita I were food, clothing, improvement in infrastructure, housing, employment expansion and spiritual well-being.

When the Brantas Project had been achieving steady progress, several ODA aid projects were initiated and implemented at various places in Indonesia in 1969, the Ular River Flood Control and improvement of Irrigation Project at North Sumatra (IDEA Consultants, Inc. and associates) was started by Japanese ODA and the implementation work had been continued until 1995. The Bengawan Solo River Basin Master Plan was formulated in 1974 (Nippon Koei Co., Ltd. and associates) and Wonogiri Multipurpose Dam Project was implemented (1976 - 1983) under the supervision of Hazama Co., Ltd. The study for Krueng Aceh Flood Control Project (Oriental Consultants Co., Ltd. and associates) was started in 1972, followed by the construction work that was continued until 1993. The study for Jeneberang River Basin Development Project was started in 1979 (CTI Engineering International Co., Ltd. and associates), including Bili Bili Multipurpose Dam Project (1992-1999, with Hazama Co., Ltd. and PT Brantas Abipraya as the main contractors). The study for Padang Area Flood Control project was started in 1982 (IDEA Consultants, Inc. and associates) and followed by the implementation work that was continued until 2002. This project was reviewed after the earthquake in 2009 and the rehabilitation work was done (2009 - 2011). The study for Bali Beach Conservation Project was started in 1982 (Nippon Koei Co., Ltd. and associates) and the implementation work to rehabilitate the beach at Sanur, Nusa Dua and Tanah Lot was undertaken (1998-2008). In Brantas River Basin, Wonorejo Multipurpose Dam was constructed (Kajima Co., Ltd. and PT Pembangunan Perumahan as the main contractors) as a part of overall Brantas River Basin Development Project (Nippon Koei Co., Ltd. and associates). Jakarta/Jabodetabek Flood Control Project (IDEA Consultants, Inc. and associates) was started in 1985 to improve the drainage function reviewing previous Master Plan to formulate action plan (2007). Upper Citarum River Basin Flood Control and Farm/Forest Land Conservation Projects (Oriental Consultants Co., Ltd. and associates) has improve the flow capacity of Upper Citarum River and conserve its catchment area (1987-2007). The Medan Flood Control Project (CTI Engineering International Co., Ltd. and associates) reduces flood disaster at the flood-prone area along the Deli River and Percut River (1990-2009). The study for Semarang Integrated Water Resource and Flood Management Project for Semarang. (CTI Engineering International Co., Ltd. and associates) was started in 1992 and currently the construction of Jatibarang Multipurpose Dam is being carried out (PT Brantas Abipraya, PT Waskita Karya and PT Wijaya Karya as the main contractors). Batutegei Dam Project (Nippon Koei Co., Ltd. and associates) was implemented at Way Sekampung River in Lampung. The dam is a multipurpose dam with a height of 122 meters (PSEA and PT Nindya Karya as the main contractors).

Sabo works are crucial to prevent sediment disaster as a country with so many active volcanoes. There are many Sabo Projects that have been carried out with the support from Japanese ODA such as the project at Mt. Merapi and Progo River Basin (1976-present), Mt. Semeru (1982-2001), Mt. Kelud (1992-1996) and Mt. Bawakarae (2005-present) (Yachiyo Engineering Co., Ltd. and associates). These projects were initiated and supported by JICA. Experts who were assigned to the Ministry of Public Works together with the JICA Technical Cooperation Project.

JICA Experts have also been assisting in developing capacity of the Ministry of Public Works for the formulation of rivers and sabo planning, designing of structures and establishing Integrated Water Resources Management policies.

3.2. Management in the period between Law Number 11 of 1974 and Law Number 7 of 2004

3.2.1. Legal Framework

There was an opinion stating after independence, that the Government was late in preparing or renewing the laws and regulations on water resources. Based on available facts, it seems that the opinion was incorrect, because since the proclamation of independence in 1945, the national political and security situation was strongly unsupportive to work for this theme, such as:

- 1947: First Military Aggression
- 1948: Second Military Aggression
- 1948: Rebellion of the Communist Party of Indonesia (PKI)
- 1949-1962: DI/TII Rebellion led by Karto Suwirjo in Java, Kahar Muzakar in Sulawesi, and Daud Beureuh in Aceh
- 1965: Rebellion of PKI/G30S
- 1966: Change of the Old Order to the New Order

In 1974, the Law Number 11 of 1974 concerning Irrigation was finally established. The term 'irrigation' in this law was defined as water management, which was then followed by its ancillary regulations, namely:

- a) Government Regulation Number 22 of 1982 concerning Water Regulation System
- b) Government Regulation Number 23 of 1982 concerning Irrigation
- c) Government Regulation Number 20 of 1990 concerning Water Pollution Control
- d) Government Regulation Number 27 of 1991 concerning Swamps
- e) Government Regulation Number 35 of 1991 concerning Rivers

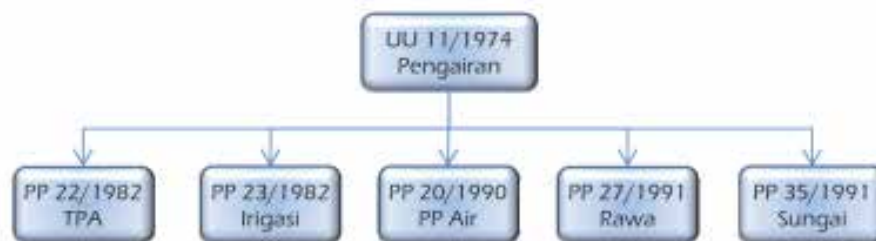


Figure 18: Law Number 11 of 1974 and Its Ancillary Regulations

From 1974 to 2004, Long-term Development (PJP) had been developed, which was broken down into 5-year stages, namely Five-year Development Plan (Repelita) I to Five-year Development Plan (Repelita) V.

Long-term Development (PJP) I consisted of 5 stages of Five-year Development Plans, namely Five-year Development Plan I to Five-year Development Plan V, while the Long-term Development (PJP) II was eventually implemented in only two stages, namely Five-year Development Plan VI and Five-year Development Plan VII.

- 1) Five-year Development Plan I 1969/70 – 1973/74
- 2) Five-year Development Plan II 1974/75 – 1978/79
- 3) Five-year Development Plan III 1978/79 – 1983/84
- 4) Five-year Development Plan IV 1984/85 – 1988/89
- 5) Five-year Development Plan V 1989/90 – 1993/94
- 6) Five-year Development Plan VI 1994/95 – 1998/99
- 7) Five-year Development Plan VII 1999/00 – 2003/04

During the Five-year Development Plan I, the purpose of development was to meet basic infrastructure requirements with emphasis placed on the field of agriculture, while during the Five-year Development Plan II, based on the 1973 Broad Outlines of the Course of the Nation (GBHN), the implementation of development in every Five-year Development Plan had to concentrate on the Trilogy of Development the essence of which were:

1. Even distribution of development and its results which leads to social justice for all.
2. Sufficiently high economic growth.
3. Healthy and dynamic national stability.

In this period, dams that were previously planned had been constructed and started to operate according to their functions. Meanwhile, agricultural infrastructures were also rehabilitated (through Prosida (Project under International Development Agency)), and new infrastructures were built, which led to a rapid growth in rice field intensification and extensification.

As the result, in 1984, Indonesia was able to meet its own requirement of rice (self-sufficiency), and even exported and provided assistance for an amount of 100.000 tonnes to Africa. The Director General of FAO, Edouard Saouma, invited President Soeharto to speak before the world forum on 14 November 1985. Edouard Saouma mentioned Soeharto as a symbol of international agricultural development. He came to Jakarta to present Soeharto with an award FAO gold medals.

The medals consist of two types; a small-sized medal and the other one is larger in size, engraved with Soeharto's image and a text, "President Soeharto Indonesia", and on the other side is a picture of a farmer planting rice with a text, "From Rice Importer to Self-Sufficiency".

Furthermore, the Minister of Public Works at the time was awarded the Mahaputera Adipradana Star by the Government.

3.2.2. Managing Institution

Water resources development during this period was carried out with project approach that was categorized in three patterns, namely:

- River Improvement and Maintenance Projects
- River Management and Maintenance Projects
- River Basin Development Projects

Among the things that differentiated the three types of projects above were the development area basis, organizational structures, and the development characteristics and scale of each project. The development scale of a project was determined according to the amount of the design flood volume. There requires times when projects were carried out due to budget constraints. The identification of the projects was done based on the condition and problems of each river as well as the priority of issue.

1) River Improvement and Maintenance Projects

River Improvement and Maintenance Projects were located in all provinces and carried out by the Regional Technical Implementation Units. The budget came from the Central Government and the implementation as well the supervision were the responsibilities of the regional governments, in this case, the Irrigation Office or Public Works Office of each province. Furthermore, the characteristics of these projects were as follows:

- a) Provincial area-based
- b) Co-Administration, Regional Technical Implementation Unit
- c) Emergency or Short-term Work
- d) Small scale (construction and cost)

2) River Management and Maintenance Projects

River Management and Maintenance Projects were carried out by the Technical Implementation Unit under the Directorate of Rivers of the Directorate General of Water Resources and these projects were medium scale projects with characteristics as follows:

- a) River basin-based
- b) Technical Implementation Unit of the Directorate of Rivers
- c) Medium level or Medium-term Work
- d) Medium scale (construction and cost)

Some of the projects were:

- Brantas River Basin Development Project
- Bengawan Solo River Basin Development Project
- JratunSeluna River Basin Development Project
- Cimanuk River Basin Development Project
- Citanduy River Basin Development Project
- Ciliwung-Cisadane River Basin Development Project
- Jeneberang River Basin Development Project
- South Kedu Multipurpose Project

In addition, there were several special projects carried out by the Technical Implementation Unit of the Directorate of Rivers, namely:

1) Volcanic Eruption Mitigation Projects:

- a. Galunggung
- b. Merapi
- c. Kelud
- d. Semeru
- e. Agung

2) Coastal Protection Projects

- a. Special Capital Region of Jakarta and West Java
- b. Bali Island
- c. North Sulawesi

3.2.3. Budgeting

The water resources management budget was provided by the Central Government through the State Budget (APBN) and Foreign Aids (BLN), and also by the regional governments through the Regional State Budget (APBD) and Co-Administration Fund.

Specifically for the management of Jatiluhur reservoir, a separate management was formed under the name of Jatiluhur Authority, which later became Perum Jasa Tirta II. The management used non-government budget.

3.2.4. Implementation

During the Five-year Development Plan I, the purpose of development was to meet basic infrastructure requirements with emphasis placed on the field of agriculture, while during the Five-year Development Plan II, based on the 1973 Broad Outlines of the Course of the Nation (GBHN), the implementation of development in every Five-year Development Plan had to concentrate on the Trilogy of Development which in essence were:

1. Even distribution of development and its results leads to social justice for all.
2. Sufficiently high economic growth.
3. Healthy and dynamic national stability.

Table 10: Construction of Water Resource Structures in 1974 – 2004

No.	Year	Structure	Location of River Basin	Main Benefit
1	1974~1977	Wlingi Dam	Brantas	Irrigation & Electricity
2	1975	Lahor Dam	Brantas	Suppletion of Karangates
3	1976	Klampis Dam	Madura	Irrigation
4	1976	Nawangan Dam	Bengawan Solo	Irrigation
5	1976~1981	Wonogiri Dam	Bengawan Solo	Flood Management, Irrigation & Electricity
6	1977~1984	Song Putri Dam	Bengawan Solo	Irrigation
7	1978	Larona Dam	Pompengan-Kalaena-Larona	Electricity
8	1978	Way Jepara Dam	Seputih-Sekampung	Irrigation
9	1979	Samboja Dam	Mahakam	Irrigation
10	1979	Sei Harapan Dam	Batam	Raw Water
11	1980	Manggar Dam	Mahakam	Raw Water
12	1980	Parangjoho Dam	Bengawan Solo	Irrigation
13	1981	Sigura-gura Dam	Asahan	Electricity
14	1981~1989	Sengguruh Baru Dam	Brantas	Multipurpose
15	1982	Batujai Dam	Lombok	Irrigation
16	1982~1985	Saguling Dam	Citarum	Hydroelectric Power Plant (PLTA)
17	1982~1987	Wadaslintang Dam	Serayu Bogowonto	Irrigation & Electricity
18	1982~1988	Mrica Dam	Serayu Bogowonto	Hydroelectric Power Plant (PLTA)
19	1983	Sampean Baru Dam	Pekalen-Sampean	Irrigation
20	1983	Siruar Dam	Asahan	Regulator
21	1983	Tangga Dam	Asahan	Electricity
22	1984	(Embung) Sepayung Dalam Dam	Sumbawa	Irrigation
23	1984	Bening Dam	Brantas	Irrigation & Electricity
24	1984	Ketro Dam	Bengawan Solo	Irrigation
25	1984	Song Putri Dam	Bengawan Solo	Irrigation
26	1984~1988	Cirata Dam	Citarum	Hydroelectric Power Plant (PLTA)

27	1986	(Embung) Selante Dam	Sumbawa	Irrigation
28	1986	Gondang Dam	Bengawan Solo	Irrigation
29	1986	Ladi Dam	Batam	Raw Water
30	1986	Pejengkolan Dam	Serayu-Bogowonto	Regulator & Electricity
31	1987~1989	Palasari Dam	Pulau Bali	Irrigation
32	1989	Kedung Ombo Dam	Jratunseluna	Irrigation & Electricity
33	1989	Palasari Dam	Bali	Irrigation
34	1990	Bakaru Dam	Sadang	Electricity
35	1991	(Embung) Roi Dam	Sumbawa	Irrigation
36	1992	Mamak Dam	Lombok	Irrigation & Electricity
37	1992	Muka Kuning Dam	Batam	Raw Water
38	1993	Lagol Dam	P Bintan	Raw Water
39	1994	(Embung) Batu Bokah Dam	Lombok	Irrigation
40	1994	Groggak Dam	Bali	Irrigation
41	1994	Pengga Dam	Lombok	Irrigation, Electricity & Raw Water
42	1994	Tiu Kulit Dam	Sumbawa	Irrigation, Electricity & Raw Water
43	1995	(Embung) Lamenta Dam	Sumbawa	Irrigation
44	1995	(Emung) Noera Dam	Sumbawa	Irrigation
45	1995	Duriangkang Dam	Batam	Raw Water
46	1995	Kalole Dam	Walanae-Cenranae	Irrigation, Electricity & Raw Water
47	1995	Lodan Wetan Dam	Jratunseluna	Irrigation & Raw Water
48	1995	Pondok Dam	Bengawan Solo	Irrigation & Electricity
49	1995	Pongkor Dam	Ciliwung-Cisadane	Gold Mine Wastewater
50	1996	Sermo Dam	Progo-Opak-Oyo	Irrigation
51	1996	Wonorejo Dam	Brantas	Irrigation, Electricity & Raw Water
52	1997	Batutegi Dam	Seputih-Sekampung	Irrigation & Electricity
53	1997	Kotopanjang Dam	Kampar	Electricity
54	1999	Bili-bili Dam	Jeneberang	Irrigation

Source: *Menyimak Bendungan di Indonesia 1910-2006*, KNIBB, 2007 and *Bendungan Besar di Indonesia*, Directorate General of Irrigation, 1995.

3.3. Management after Law Number 7 of 2004

3.3.1. Legal Framework

In the 1980s, there emerged a very strong issue concerning the environment and in the 1990s, there emerged the issue of human rights. Community movements that supported both issues emerged in many regions. The issues grew stronger after the land acquisition problem occurred during the construction of Kedung Ombo Dam.

In 1998, the Reformation governance replaced the New Order governance, which resulted in greater demands for regional autonomy.

This reformation had produced several changes in laws and regulations, among them were those related to the issue of water resources management, namely:

- Law Number 7 of 2004 regarding Water Resources, along with its ancillary regulations, namely:
 - Government Regulation Number 20 of 2006 regarding Irrigation
 - Government Regulation Number 42 of 2008 regarding Water Resources Management
 - Government Regulation Number 43 of 2008 regarding Groundwater
 - Government Regulation Number 38 of 2011 regarding Rivers
- Law Number 32 of 2004 concerning Regional Autonomy

The Law Number 7 of 2004, for instance, prescribes the authorities and responsibilities of water resources management for the central government, provincial governments and regency/municipal governments, as well as the establishment of water resources management policies by each government.

Meanwhile, the number of provincial administrations, particularly the number of regency and municipal administrations, continued to increase and today the numbers are as follows:

- 33 provinces
- 299 regencies, and
- 98 municipalities

The new provinces established in this era are:

- The Province of Bangka-Belitung Islands
- The Province of Banten
- The Province of Gorontalo
- The Province of North Maluku
- The Province of West Sulawesi
- The Province of West Papua

Actually, several provinces already have adequate human resources, experience and financial support to perform their authorities and obligations in water resources management. However, for some other provinces and regency/municipalities, their human resource, experience, and financial conditions were not adequate to perform their authorities and obligations, especially the provinces and regency/municipalities that were newly established. Therefore, the Central Government and the House of People's Representatives finally agreed to set a moratorium and not to establish new province and regency/municipal.

In 1997, an economic crisis hit the world, including Indonesia. This resulted in the emerging of policies, which among them was the restriction of new employee recruitment for central government and regional government agencies.

The consequence of these conditions led to negligence of water resources management, especially the maintenance of water resources structures. Erosion and sedimentation causes siltation reservoirs, irrigation structures and river structures, and damages to infrastructures, which was difficult to handle.

As a result, self-sufficiency in rice production could not be maintained, and Indonesia returned to being an importer of rice.

Furthermore, the reformation also mandated greater involvement of the people, especially stakeholders, in every aspect of development, from the planning, implementation to the monitoring of development. The preparation of development programs was carried out by accommodating regional wishes in addition to sectoral expectations, through various levels of consultation, namely the Consultation Forum for Development Planning (National Consultation Forum for Development Planning, Regional Consultation Forum for Development Planning). The results were enacted into a law, namely the National Long-term Development Plan (RPJPN) of 2005 – 2025. The plan was then broken down into National Medium-term Development Plan (RPJMN) at national level and Strategic Plan at ministerial/institutional level as well as Regional Medium-term Development Plan (RPJMD) at regional level, both with five-year term. Furthermore, it was broken down into Annual Work Program or Regional Government Work Plan (RKPD).

Coordination forums have been established in the field of water resources; those that are based on administration areas, namely Water Resources Councils (National, Provincial, Regency/Municipal Water Resources Councils) and those that are based on river basins, namely Water Resources Management Coordinating Teams (TKPSDA).

All these were established through various regulations, such as:

- 1) Law Number 7 of 2004 regarding Water Resources
- 2) Law Number 25 of 2004 regarding National Development Planning System
- 3) Law Number 33 of 2004 regarding Financial Balance between the Central Government and Regional Governments
- 4) Law Number 17 of 2007 regarding National Long-term Development Plan (RPJN)
- 5) Presidential Regulation Number 12 of 2008 regarding Water Resources Councils (DSDA)
- 6) Presidential Regulation Number 33 of 2011 regarding National Policies for Water Resources
- 7) Decree of the Minister of Public Works Number 04/PRT/M/2008 regarding Water Resources Management Coordinating Teams
- 8) Regulation of the Minister of Public Works Number 02/PRT/M/2010 regarding Strategic Plan of 2010-2014.

For the implementation of the above laws and regulations, based on a suggestion from the National Water Resources Council established under the Presidential Regulation Number 12 of 2008 regarding National Water Resources Council, the President has issued the Presidential Regulation Number 33 of 2011 regarding National Policies for Water Resources.

The National Policies concept outlines the general policies and technical policies in accordance with the mandates in Law Number 7 of 2004 regarding Water Resources.

The mandates of the National Policies for Water Resources are summarized as follows:

- 1) The load of water resources management will increase if the population growth is not controlled. Therefore, population control needs to be concerned in order to minimize the vulnerability at regions' level to five types of water-related hazards.
- 2) The National Policies for Water Resources Management are strategic directives for water resources management for the period of 2010-2030. Related ministries and institutions follow-up strategic plan in their respective work areas as part of the National Medium-term Development Plan.
- 3) Implementation of a principle of financial management service to water resources management policies at provincial level.
- 4) The monitoring and evaluation of the implementation of water resources management

policies need to be conducted annually in order to assess the success and failure in the achievement of objectives and trace the cause of the failure to serve as feedback for formulating corrective actions toward maximum success.

In the National Development Planning Meeting, national policies for water resources were proposed to be one of the inputs in the preparation of the Draft National Long-term Development Plan which is prescribed in Law Number 17 of 2007 regarding the National Long-term Development Plan of 2005-2025. This National Long-term Development Plan was then broken down into the Medium-term Development Plan and Strategic Plan (the plans and strategies of development for five-year periods for ministerial and institutional level) and the Regional Medium-term Development Plan (for regional level).

In addition, the National Policies for Water Resources also become a reference for the preparation of Water Resources Management Model and Plan by Water Resource Councils at provincial and Regency/municipal level as well as by the Water Resources Management Coordinating Teams (TKPSDA) in each river basin.

Furthermore, the Directorate General of Water Resources, as the organization in charge of water resources management, has set its vision and missions as follows:

Vision of 2025:

Materialize the benefits of sustainable water resources for the greatest possible welfare of the people.

The general overview of the state to be achieved in 2025 is as follows:

1. Water resources management policies at provincial level need to be prepared with referring to the National Policies for Water Resources by tailoring them to the local conditions and problems. Water resources management policies at regency/municipal level are prepared with referring to the water resources management policies at provincial level.

Promote active involvement of the people in water resources management through Water Resource Councils which act as a legitimate Dialogue and Coordination Forum for Stakeholders.

2. Enhance community protection against disasters caused by water destructive power.
3. Accomplished water resources management based on a comprehensive, integrated, sustainable and environmentally friendly river basin management model.
4. Fulfilled water sufficiency for the majority of the people with the people's basic needs and smallholder agriculture as the highest priority.
5. Water resources can provide incentives and disincentives by utilizing various resources in a synergistic and integrated manner.

Missions of 2025:

1. To conserve water resources in a sustainable manner.
2. To utilize water resources equally as well as to meet the quality and quantity requirements for various needs of the people.
3. To control water destructive power.
4. To empower and enhance the role of the people and the Government in water resources management.
5. To increase the transparency and availability of data and information in water resources management.

To carry out the vision, mission and policies, the Directorate General of Water Resources has set up a Water Resources Management Strategy as seen on the following Figure 19.

The essence of this Water Resources Management Strategy is as follows:

- Improve the empowerment of stakeholders, including effective service and accountability of management institutions, through various activities.
- Improve the internal empowerment, including the stakeholders, to enhance the performance and effectiveness of institutions development.
- Learning and development, especially related to the competence of the human resources/personnel, performance-based organization, and optimizing the use of information technology.

In a word, the management of water resources must be promoted in accordance with the legal basis in the form of laws and regulations, as well as the national policies, vision and mission and strategies as described above. Technically, the management of water resources must be exercised in accordance with the National Long-term Development Plan, Medium-term Development Plan, Strategic Plan for ministries and institutions, as well as the Regional Long-term Development Plan, Medium-term Development Plan, and Regional Government Work Plan for regional governments.

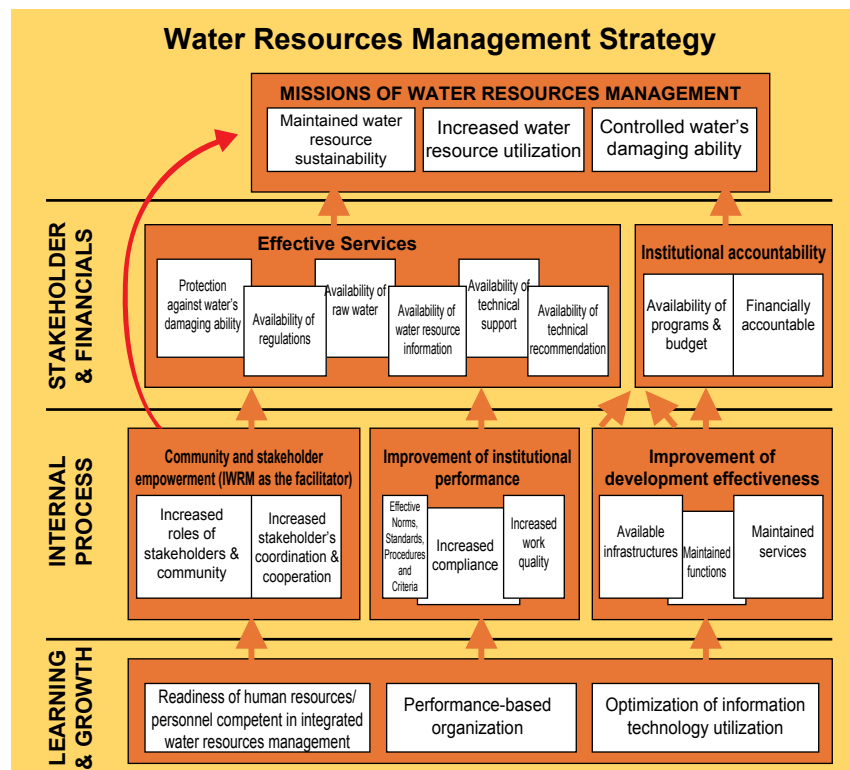


Figure 19: Water Resources Management Strategy

3.3.2. Managing Institutions

The management of water resources at central and regional levels are carried out by organizations established based on a decree issued by the Governor (for those under the authority of Provincial Government) or by the Minister of Public Works (for those under the authority of Central Government). These organizations are as follows:

- 1) Water Resource Utilization Organizations
 - a) These organizations serve as Provincial Technical Implementation Units (UPTD).
 - b) They operate based on cross-regency/municipality river basins.
- 2) River Basin Organizations
 - a) They serve as the Technical Implementation Units (UPT) in the field of water resource conservation, water resource utilization and control of water destructive power in river basins.
 - b) Assistance tasks are carried out by Non-Vertical Work Units for Particular Purpose (SNVT).
 - c) They are the subordinate of and responsible to the Director General of Water Resources.
- 3) Large River Basin Organizations
 - a) They serve as the Technical Implementation Units (UPT) in the field of water resource conservation, water resource development, water resource utilization and control of water destructive power in river basins.
 - b) Assistance tasks are carried out by Non-Vertical Work Units for Particular Purpose (SNVT).
 - c) They are the subordinate of and responsible to the Director General of Water Resources.

3.3.3. Budgeting

In accordance with the managing institutions and the legal framework for management and based on Law Number 33 of 2004 regarding Financial Balance between the Central Government and Regional Governments, the budget for river management can be put into three categories, namely:

- 1) The State Budget (APBN), including funds originating from Foreign Aids, both in the form of grants and loans. Funds from Foreign Aids may come from international financial institutions (such as World Bank) or regional financial institutions (such as Asian Development Bank or ADB), as well as from foreign governments (Government to Government or G to G) such as Japan, Australia, the Netherlands, Korea, China, and so on.
- 2) The Regional Budget (APBD), including Special Allocation Funds (DAK).

Special Allocation Funds (DAK) are from the State Budget to allocate for certain provinces/regency/municipalities, the purpose which is to finance special operations that are carried out by regional governments and are in accordance with national priorities.

General Allocation Funds (DAU) are funds from the revenues of the State Budget with a purpose of equalizing the financial capacities of the regions in funding regional requirements as part of the implementation of decentralization.

- 3) Third Party Budgets are non-government. In terms of water resources, there are state-owned enterprises (SOEs) which are given the authority and responsibility for management of water resources in particular regions, which are called Perum Jasa Tirta I and Perum Jasa Tirta II (PJT).

3.3.4. Implementation

Since the decade of the nineties, the implementation of management, including water resource development, has been facing many problems, especially in the provision of land for structures. In several cases, constructions had to be cancelled because land acquisition could not be done, such as in the construction plan of Depok dam, Limo dam, and so on.

In another case, the removal of the illegal settlements on the banks of the Ciliwung river in Kampung Melayu and along the bank of the Pluit reservoir, for example, has still not been successfully implemented.

On the other hand, with full support from the regional government and sufficient fund availability, land acquisition for the construction of East Flood Canal in Jakarta, for example, was successfully carried out within a relatively short time and it did not cause any significant social problems.

The following table shows some of the constructions of large water resource structures that have been carried out after 2004:

Table 11: Constructions of Water Resource Structures after 2004

No	Year	Structure	Location of River Basin	Main Benefit
1	2003-2006	TelagaTunjung Dam, Tabanan	Bali-Penida	Irrigation
2	2010	Benel Dam, Jembrana	Bali-Penida	Irrigation
3	2010	East Flood Canal	Ciliwung-Cisadane	Flood Management
4	Under construction	Jatibarang Dam	Jratunseluna	Multipurpose
5	Under construction	Jatigede Dam	Cimanuk	Multipurpose
6	Under construction	Karian Dam	Cidanau-Ciujung-	Multipurpose
7	2012 -	TitabBuleleng Dam	Bali-Penida	Irrigation, Hydroelectric Power Plant (PLTA)
8	2012 -	Bajulmati Dam	Brantas	Irrigation, Hydroelectric Power Plant (PLTA)
9	2012 -	Pandanduri Dam	NTB	Irrigation

Meanwhile, studies are currently being conducted for the construction of three dams in the island of Bali; one in Klungkung, which utilizes the water from the Unda River, one in Gianyar, which relies on the stream of the Petanu, and the dam that is going to be built in Tabanan utilizes the water from the Penet River.

4. RIVER MANAGEMENT IN THE FUTURE

4.1. General

Along with the development, the population of Indonesia will continue to grow. As a result, the need for land, for settlements and city infrastructures and others, will continue to increase. In major cities, the need for land will increase more due to the urbanization by the rural people. Similarly, the need for water, both for households and industries will continue to increase.

In some places in big cities like Jakarta, Bandung and Semarang, for example, there are indications of land subsidence that is believed to be due to, among others, excessive exploitation of groundwater.

Therefore, the management of water resources in river basins should be done with increase the efficiency of land use and the water itself.

4.2. Human Resource Development

Human beings are both the main subject and object of water resources management. As the main subject or actor, efforts are needed to improve their capacities continuously, as well as demonstrate their capacities in order to bring positive impacts on the environment. In due course, this individual capacity improvement can improve the capacity of managing institutions and eventually leads to increased capacity of the environment.

As the main object or stakeholders, people as individuals or as community groups, have diverse interests and these interests are not always the same. When this interest divergence is not managed properly, it will cause clashes, conflicts and new problems that are more serious. Conversely, if it can be managed properly, it will lead to tolerance and common motivation to manage water resources properly and equitably.

Every human being needs an average amount of 60 liters of water a day for various requirements. Indonesia, with a population of 235 million peoples, will consume water in an amount of 14,100 billion liters a day.

- If this consumption can be reduced by only 5%, we will obtain a saving of 750 million liters of water per day.
- If only 5% of the water that has been consumed is stored in the yard, in the form of infiltration well for example, and not discharged directly into a channel/river, we will obtain a saving of 750 million liters of water per day, while reducing the flow discharge in channels and in rivers.
- The same way of saving can be applied to rainwater that falls on the yard which will reduce the flooding in the rainy season.

Economizing applied to industrial water will also saving a large amount of water. This will increase reserves of water which will be beneficial to all mankind.

Therefore, water conservation campaigns need to be improved further, both by individual means and formal-legal means through relevant institutions and agencies, such as the National Movement for Water Safeguard Partnership (GNKPA), Water Resources Management Coordinating Teams (TKPSDA) and so on. Management of water resources in the future should consider public awareness campaign programs for greater efficiency in water consumption and contribution to the preservation of water.

4.3. Impacts of Global Climate Changes

It is believed that most of the increase in global average temperatures since the mid-20th century is most likely caused by the increased concentrations of greenhouse gases resulting from human activities through the greenhouse effect. The increase in global surface temperatures is anticipated to rise between 1,1 to 6,4°C between 1990 and 2100.

Increasing global temperature is anticipated to provide other changes such as rising sea levels, increased intensity of extreme weather phenomena and changes in the amount and pattern of precipitation. Other results are the impacts on agricultural outputs, the loss of glaciers and the extinction of various animal species.

Global warming will also melt the polar ice caps, causing sea level rise that is expected to reach 10-25 cm during the 20th century and 9-88cm in the 21st century. On lands located near the coast, it will cause a tidal flooding (rob) through the mouth of tidal rivers. It will also cause coastal cliff erosion and the formation of puddles or swamps in coastal areas, as well as changes in the ecosystem.

High temperatures can also cause crop failure leading to hunger and malnutrition. Extreme climate changes and sea level rise also cause diseases associated with catastrophes resulting from floods, storms and fires, and deaths due to trauma.

Ecosystem changes may affect the spread of diseases through water or through vectors, such as increased cases of dengue fever due to the emergence of new ecosystems for mosquitoes to breed in. Some types of viruses, bacteria, and plasmodium become more resistant to certain drugs.

However, not all scientists agree about the global warming and climate changes. It is acknowledged that there have been changes, but the predictions made about the future are considered too excessive.

But there are also things that are agreed upon by almost all scientists in facing the global climate changes, which are the need for mitigation and adaptation for the people, especially those who live in the areas that are to be affected.

4.4. Excessive Exploitation of Groundwater

Water is a renewable resource, but its presence in a given place at a given time is limited.

The increasing number of population and the development of industrial zones and urban infrastructures have also led to the increasing number of demands for water. Agencies in charge of water supply can only meet a small fraction of these requirements of water, so with their own efforts, consumers try to meet most of these water requirements through a way that is considered the fastest, which is by creating wells to abstract groundwater.

Ideally, rivers obtain supply from groundwater (effluent), especially in the dry season. Due to excessive groundwater abstraction, the surface decreases, so what happens is the groundwater obtains its supply from rivers or from puddles on the surface (influent). This flow also carries a variety of pollutants from rivers and other surface puddles, causing a contamination of river water by these pollutants. In coastal areas, seawater intrusion can occur even far inland, making groundwater taste brackish or even salty.

Decline in groundwater level is also believed to cause land subsidence. Land subsidence is a phenomenon that cannot be restored, but it can be prevented or reduced in its rate of decline by means of groundwater recharge until it reaches the previous level. In areas where the soil is relatively impervious such as clay or sandstone, this groundwater recharge is very slow or does not even occur. Construction of large dams that allow the storage of large amounts of water in upper watershed area is a relatively faster way to recharge groundwater.

In addition, excessive abstraction of groundwater must be stopped and the Government Regulation Number 43 of 2008 regarding Groundwater must be enforced.

4.5. Comprehensive and Integrated Water Resources Management

The Global Water Partnership 2000 explains Integrated Water Resources Management as “a process which promotes the coordinated management and development 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 eco-systems”¹⁾.

The effort required to improve the performance of water resources management is to promote an understanding of the concept of Integrated Water Resources Management to all related parties concerned. The integration of water resources management consists of two main components, namely the natural systems and non-natural systems.

The integration in the component of natural systems management includes:

- 1) Upstream areas and downstream areas
- 2) Water quality and water quantity
- 3) Rainwater with surface water and groundwater
- 4) Land use and water utilization

The integration in the component of non-natural systems management includes:

- 1) Integration of all sectors related in the formulation of policies and programs at central and regional levels.
- 2) Integration of all parties related in the planning and decision making.
- 3) Integration of all administrative areas, both horizontally and vertically.

The Integrated Water Resources Management has been carried out in several river basins in Indonesia. However, it is still facing many obstacles, especially at the level of field implementation.

The process to achieve this integration is a series of activities that must be performed continuously with clear targets for each stage of its activities. The accountability of each designed stage should be assessed and its success should be measured at least based on three main criteria, namely economic efficiency, equity and environmental function sustainability.

5. CLOSING

Based on the descriptions in the previous chapters, we can conclude as follows:

- 1) River management in Indonesia, including constructions of large water resource structures, has been carried out since the days of the kingdoms, long before the proclamation of independence. Some structures are still functioning well, and others are known only from the discovery of several inscriptions that tell the creation and existence of the structures.

Constructions of large water resource structures at each period of implementation are summarized in Table 12:

Table 12: Recapitulation of Water Resource Structure Constructions

No	Period	Number of Large Water Resource Structures	Term (year)
1	Until 1945	29	
2	1945-1974	9	29
3	1974-2004	54	30
4	> 2004	9	
	Total	101	

In the table above, it can be seen that the period of 1945-1974 was a “difficult” period for the construction of large structures due to some limitations in human resources, financial resources and internal political and security stability, while the period of 1974-2004 was the most productive period in generating large structures. This development was supported by the development of human resources, financing aids from international institutions such as the World Bank (IBRD), Asian Development Bank (ADB) and Japanese ODA (OECD / JICA), as well as the stable internal political and security conditions.

Meanwhile, during the period after 2004 until now (2012), only nine large structures have been built. This is due to the impact of the 1998 global economic crisis, in addition to the internal socio-political situation which often heats up due to various issues including regional autonomy and land acquisition which has been linked with human rights issues.

The existence of large dams has proven to provide enormous benefits for flood mitigation and drought control, inexpensive power generation, and it greatly supports national food security. Therefore, the construction of large dams should be improved in the future.

- 2) Based on the Presidential Decree Number 12 regarding Establishment of River Basins, the majority of river basins in Indonesia is under the authority of the Central Government, which amounts to 63 river basins, consisting of 4,300 watersheds, as seen in the following Table 13:

Table 13: Managers of River Basins and Watersheds

No	Manager	Number of River Basins	Number of Watersheds
1	Central Government	63	4,300
2	Provincial Governments	53	3,168
3	Regency/Municipal Governments	15	504
	Total	131	7,972

In the future, regional governments should be encouraged in improving their capabilities, particularly in terms of human resources, so that they will be able to assume greater responsibility in managing river basins, especially the national strategic river basins, to be used as regional assets.

- 3) Deterioration of watersheds due to deforestation, logging in forests, fires, forest clearing and so on greatly affects the quality and quantity of water resources, while efforts of rehabilitation are much lower than the deterioration that occurs. Therefore, breakthrough efforts are needed to reduce this deterioration, including the effort of law enforcement.
- 4) The population continues to increase, and the need for land (land-hunger) will continue to increase. Similarly, urbanization with all its effects such as increased ecological footprint and reduced environmental quality index, including rising amount of domestic waste, especially in urban areas, excessive groundwater abstraction, and so on, greatly affect the quality of water resources as well as human life. Therefore, government, including regional governments and other stakeholders should produce water resources management models and plans with anticipating above changes .
- 5) Science and technology, as well as river management develop from time to time, and this might provide us a more integrated and comprehensive problem-solving. Potential parties and people that are not yet involved in water resources management should be included formally in water resources development.
- 6) This book introduces eleven Large River Basin Organizations (BBWS). There are eleven Large River Basin Organizations (BBWS) namely:
 1. BBWS Brantas
 2. BBWS Bengawan Solo
 3. BBWS Pemali-Juana
 4. BBWS Serayu-Opak
 5. BBWS Cimanuk-Cisanggarung
 6. BBWS Pompengan-Jeneberang
 7. BBWS Citarum
 8. BBWS Mesuji-Sekampung
 9. BBWS Citanduy
 10. BBWS Ciliwung-Cisadane
 11. BBWS Cidanau-Ciujung-Cidurian

As many as nine organizations are located in the island of Java, one organization in the island of Sumatra and one organization in Sulawesi. These organizations are selected because of the data availability in the limited time.

LIST OF ATTACHMENTS

- 1. Japanese ODA to Indonesia**
- 2. List of River Basins and Watersheds**
- 3. List of References**

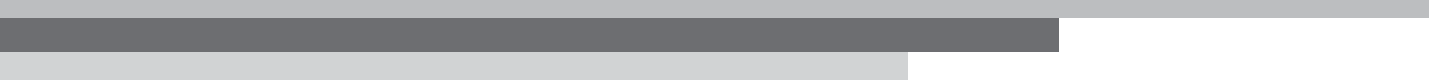
Japanese ODA to Indonesia

Attachment 1

No.	Project Name	Project Site	Province / BBWS BWS	Project Period	Name of JICA Expert / Consultant	Project Type
1	Krueng Aceh Urgent Flood Control Project	The Krueng Aceh Basin	BWS Sumatera I	Preliminary Study : 1972-1973 Feasibility Study : 1979 Detail Design : Feb 1981 - Nov 1982 Construction : Aug 1983 - Jan 1993	Oriental Consultants Co., Ltd. & Associates	TC & ODA Loans
2	Medan Flood Control Project	Medan City	BWS Sumatera II	Study of Blawan Padang Int'd RB Dev. (MasterPlan & FS) : Mar 1990 - Mar 1992 Detail Design : Mar 1995 - Sep 1996 Construction : Jan 1999 - Jan 2009	CTI Eng. Int'l Co., Ltd. & Associates	TC & ODA Loans
3	Ular River Flood Control and Improvement of Irrigation Project	Deli Serdang Regency	BWS Sumatera II	Urgent Work (JICA & IP-197) : 1969-1976 Mplan, FS, DD & Con'tn (IP-236) : 1976 - 1989 Sustainability Works (IP-347) : 1989 - 1995	IDEA Consultants, Inc. & Associates	TC & ODA Loans
4	Lower Asahan River Flood Control	Kisaran and Tanjung Balai City, Asahan Regency	BWS Sumatera II	MasterPlan : 1984 - 1985 Detail design : Feb 1988 - Feb 1990	Nippon Koei Co., Ltd. & Associates	TC & ODA Loans
5	Padang Area Flood Control Project	Padang City & Padang Pariaman Regency	BWS Sumatera V	Master Plan & FS (JICA) 1982 - 1984 Detail Design (IP-292) : 1987 - 1990 (Stage I) Construction (IP-360) : 1991 - 1996 (Stage II) Construction (IP-451) : 1996 - 2002 Port Earth-quake Rehab'n Work (JICA Grant Aid) : 2009 - 2011	IDEA Consultants, Inc. & Associates	TC & ODA Loans & GA
6	South Sumatera Swamp Improvement Project	Air Sugihan/ Pulau Limau	BBWS Sumatera VIII	Detail Design : Jan 1993 - Sep 1996	EUROCONSULT in association with Oriental Consultants Co., Ltd.	ODA Loans
7	Batuteji Dam Project (Way Sekampung Irrigation Project)	Way Sekampung River, Bandar Lampung	BBWS Mesuji - Sekampung	Construction : Feb 1994 - Nov 2003	Nippon Koei Co., Ltd. & Associates	ODA Loans
8	The Project for Urgent Reconstruction of East Pump Station of Pluit in Jakarta	Pluit Pump Station	BBWS Ciliwung - Cisadane	January 2011 - March 2014 (Tentative)	Yachiyo Engineering Co., Ltd.	GA
9	Jakarta/Jabodetabek Flood Control Project	JABODETABEK Area	BBWS Ciliwung - Cisadane	West Jakarta, DD & Constr'n (IP-264 & IP-273) : 1985-1992 East Jkt, DD & Const'n (IP-328 & IP-347 & IP-373) : 1988 - 1999 Ancol Pumping Station, DD & Const'n (IP-373) : 1991 - 1998 Ciliwung-Cisadane, MPlan, FS & DD (JICA & IP-496) : 1994 - 2008 Mobile Pumps (Grand Aid) : 2003 - 2004	IDEA Consultants, Inc. & Associates	TC, ODA Loans & GA
10	Capacity Development of Jakarta Comprehensive Flood Management	Ciliwung River Basin	BBWS Ciliwung - Cisadane	October 2010 - September 2013	Takaya TANAKA, Yachiyo Engineering Co., Ltd.	TC
11	Upper Citarum River Basin Flood Control and Farm/ Forest Land Conservation Project	The Upper Citarum River Basin	BBWS Citarum	Project Period from 1987 to 2010 1) Study on the Flood Control Plan of the Upper Citarum Basin (Master Plan & Feasibility Study : 1987 - 1988 2) Upper Citarum Basin Urgent Flood Control Project Detail Design (ODA Loan, IP-347) : 1992 - 1993 3) Upper Citarum Basin Urgent Flood Control	Oriental Consultants Co., Ltd. & Associates	TC & ODA Loans

				Project (Stage I) Construction (ODA Loan, IP-405) : 1994 - 1999 4) Upland Plantation and Land Development Project at Citarik Sub-Watershed (ODA Loan, IP-455) : 1995 - 2006 5) Upper Citarum Basin Urgent Flood Control Project (Stage II) Construction (ODA Loan, IP-497) : 2000 - 2007 6) Preparatory Survey for Upper Citarum River Basin Tributaries Flood Management Project (Preparatory Survey) : 2010		
12	Capacity Development Project for River Basin Organizations in Practical Water Resources Management and Technology	Bandung and Solo	BBWS B. Solo	July 2008 to July 2011	SUGI Masakazu, SUGIMURA Yokito, SHIRAKAWA Nobuyuki, OJIMA Satoshi, OHARA Katsuhiko	TC
13	Development Project for Sabo: 1). Volcanic Sabo Technical Centre (VSTC) Project 2). Sabo Technical Centre (STC) Project 3). Integrated Sediment-related Disaster Management (ISDM) Project	Yogyakarta	BBWS Serayu-Opak	VSTC : From August 1982 until March 1990 STC : From April 1992 until March 1997 ISDM : From April 2001 until March 2006	All JICA Expert for Sabo	TC & GA
14	Volcanic Disaster Countermeasure Project for Mt. Merapi	Mt. Merapi	BBWS Serayu-Opak	1. Mt. Merapi Urgent Volcanic Debris Control Project (Phase I) Detail Design & Construction : January 1987 - June 1992 2. Mt. Merapi and Mt. Semeru Volcanic Disaster Countermeasure Project (Phase II) Detail Design & Construction : July 1996 - November 2001	Y a c h i y o Engineering Co., Ltd. & Associates	TC & ODA Loans
15	Urgent Disaster Reduction Project for Mt. Merapi Progo River Basin	Progo River Basin	BBWS Serayu-Opak	DD & Construction : July 2005 - July 2014	Y a c h i y o Engineering Co., Ltd. & Associates	ODA Loans
16	Integrated Water Resources and Flood Management Project for Semarang	Semarang City	BBWS Pemali-Juana	Master Plan & FS (by JICA) 1992 - 1993 Detail Design (by JICA) : 1997 - 2000 Construction : 2007 - 2014	CTI Engineering International Co., Ltd. & Associates	TC & ODA Loans
17	Wonogiri Multipurpose Dam Project	Bengawan Solo River Basin	BBWS B. Solo	M Plan of B. Solo River Basin : Juni 1972 - Mar 1974 Detail Design & Construction : 1976 - 1983 Grant Aid : 2001 - 2004	Nippon Koei Co., Ltd.	TC, ODA Loans & GA
18	Madiun River Urgent Flood Control Project	Madiun, Bengawan Solo	BBWS B. Solo	Detail Design & Construction : 1983 - 1995	Nippon Koei Co., Ltd.	TC & ODA Loans
19	Lower Solo River Improvement Project Phase-I	River Basin B. Solo River Basin	BBWS B. Solo	Master Plan of Bengawan Solo River Basin : June 1972 - March 1974 Grant Aid : 1991 Detail Design : 1992 - 1994 Construction : February 1997 - August 2004	Nippon Koei Co., Ltd. & Associates	TC, ODA Loans & GA
20	Lower Solo River Improvement Project Phase-II	B. Solo River Basin	BBWS B. Solo	Construction : Sept 2007 - Nov 2013	Nippon Koei Co., Ltd. & Associates	ODA Loans

21	Wonorejo Multipurpose Dam Project	Tulungagung Area, Brantas River Basin	BBWS Brantas	DD & Construction : Sept 1982 - Oct 2000	Nippon Koei Co., Ltd. & Associates	TC & ODA Loans
22	Mt. Kelud Urgent Volcanic Disaster Mitigation Project	Kediri, Blitar, Tulungagung Regencies	BBWS Brantas	DD & Construction : Oct 1992 - May 1996	Yachiyo Engineering Co., Ltd. & Associates	ODA Loans
23	Wlingi Multipurpose Dam Project	Tulungagung Area, Brantas River Basin	BBWS Brantas	Master Plan : August 1971 - March 1973 DD & Construction : 1975 - 1978	Nippon Koei Co., Ltd.	TC & ODA Loans
24	Water Resources Existing Facilities Rehabilitation and Capacity Improvement Project	Brantas River Basin	BBWS Brantas	Const'n/Rehabilitation : Dec 2003 - Dec 2011	Nippon Koei Co., Ltd. & Associates	ODA Loans
25	Brantas Middle Reaches River Improvement Project	Brantas River	BBWS Brantas	Master Plan : August 1971 - March 1973 Detail Design : 1978 - 1980 Construction : 1980 - 1990	Nippon Koei Co., Ltd. & Associates	TC & ODA Loans
26	Surabaya River Improvement Project (SRIP) & Surabaya Urban Development Project (SUDP)	Surabaya City	BBWS Brantas	Master Plan & FS (JICA) : 1971 - 1973 Detail Design & Construction of Stage I Works (SRIP I, IP-109) : 1975 - 1980 Detail Design & Construction of Stage II-1 Works (IP-308 & IP-362) : 1987 - 1996 Detail Design & Construction of SUDP (IP-400) : 1994 - 2002	IDEA Consultants, Inc. & Associates	TC & ODA Loans
27	Volcanic Disaster Countermeasure Project for Mt. Semeru	Lumajang	BBWS Brantas	1. Mt. Semeru Urgent Rehabilitation Project (Phase I) Detail Design & Construction : 1986 - 2. Mt. Merapi and Mt. Semeru Volcanic Disaster Countermeasure Project (Phase II) Detail Design & Construction : July 1996 - November 2001 November 2008 - November 2011	Yachiyo Engineering Co., Ltd. & Associates	TC & ODA Loans
28	Integrated Disaster Mitigation Management Project for "Banjir Bandang"	Jember Regency and Neighboring Area	BBWS Brantas	The Study on the Urgent Bali Beach Conservation Project Feasibility Study : 1988 - 1989 Detail Design : Nov 1991 - Feb 1993, Construction : April 1998 - December 2008	UENO Toshiyasu, SHIIBA Shusaku, YOSHIDA Keiji	TC
29	Bali Beach Conservation Project	Sanur, Nusa Dua, Kuta and Tanah Lot	BWS Bali-Penida	1. FS of Jenebarang River Flood Control Project by JICA (Feb 1979 - Sep 1980) 2. FS of Jenebarang River Flood Control Project Phase II by JICA (Feb 1981 - Mei 1982) (Construction)	Nippon Koei Co., Ltd. & Associates	TC & ODA Loans
30	Jenebarang River Basin Development Project	Makassar City, Gowa Regency, Takarar Regency	BBWS Pompengan-Jenebarang	1. Lower Jenebarang River Flood Control and Primary Drainage Channel Improvement in Makassar City (Detail Design : 1983 - 1984) Construction : 1988 - 1993 2. Bili-Bili Multipurpose Dam (1992 - 1999) 3. Municipal Water Supply System (Somba-Opu Water Treatment Plant and Water Transmission) (1995 - 2001) 4. Environmental Improvement Works for Bili-Bili Dam (1993 - 2001) 5. Pampang River Improvement Project (1996 - 2001) 6. Bili-Bili Irrigation Project (1997 - 2004) 7. Bili-Bili Hydroelectric Power Plant (2002-2006)	CTI Engineering International Co., Ltd. & Associates	TC & ODA Loans
31	Urgent Disaster Reduction Project for Mt. Bawakaraeng	Mt. Bawakaraeng	BBWS Pompengan-Jenebarang	DD & Construction : July 2005 - July 2014	Yachiyo Engineering Co., Ltd. & Associates	TC & ODA Loans



River Basins and Watersheds Presidential Decree Number 12 of 2012

Attachment 2

No	River Basin Code	Name of River Basin	Number of Watersheds	Name of Watershed	Location
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1. Cross-country

1	03.07.A1	Benanain	45	As shown on Appendix V.79 Map	East Nusa Tenggara - Timor Leste
2	03.08.A1	Noelmina	186	As shown on Appendix V.80 Map	East Nusa Tenggara - Timor Leste
3	04.17.A1	Sesayap	19	As shown on Appendix V.97 Map	East Kalimantan - Serawak (Malaysia)
4	07.04.A1	Memberamo - Tami - Apauvar	25	As shown on Appendix V.130 Map	Papua - Papua New Guinea
5	07.05.A1	Einlanden - Digul - Bikuma	29	As shown on Appendix V.131 Map	Papua - Papua New Guinea
5 River Basins			304	Watersheds	

2. Cross-province

1	01.09.A2	Alas - Singkil	8	Kuala Hitam, Hitam, Anun, Singkil, Simardokar, Banyak, Tuangku	Aceh - North Sumatera
2	01.18.A2	Batang Natal - Batang Batahan	40	As shown on Appendix V.18 Map	North Sumatera - West Sumatera
3	01.23.A2	Rokan	15	As shown on Appendix V.23 Map	North Sumatera - Riau - West Sumatera
4	01.27.A2	Kampar	7	Kampar, Teluk, Upih, Teluk Beringin, Solok, Tanjung Sum, and Teluk	Riau - West Sumatera
5	01.29.A2	Indragiri - Akuaman	24	As shown on Appendix V.29 Map	Riau - West Sumatera
6	01.37.A2	Batanghari	2	Batanghari and Air Hitam	Jambi - West Sumatera
7	01.38.A2	Teramang - Muar	15	As shown on Appendix V.38 Map	Bengkulu - Jambi
8	01.42.A2	Nasal - Padang Guci	19	As shown on Appendix V.42 Map	Bengkulu - South Sumatera - Lampung
9	01.43.A2	Musi-Sugihan-Banyuasin-Lemau	28	As shown on Appendix V.43 Map	South Sumatera - Jambi - Bengkulu
10	01.46.A2	Mesuji - Tulang Bawang	2	Mesuji and Tulang Bawang	Lampung - South Sumatera
11	02.03.A2	Cidanau - Ciujung - Cidurian*	34	As shown on Appendix V.51 Map	Banten - West Java
12	02.04.A2	Kepulauan Seribu	40	As shown on Appendix V.52 Map	Jakarta - Banten
13	02.05.A2	Ciliwung - Cisadane*	15	As shown on Appendix V.53 Map	Jakarta - Banten - West Java
14	02.09.A2	Cimanuk - Cisanggarung	25	As shown on Appendix V.57 Map	West Java - Central Java
15	02.10.A2	Citanduy	24	As shown on Appendix V.58 Map	West Java - Central Java
16	02.17.A2	Progo - Opak - Serang	3	Opak, Progo and Serang	Yogyakarta - Central Java

17	02.18.A2	Bengawan Solo	96	As shown on Appendix V.66 Map	East Java - Central Java
18	04.05.A2	Jelai - Kendawangan	11	As shown on Appendix V.85 Map	Central Kalimantan - West Kalimantan
19	04.09.A2	Barito	4	As shown on Appendix V.89 Map	Central Kalimantan - South Kalimantan
20	05.03.A2	Dumoga - Sangkub	55	As shown on Appendix V.100 Map	North Sulawesi - Gorontalo
21	05.04.A2	Limboto - Bolango - Bone	75	As shown on Appendix V.101 Map	Gorontalo - North Sulawesi
22	05.06.A2	Randangan	14	As shown on Appendix V.103 Map	Gorontalo - Central Sulawesi
23	05.08.A2	Palu - Lariang	52	As shown on Appendix V.105 Map	Central Sulawesi - West Sulawesi
24	05.13.A2	Kalukku - Karama	74	As shown on Appendix V.110 Map	West Sulawesi - South Sulawesi
25	05.14.A2	Pompengan - Larona	27	As shown on Appendix V.111 Map	South Sulawesi - North Sulawesi
26	05.15.A2	Saddang	24	As shown on Appendix V.112 Map	South Sulawesi - West Sulawesi
27	05.18.A2	Towari - Lasusua	28	As shown on Appendix V.115 Map	Southeast Sulawesi - South Sulawesi
28	05.19.A2	Lasolo - Konawehea	25	As shown on Appendix V.116 Map	North Sulawesi - Central Sulawesi
29	07.02.A2	Omba	73	As shown on Appendix V.128 Map	Papua Barat - Papua
29	River Basins		859	Watersheds	

3. National Strategic

1	01.01.A3	Aceh - Meureudu	30	As shown on Appendix V.1 Map	Aceh
2	01.04.A3	Woyla - Bateue	13	As shown on Appendix V.4 Map	Aceh
3	01.05.A3	Jambo Aye	13	As shown on Appendix V.5 Map	Aceh
4	01.11.A3	Belawan - Ular - Padang	11	As shown on Appendix V.11 Map	North Sumatera
5	01.13.A3	Toba - Asahan	1	Toba - Asahan	North Sumatera
6	01.25.A3	Siak	2	As shown on Appendix V.25 Map	Riau
7	01.34.A3	Batam - Bintan Islands	31	As shown on Appendix V.34 Map	Riau Islands
8	01.44.A3	Bangka	63	As shown on Appendix V.44 Map	Bangka Belitung
9	01.48.A3	Seputih - Sekampung	42	As shown on Appendix V.48 Map	Lampung
10	02.06.A3	Citarum*	19	As shown on Appendix V.54 Map	West Java
11	02.10.A3	Serayu - Bogowonto	15	As shown on Appendix V.60 Map	Central Java
12	02.14.A3	Jratunseluna	69	As shown on Appendix V.64 Map	Central Java
13	02.17.A3	Brantas	220	As shown on Appendix V.67 Map	East Java
14	03.01.A3	Bali - Penida	391	As shown on Appendix V.73 Map	Bali
15	03.02.A3	Lombok	197	As shown on Appendix V.74 Map	West Nusa Tenggara
16	03.03.A3	Sumbawa	555	As shown on Appendix V.75 Map	West Nusa Tenggara
17	03.05.A3	Flores	472	As shown on Appendix V.77 Map	East Nusa Tenggara
18	04.03.A3	Kapuas	9	As shown on Appendix V.83 Map	West Kalimantan
19	04.07.A3	Mentaya - Katingan	2	Mentaya and Katingan	Central Kalimantan
20	04.14.A3	Mahakam	12	As shown on Appendix V.93 Map	East Kalimantan

21	05.01.A3	Tondano - Sangihe-Talaud - Miangas	89	As shown on Appendix V.98 Map	North Sulawesi
22	05.05.A3	Paguyaman	20	As shown on Appendix V.102 Map	Gorontalo
23	05.09.A3	Parigi - Poso	50	As shown on Appendix V.106 Map	Central Sulawesi
24	05.16.A3	Walanae - Cenranae	39	As shown on Appendix V.113 Map	South Sulawesi
25	05.17.A3	Jeneberang	58	As shown on Appendix V.114 Map	South Sulawesi
26	06.01.A3	North Halmahera	130	As shown on Appendix V.120 Map	North Maluku
27	06.02.A3	South Halmahera	265	As shown on Appendix V.121 Map	North Maluku
28	06.05.A3	Ambon - Seram	166	As shown on Appendix V.124 Map	Maluku
29	06.07.A3	Yamdena - Wetar Islands	153	As shown on Appendix V.126 Map	Maluku
29 River Basins			3,137	Watersheds	

4. Cross-regency/municipality

1	01.02.B	Teunom - Lambeuso	14	As shown on Appendix V.2 Map	Aceh
2	01.03.B	Pase - Peusangan	10	Pandrah, Nalon, Peudada, Ihong, Peusangan, Tuam, Buluh, Pase	Aceh
3	01.06.B	Tamiang - Langsa	17	As shown on Appendix V.6 Map	Aceh
4	01.07.B	Baru - Kluet	21	As shown on Appendix V.7 Map	Aceh
5	01.10.B	Wampu - Besitang	13	As shown on Appendix V.10 Map	North Sumatera
6	01.12.B	Bah Bolon	5	Sipare-pare, Bolon, Perupuk, Kiri, and Silau Bonto	North Sumatera
7	01.14.B	Nias	43	As shown on Appendix V.14 Map	North Sumatera
8	01.15.B	Sibundong - Batang Toru	16	As shown on Appendix V.15 Map	North Sumatera
9	01.16.B	Barumon - Kualuh	2	Panai dan Aek Barumon	North Sumatera
10	01.17.B	Batang Angkola - Batang Gadis	5	Toru, Nagor, Batang Singkuang, Batang Gadis, and Tabuyung	North Sumatera
11	01.30.B	Rete	3	Apung	Riau
12	01.31.B	Bengkalis - Meranti	37	As shown on Appendix V.31 Map	Riau
13	01.19.B	Masang - Pasaman	8	Bangis, Sikilang, Maligi, Pasaman, Ampu, Simpang, Palembayan	West Sumatera
14	01.21.B	Silaut - Tarusan	17	As shown on Appendix V.21 Map	West Sumatera
15	01.36.B	Pengabuan - Lagan	5	Pengabuan, Betara, Pangkal Duri, Mandahara and Lagan	Jambi
16	01.39.B	Sebelat - Ketahun - Lais	19	As shown on Appendix V.39 Map	Bengkulu
17	01.40.B	Bengkulu - Alas - Talo	9	Bengkulu, Jenggalu, Nelas, Kungkai, Seluma, Penago, Talo, Alas	Bengkulu
18	01.45.B	Belitung	91	As shown on Appendix V.45 Map	Bangka Belitung
19	01.47.B	Semangka	116	As shown on Appendix V.47 Map	Lampung
20	02.01.B	Cibaliung - Cisawarna	75	As shown on Appendix V.49 Map	Banten
21	02.02.B	Ciliman - Cibungur	27	As shown on Appendix V.50 Map	Banten
22	02.05.B	Cisadea - Cibareno	74	As shown on Appendix V.55 Map	West Java
23	02.06.B	Ciwulan - Cilaki	72	As shown on Appendix V.56 Map	West Java
24	02.09.B	Pemali - Comal	32	As shown on Appendix V.59 Map	Central Java
25	02.11.B	Bodri - Kuto	12	As shown on Appendix V.61 Map	Central Java

26	02.18.B	Madura - Bawean	173	As shown on Appendix V.68 Map	East Java
27	02.19.B	Welang - Rejoso	36	As shown on Appendix V.69 Map	East Java
28	02.20.B	Bondoyudo - Bedadung	47	As shown on Appendix V.70 Map	East Java
29	02.21.B	Pekalen - Sampean	56	As shown on Appendix V.71 Map	East Java
30	02.22.B	Baru - Bajulmati	60	As shown on Appendix V.72 Map	East Java
31	03.04.B	Sumba	130	As shown on Appendix V.76 Map	East Nusa Tenggara
32	03.06.B	East Flores - Lembata - Alor Islands	439	As shown on Appendix V.78 Map	East Nusa Tenggara
33	04.01.B	Sambas	4	Polah, Sambas, Sebangkau, and Selakau	West Kalimantan
34	04.02.B	Mempawah	5	Raya, Duri, Mempawah, Karimunting, and Lemukutan	West Kalimantan
35	04.06.B	Seruyan	3	Perlu, Segitung, and Seruyan	Central Kalimantan
36	04.08.B	Kahayan	2	Sebangan and Kahayan	Central Kalimantan
37	04.10.B	Cengal - Batulicin	62	As shown on Appendix V.90 Map	South Kalimantan
38	04.12.B	Kendilo	9	As shown on Appendix V.92 Map	East Kalimantan
39	04.14.B	Karangan	43	As shown on Appendix V.94 Map	East Kalimantan
40	04.15.B	Berau - Kelai	15	As shown on Appendix V.95 Map	East Kalimantan
41	04.16.B	Kayan	9	Kayan	East Kalimantan
42	05.02.B	Poigar - Ranoyapo	24	As shown on Appendix V.99 Map	North Sulawesi
43	05.07.B	Lambunu - Buol	99	As shown on Appendix V.104 Map	Central Sulawesi
44	05.10.B	Bongka - Mentawa	109	As shown on Appendix V.107 Map	Central Sulawesi
45	05.12.B	Laa - Tambalako	89	As shown on Appendix V.109 Map	Central Sulawesi
46	05.20.B	Poleang - Roraya	174	As shown on Appendix V.117 Map	Southeast Sulawesi
47	05.21.B	Muna	106	As shown on Appendix V.118 Map	Southeast Sulawesi
48	05.22.B	Buton	95	As shown on Appendix V.119 Map	Southeast Sulawesi
49	06.03.B	Sula - Obi Islands	184	As shown on Appendix V.122 Map	North Maluku
50	06.04.B	Buru	53	As shown on Appendix V.123 Map	Maluku
51	06.06.B	Kei - Aru Islands	211	As shown on Appendix V.125 Map	Maluku
52	07.01.B	Kamundan - Sebyar	91	As shown on Appendix V.127 Map	Papua Barat
53	07.03.B	Wapoga - Mimika	97	As shown on Appendix V.129 Map	Papua
53	River Basins		3,168	Watersheds	

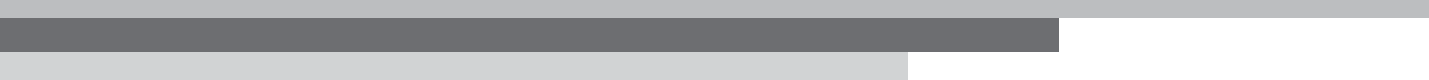
5. Within one regency/municipality

1	01.08.C	Simeulue	26	As shown on Appendix V.8 Map	Aceh, Simeulue
2	01.22.C	Kubu	8	Paripahan, Pasir Limau Kapas, Pasir Limau, Sungai Daun, Teluk	Riau, Rokan Hilir
3	01.24.C	Bukit Batu	2	Sepahat and Bukit Batu	Riau, Bengkalis
4	01.26.C	Rawa	6	Rawa, Metas, Mungkal, Belat, Lakar, and Kimas	Riau, Siak
5	01.28.C	Guntung - Kateman	1	Danai, Kateman, Burung, and Busung	Riau, Indragiri Hilir
6	01.32.C	Karimun Islands	22	As shown on Appendix V.32 Map	Riau Islands, Karimun
7	01.33.C	Lingga Islands - Singkep	35	As shown on Appendix V.33 Map	Riau Islands, Lingga
8	01.35.C	Natuna - Anambas Islands	29	As shown on Appendix V.35 Map	Riau Islands, Natuna

9	01.20.C	Siberut - Pagai - Sipora	86	As shown on Appendix V.20 Map	West Sumatera, Mentawai
10	01.41.C	Enggano	10	Mae, Tanjung Kooma, Tanjung Lakoaha, Mahame, Kokodo	Bengkulu, North Bengkulu
11	02.12.C	Karimunjawa Islands	20	As shown on Appendix V.62 Map	Central Java, Jepara
12	02.13.C	Wiso - Gelis	27	As shown on Appendix V.63 Map	Central Java, Jepara
13	04.04.C	Pawan	6	Semadang, Semanai, Siduk, Tolak, Pawan and Pesaguan	West Kalimantan, Ketapang
14	04.12.C	Laut Island	41	As shown on Appendix V.91 Map	South Kalimantan, Kota Baru
15	05.11.C	Banggai Islands	185	As shown on Appendix V.108 Map	Central Sulawesi, Banggai Islands
15	River Basins		504	Watersheds	

TOTAL

131	River Basins	7,972	Watersheds
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5. Government Regulation Number 42 of 2008 regarding Water Resources Management pdf file
6. Government Regulation Number 15 of 2010 regarding Spatial Planning Implementation pdf file
7. Government Regulation Number 38 of 2011 regarding Rivers pdf file
8. Government Regulation Number 37 of 2012 regarding Watershed Management pdf file
9. Presidential Regulation Number 33 of 2011 regarding National Policies on Water Resources pdf file
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| 1. | Profile of BBWS Brantas, 2008 | pdf file |
| 2. | Profile of BBWS Brantas, 2011 | pdf file |
| 3. | Profile of BBWS Bengawan Solo | pdf file |
| 4. | Profile of BBWS Pemali-Juana | pdf file |
| 5. | Profile of BBWS Serayu-Opak | pdf file |
| 6. | Profile of BBWS Cimanuk-Cisanggarung | pdf file |
| 7. | Profile of BBWS Jeneberang-Pompeungan | pdf file |
| 8. | Profile of BBWS Citarum | pdf file |
| 9. | Profile of BBWS Mesuji- Profile of BBWS Sekampung | pdf file |
| 10. | Profile of BBWS Sumatera VIII | pdf file |
| 11. | Profile of BBWS Citanduy | pdf file |
| 12. | Profile of BBWS Ciliwung-Cisadane | pdf file |
| 13. | Profile of BBWS Cidanau-Ciujung-Cidurian | pdf file |
| 14. | Profile of BWS Sumatera I | pdf file |
| 15. | Profile of BWS Sumatera II | pdf file |
| 16. | Profile of BWS Sumatera V | pdf file |
| 17. | Profile of BWS Sumatera VI | pdf file |
| 18. | Profile of BWS Sumatera VII | pdf file |
| 19. | Profile of BWS Bali-Penida | pdf file |
| 20. | Profile of BWS Nusa Tenggara I | pdf file |
| 21. | Profile of BWS Kalimantan II | pdf file |
| 22. | Profile of BWS Sulawesi III | pdf file |
| 23. | Profile of BWS Nusa Tenggara II | pdf file |
| 24. | Profile of BWS Kalimantan I | pdf file |
| 25. | Profile of BWS Sulawesi I | pdf file |
| 26. | Profile of BWS Papua | pdf file |

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| 5. | Japanese ODA to Indonesia | pdf file |
| 6. | <i>Kemitraan Setengah Abad</i> , Japanese ODA in Indonesia | pdf file |
| 7. | <i>Penyusunan Pola Pengelolaan Wilayah Sungai Jeneberang</i> , 2012 | hard copy |

E. Presentation

- | | | |
|----|--|----------|
| 1. | Collection of presentations on water resource issues | pdf file |
|----|--|----------|

F. Others

- | | | |
|----|---------------------------------------|-----------|
| 1. | List of River Organizations Addresses | hard copy |
|----|---------------------------------------|-----------|

APPENDICES

- A1. BBWS Brantas**
- A2. BBWS Bengawan Solo**
- A3. BBWS Pemali-Juana**
- A4. BBWS Serayu-Opak**
- A5. BBWS Cimanuk-Cisanggarung**
- A6. BBWS Pompengan-Jeneberang**
- A7. BBWS Citarum**
- A8. BBWS Mesuji-Sekampung**
- B1. BBWS Citanduy**
- B2. BBWS Ciliwung-Cisadane**
- B3. BBWS Cidanau-Ciujung-Cidurian**

A1. LARGE RIVER BASIN ORGANIZATION OF BRANTAS

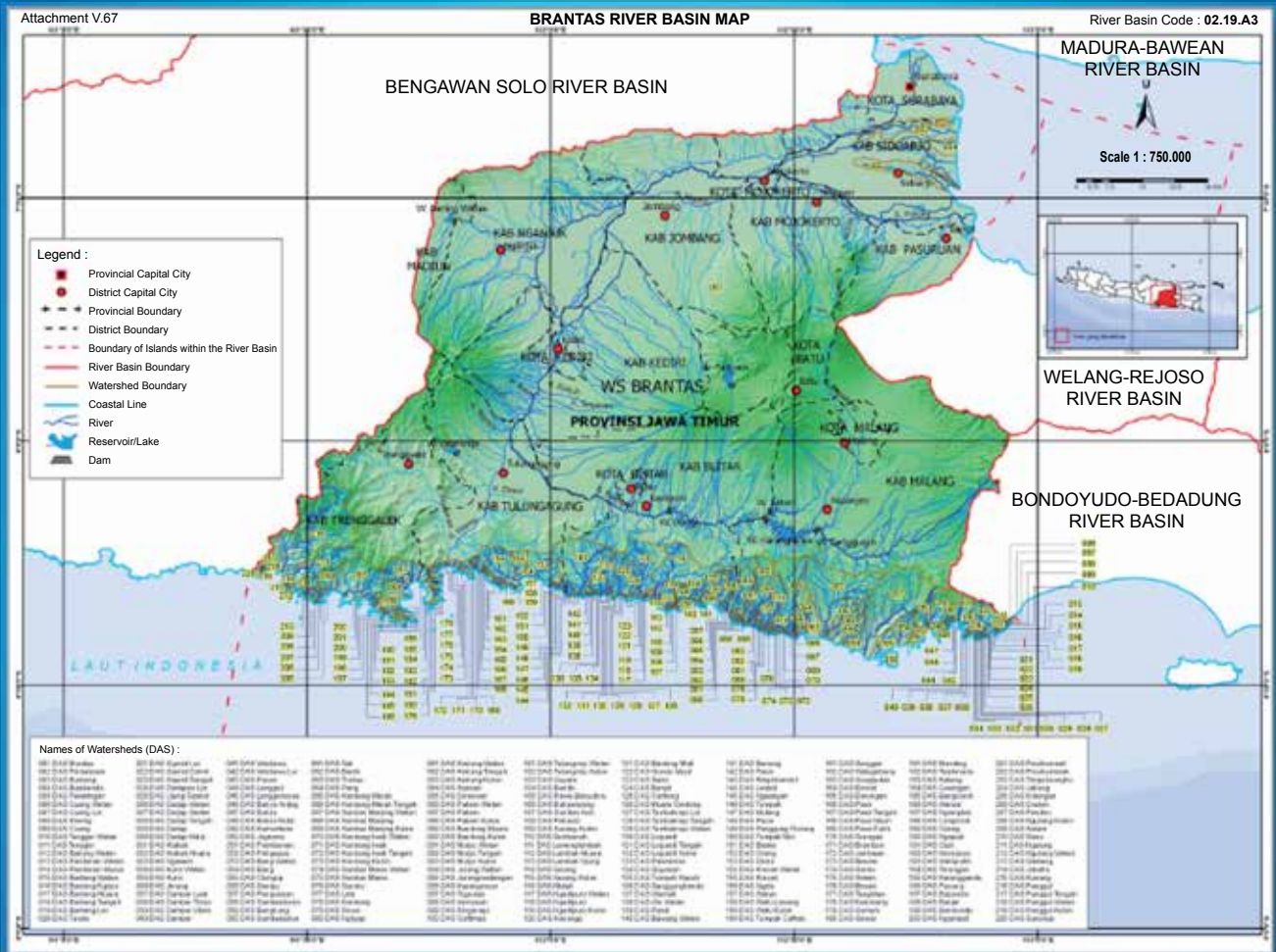


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1. DESCRIPTION OF ORGANIZATION

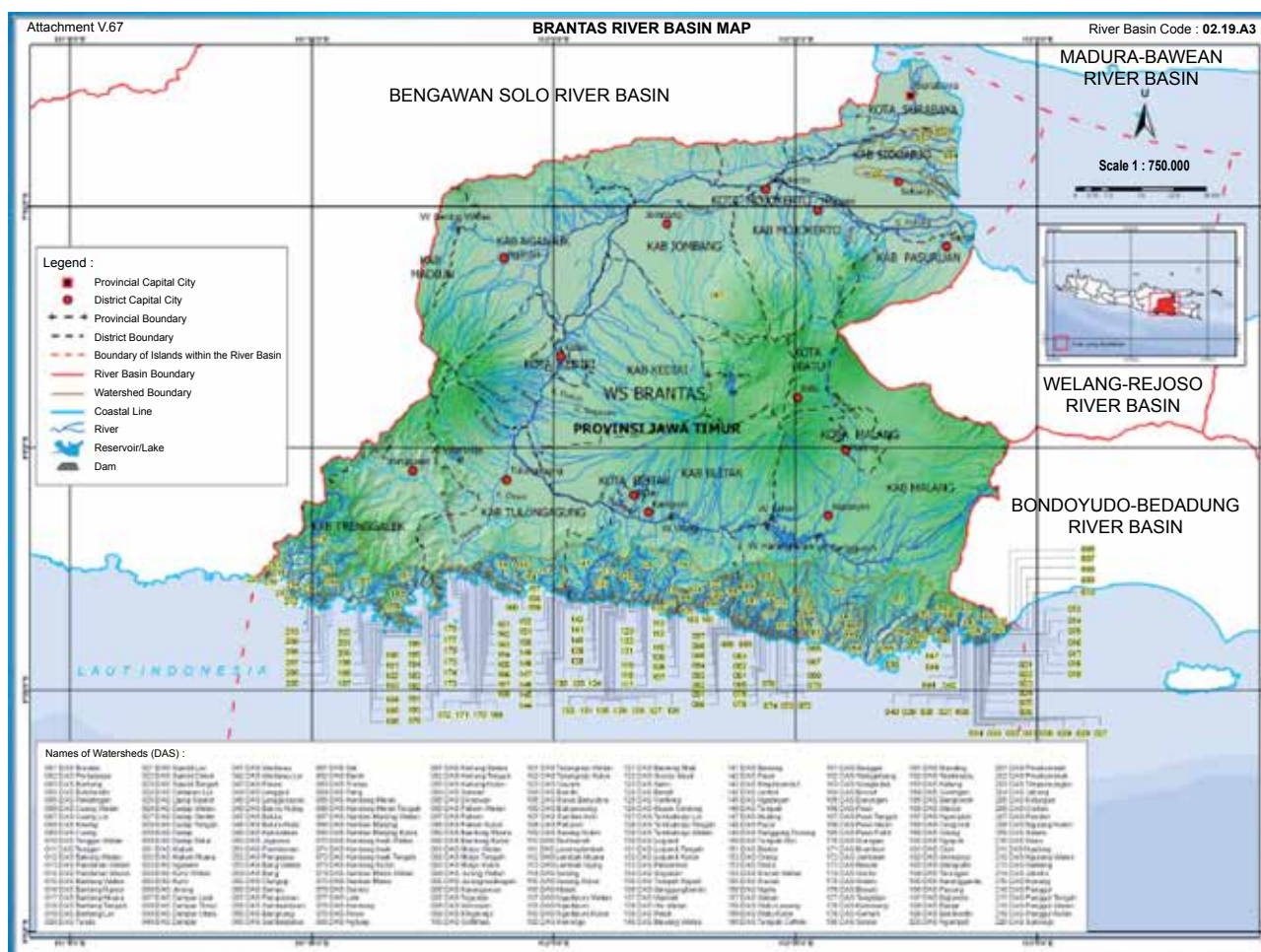


Figure 1: Brantas River Basin

1.1. General Information

Name : Balai Besar Wilayah Sungai Brantas
 Address : Jl. Manganti 312 Wiyung
 Municipality : Surabaya
 Telephone : (031) 7533171
 Facsimile : (031) 7521547
 Website : <http://www.bbwsbrantas.com>
 E-mail :
 Legal Basis : Regulation of Minister of Public Works Number 23/PRT/M/2008
 Work Area : Brantas River Basin, River Basin Code: 02.17.A3
 River Basin Classification : National Strategic River Basin

1.2. Brief History

1959 : Brantas Project
 1980 : Brantas River Basin Development Project
 PerumJasaTirta 1
 PT IndraKarya
 PT BrantasAbiPraya
 1990 : Master Plan for Brantas River Basin Development
 2008 : Balai Besar Wilayah Sungai Brantas (Large Organization River Basin of Brantas)

1.3. Organization Structure

The Balai Besar Wilayah Sungai (BBWS) Brantas categorized as a type-A large river basin organization which organizational structure consists of:

- 1) Administration Department
- 2) Program and Evaluation Division
- 3) Water Source Network Implementation Division
- 4) Water Utilization Implementation Division
- 5) Water Resources Operation and Maintenance Division

There are 3 (three) Work Units for the implementation of operational budget, namely:

- 1) Work Unit of *Balai Besar Wilayah Sungai Brantas*, consisting of 4 Contract Executive Officers:
 - a) Contract Executive Officer for Administration
 - b) Contract Executive Officer for Planning and Program
 - c) Contract Executive Officer for Water Resources Operation and Maintenance
 - d) Contract Executive Officer for Equipment Utilization
- 2) Non-Vertical Work Units for Particular Purpose (SNVT) for Water Source Network of *Balai Besar Wilayah Sungai Brantas*, consisting of 5 Contract Executive Officers:
 - a) Contract Executive Officer for Rivers and Beaches I
 - b) Contract Executive Officer for Rivers and Beaches II
 - c) Contract Executive Officer for Mount Kelud Lava Control
 - d) Contract Executive Officer for Mount Semeru Lava Control
 - e) Contract Executive Officer for Bajulmati Reservoir
- 3) Non-Vertical Work Units for Particular Purpose (SNVT) for the Implementation of Water Source Network of *Balai Besar Wilayah Sungai Brantas*, consisting of 6 Contract Executive Officers:
 - a) Contract Executive Officer for Water Resources Conservation
 - b) Contract Executive Officer for Nipa Palm
 - c) Contract Executive Officer for Raw Water Development I
 - d) Contract Executive Officer for Raw Water Development II
 - e) Contract Executive Officer for Irrigation
 - f) Contract Executive Officer for Groundwater Utilization

1.4. Human Resources

The number of BBWS Brantas employees amount to 956 people, which consists of 168 Technical Employees and the rest are non-technical employees.

Table 1: Human Resources

Education	Civil Servant (PNS)	NPN	Probationary Civil Servant (CPNS)	Total
Master's Degree (S2)	41	0	0	41
Bachelor Degree (S1)	118	6	47	171
Associate Degree (D3)	51	0	20	71
High School	259	171	0	430
Middle School	39	78	0	117
Elementary School	22	104	0	126
Total	530	359	67	956

1.5. General Condition of Work Area

The Brantas River Basin is the second largest river basin in Java Island, located in the East Java Province at 110°30' East Longitude to 112°55' East Longitude and 7°01' South Latitude to 8°15' South Latitude.

The Brantas River extends to ± 320 km in length and it has a catchment area extending to $\pm 14,103$ km² which covers $\pm 25\%$ of the total area of East Java Province or $\pm 9\%$ of the total area of Java Island.

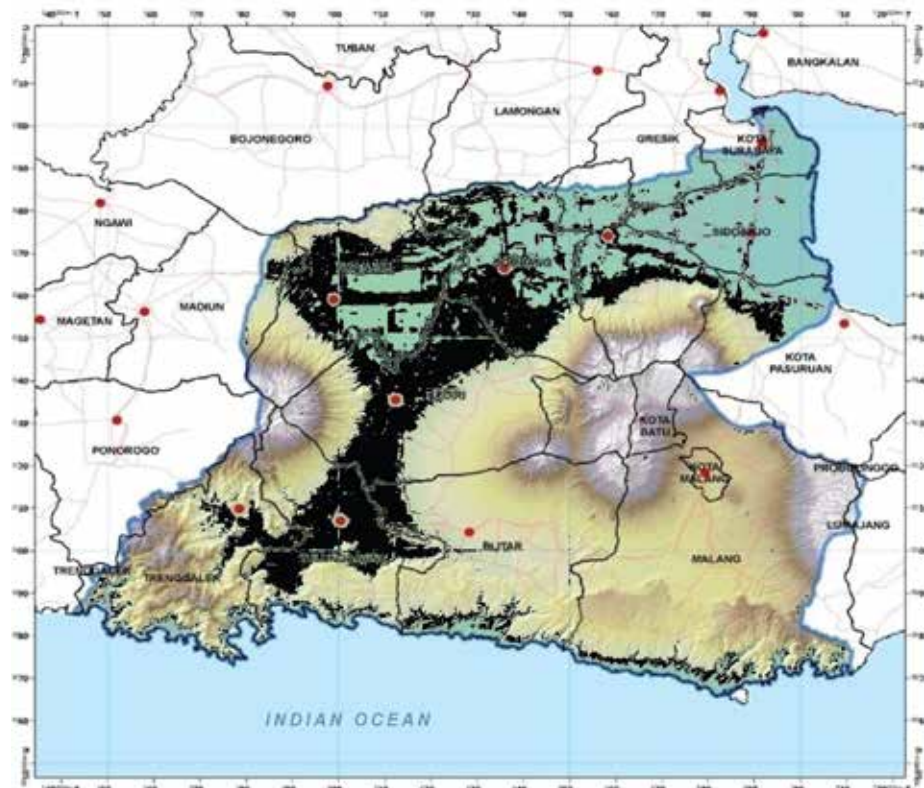


Figure 2 Condition of Brantas River Basin

The average rainfall reaches 2,000 mm/year, around 85% occurring during the rainy season. The average surface water potential per year is 13,232 billion m³, with utilized amount of around 5-6 billion m³/year.

The Brantas River Basin consists of the Brantas Watershed, which extends to 11,988 km², and more than 100 small watersheds that flow into the south coast of Java Island, including the Kali Tengah watershed, Ringin Bandulan watershed, Kondang Merak watershed, and other small watersheds with a total area of around 2,115 km².

1.6. Hydrology

The climate in Brantas River Basin is influenced by 2 (two) seasons, namely the dry season and rainy season. Temperatures range from 24° to 31° Celcius, with average rainfall of 3,000 mm/year.

There are 9 AWLR stations, 2 Climatology stations, 9 Realtime AWLR stations, 9 Realtime ARR / Telemetry stations and 36 locations of water quality monitoring points that have been built in the work area of BBWS Brantas, as seen on the following Figure 3.

In addition, there are also 20 Hydrology Checkpoints spread over several rivers.

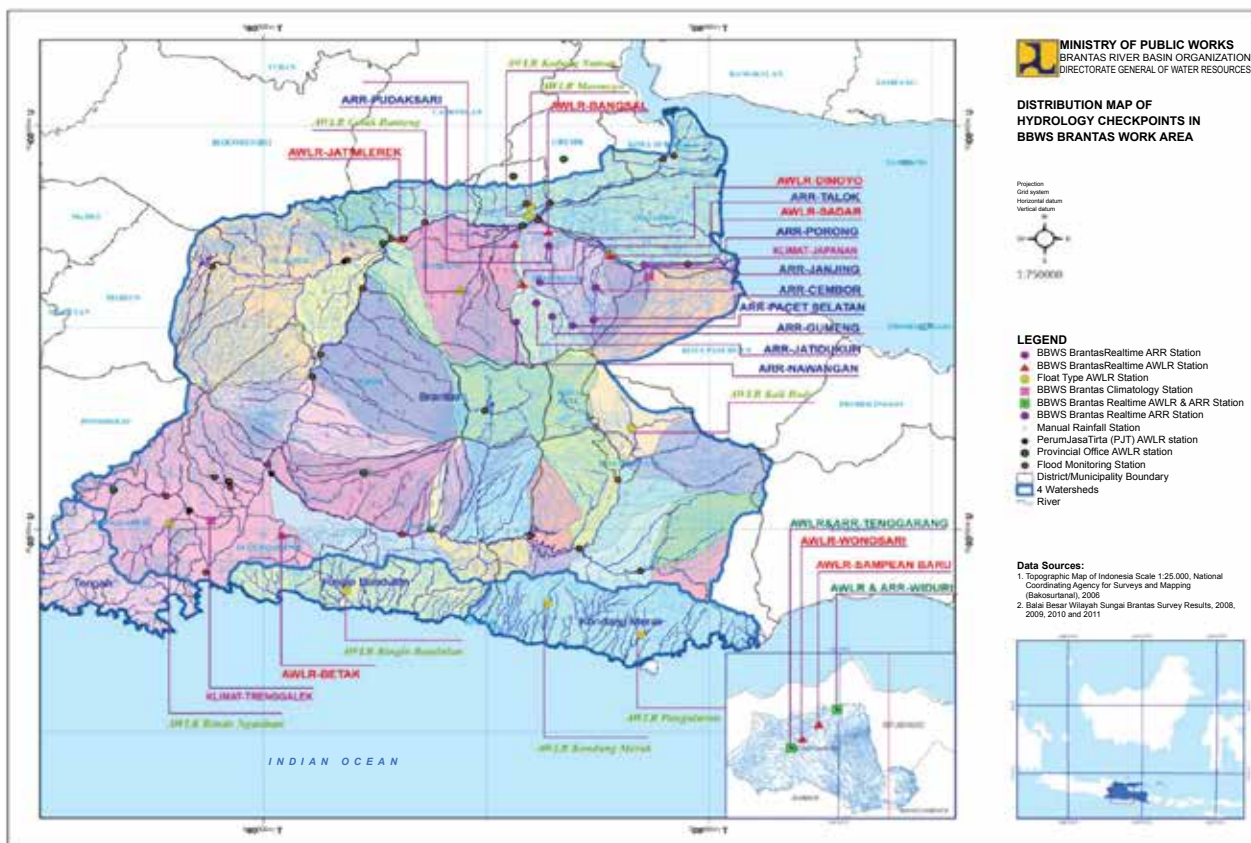


Figure 3: Distribution Map of Hydrology Checkpoints in BBWS Brantas

1.7. Watersheds, Rivers and Tributaries

The Brantas River consists of one main river and hundreds of tributaries which total to 376 rivers, as seen in the following Table 4: The Brantas River Basin consists of four sub-watersheds and based on the Presidential Decree Number 12/2012, it consists of 220 watersheds, as seen in this book's cover image.

Table 2: River Orders, River Lengths and Watershed Areas

No	River Order	Total	Length (Km)	Area of Watershed (Km ²)
1	1	99	1,065	14,638
2	2	117	1,662	6,479
3	3	104	1,238	2,870
4	4	45	532	7,723
5	>4	11	82	39
Total		376	4.579	31.749

Table 3: Dams

No	Name of Dam	River	Type	Height (m)	Length (m)	Capacity (103m³)	Function	CA (Km²)
1	Sutami	Brantas	Rockfill	97.5	822	343,000	Irrigation & Hydroelectric Power Plant	2,050
2	Lahor	Brantas	Rockfill	74	433	36,100	Irrigation & Hydroelectric Power Plant	160
3	Selorejo	Konto	Earth	49	447	6,300	Irrigation & Hydroelectric Power Plant	236
4	Sengguruh	Lesti	Rockfill	34	378	23,000	Irrigation & Hydroelectric Power Plant	1,659
5	Wlingi	Brantas	Earth Gravity	46	736	24,000	Irrigation & Hydroelectric Power Plant	2,890
6	Lodoyo	Brantas	Barrage	94	96	5,900	Irrigation & Hydroelectric Power Plant	3,017
7	Wonorejo	Brantas	Rockfill	97	545	122,000	Irrigation & Hydroelectric Power Plant	136
8	Bening	Brantas	Rockfill	35	700	37,500	Irrigation & Hydroelectric Power Plant	238
Outside Brantas area								
9	Klampis	Klampis	Gravity	22	44	10,250	Irrigation	51
10	SampeanBaru	Sampean	Rockfill	41	174	2,150	Irrigation	725

1.8. Issues

The management of water resources in Brantas River Basin faces many issues related to the sustainability of water resources in Brantas River Basin, which are as follows:

- 1) Forest areas and conditions continue to decline. These damages to the a broad impact, which is the damage to the ecosystem in the arrangement of the river basin. The problem was also spurred by alack of coordination between the upstream and downstream, and also by the institutions' conditions that are still weak.
- 2) Weak law enforcement.
- 3) Low capacities of forest managers, human resources, funding, facilities-infrastructure and institutions, as well as limited incentives for forest managers.
- 4) The utilization of non-timber forest products and environmental services has still not developed.
- 5) The laws and regulations on environment and the laws and regulations on other sectors are still not harmonized.
- 6) The people's awareness in environmental maintenance is still low.

The levels of erosion and sedimentation are relatively high, especially in the areas of Tengah, Ringin Bandulan and Kondang Merak watersheds, as well as at the upper and middle parts of Brantas watershed, due to a large number of slope failures, particularly in areas with steep slopes. The condition of the lower part of Brantas River is relatively stable and the erosion and sedimentation rates are relatively low. On the other hand, excessive sand mining in Brantas River Basin, especially at the middle part (from Tulungagung to Mojokerto) has resulted in river bed degradation.

In early 2005, critical lands in Brantas River Basin extended to around 280,258 ha, consisting of very critical lands (26,267 ha), critical (93,459 ha), rather critical (120,953 ha) and potentially critical (39,569 ha).

Water Quality

The development of major cities where the Brantas River flows through has resulted in an increase of clean water and raw water requirements. Other than that, the increasingly high concentrations of inhabitants and industries in urban areas have given rise to several problems such as the emergence of slums along riverbanks, decreasing water quality and floods due to disrupted water flow because of a large number of garbage, siltation, or reduced river width. The dominant pollutants of Brantas River are as follows:

- **Industrial waste**

In Brantas River Basin, there are 483 industries that have the potential to dispose their waste into the river basin.

- **Domestic waste**

Domestic waste (households, hotels, restaurants, and so forth) is the biggest source of pollution.

- **Agricultural waste**

Pollutants from agriculture come from residual pesticides and inorganic fertilizers that flow into the river together with residual irrigation water.

Issues in Pollution Control

Issues encountered in the efforts of controlling pollution in the Brantas River Basin include the following:

- Since the implementation of the Clean River Program, the controlling on sources of pollution has only been implemented on industrial waste. No control has been implemented on domestic waste, while based on research, the load of domestic waste pollution reaches 62% of the total loads that enter the river.
- Law enforcement against polluters is still weak since social, economic, work opportunity and other aspects are still taken into consideration.
- There are many industries which Waste Water Treatment Plant (IIPAL) capacities are lower than the produced waste and therefore the waste disposal does not meet the established quality standards.
- Water pollution control is a complex issue that requires a large amount of funds and a long time as well as the commitment of all parties concerned.
- Many settlements are established in riparian areas, resulting in large amounts of garbage and domestic waste that are directly disposed into the river.
- Lack of public awareness to participate in providing positive (active-constructive) social control.

Issues of Control of water destructive power, Erosion and Sedimentation in Brantas River Basin

In Brantas River Basin, erosion and sedimentation are some of the problems that pose threat on the sustainability of water resources' functions and the continuity of the benefits gained from efforts of water resources development and management.

- Riverbed lowering in Brantas River, starting from Plosoto Mojokerto as well as in Porong River, which are caused by illegal sand mining.
- Damages to irrigation infrastructures which are caused by, among others, illegal sand mining.
- Reservoir sedimentation resulting from damages to catchment areas due to forest clearing, protection forest logging and inappropriate agricultural model.
- Settlements in riparian areas.

2. WATER RESOURCES MANAGEMENT

Management of water resources in the Brantas river basin was originally implemented primarily as a means of flood control and water use for irrigation. The Brantas River Master Plan consists of three stages:

- Stage 1: The South Tulungagung Drainage Plan in 1958, followed by the First Master Plan in 1962 which was focused on the development of the main river and the construction of Selorejo dam in 1972.
- Stage 2: The Second Master Plan in 1972 was focused on the construction of multipurpose dams in the upper part, namely the Sutami dam in 1979, Lahor dam in 1977, Lengkong dam in 1974, Wlingi dam in 1979, Lodayo dam in 1983, Lodayo irrigation in 1985, and flood control and irrigation in the lower part, as well as embankment repair in the city of Kediri.
- Stage 3: The Third Master Plan in 1985 was concerned with the development of the entire river basin and its tributaries, including the Neyama Tunnel in 1991 and the Jatimlerek rubber dam in 1993, as well as the normalization of Mas River, Sengguruh dam in 1996.

The funds for each of those stages were obtained from loans provided by the Japanese Government.

In accordance with Law Number 7 of 2004 regarding Water Resources, management of water resources must be based on a management model which preparation must involve all stakeholders, including the efforts of community empowerment, monitoring and involvement through the Water Resources Management Coordination Team (TKPSDA).

Therefore, in 2010, such management model was prepared by taking into consideration various management aspects, not only flood control and irrigation efforts.

2.1. Water Resources Conservation

The Brantas River Basin, which consists of 4 (four) sub-river basins, namely Brantas, Tengah, Ringin Bandulan and Kondang Merak, is presented in detail in the figure below:

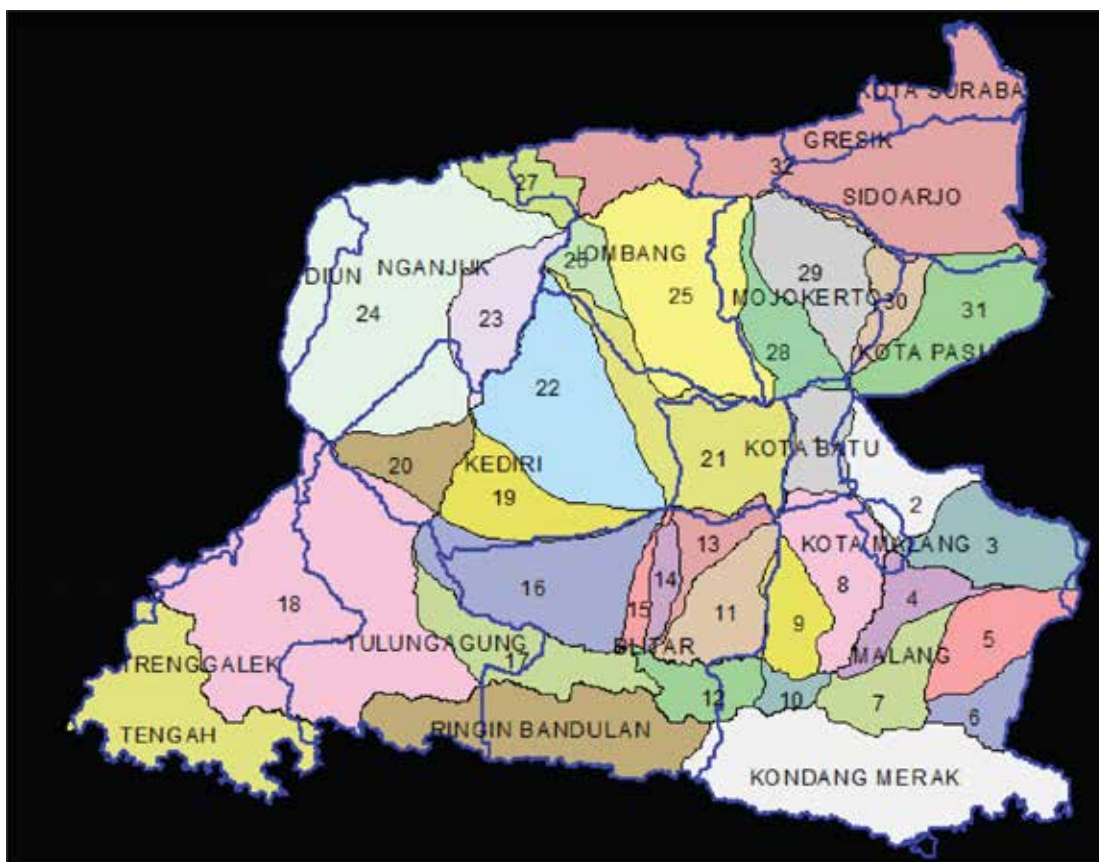


Figure 4: Map of Watersheds in Brantas River Basin

Soil and Water Resources Conservation in Brantas River Basin

Vegetative Conservation, carried out by means of:

- Permanent plant cover;
- Strip cropping;
- Multiple cropping; and
- Reforestation.

Mechanical Conservation, which includes:

- Soil cultivation;
- Contour cultivation;
- Counter bands;
- Terraces;
- Waterways;
- Infiltration wells; and
- Stabilization structures (check dams).



Figure 5: Bamboo Tree Planting in Pujon

Water Conservation

The main cause of flooding is environmental damage, especially in the upper reaches of the basin as a water catchment area. The condition above fosters the awareness of all parties to conduct Forest and Land Rehabilitation in the damaged areas in order to repair and restore the function and productivity of the natural resources. The movement is called the National Movement for Forest and Land Rehabilitation (Gerakan Nasional Rehabilitasi Hutan dan Lahan/GNRHL).

On 28 April 2005, the National Movement for Water Safeguard Partnership will (GN-KPA) on Critical Watershed Rehabilitation for Land and Water Resources was announced in the Brantas River Basin, which has implemented the movement, and it will be done in stages, starting from the sub-river basins of Upper Brantas, Konto River, Ngasinan, Lekso, and Brangkal.



Figure 6: Conservation Activities in BBWS Brantas

2.2. Water Resources Utilization

The main infrastructures that have been built in the Brantas River Basin are used for meeting various requirements, including irrigation, raw water for drinking water and industries, power plants, fishery, flushing and tourism.

The number of industries that utilized water allocation in Brantas River Basin in 2005 amounted to 129 industries. The average water usage volume for industries for the past 10 years (1995-2005) is 137,8 million m³. The lowest industrial water usage level occurred in 1998, which was 126,52 million m³.

Domestic and urban water requirements met by Regional Drinking Water Companies (PDAM) depend on the number of population in each regency/city. The number of PDAMs that utilized the water in the Brantas River Basin in 2005 amounted to 12 PDAMs out of the total 16 PDAMs.

Water Requirement Analysis

- **Water Requirements for Irrigation**

Based on the data obtained in 1994, the irrigation areas in Brantas River Basin extended to 324.555 ha, and in 2008 they extended to 304,670 ha. Therefore, there has been an average annual areal reduction of 0,427% (1,388 ha per year) as a result of the rapid growth of urbanization and industrialization.

The extent of irrigation areas and water requirements in Brantas River Basin are projected as follows:

In 2008: 304,620 ha, Water Requirement: $3,610 \times 10^6$ m³/year

In 2020: 298,803 ha, Water Requirement: $3,765 \times 10^6$ m³/year

In 2030: 294,621 ha, Water Requirement: $3,718 \times 10^6$ m³/year

The schematization of the water system in Brantas River Basin is as seen in the following Figure 7.

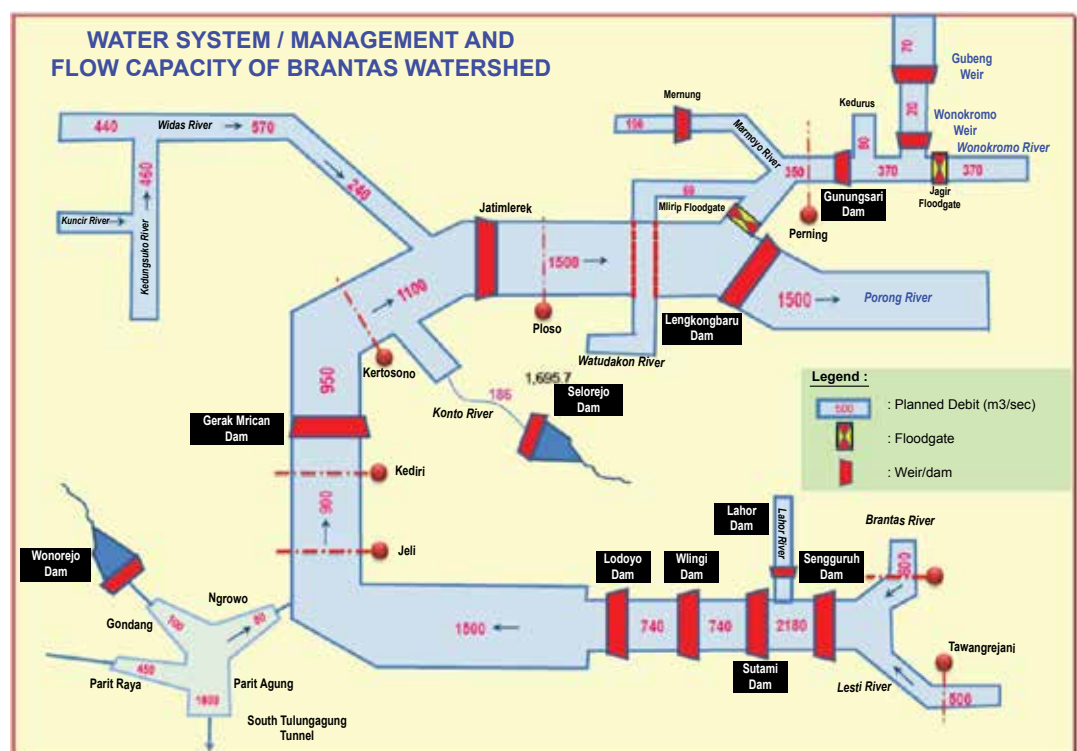


Figure 7: Water System Schematization in Brantas River Basin

- **Water Requirements for Domestic and Non-domestic Purposes**

Water requirement is measured based on the population number. The amounts of domestic and non-domestic water requirements are measured based on the provisions from the Directorate General of Human Settlements.

Based on the measurement, the projected amount of ideal water requirements that has to be met, for both domestic and non-domestic purposes, in Brantas River Basin in 2020 is 81,336 m³/sec and 90,510 m³/sec in 2030.

- **Water Requirements for Industries**

For the measurement of industrial water requirements in Brantas River Basin, the existing industries are grouped according to their type of industry, in which for Brantas River Basin, there are 3 major industrial groups, consisting of 1) Paper industry, 2) Sugar Industry, and 3) Other Industries (including steel, tobacco, textile dyeing, and food industries), with average usage as follows:

- Sugar: 1.25 m³/sec
- Paper: 1.57 m³/sec
- Others: 1.67 m³/sec

- **Water Requirements for Fishponds**

The total area of fishponds in Brantas River Basin is 19,583 ha (in 2005), in which the majority is located near coastal areas. The water requirements for fishponds in Brantas River Basin today amount to around 19,60 m³/sec. Water requirements for fishponds are measured by assuming a requirement of 1 liter/sec/ha.

In carrying out its functions, the BBWS Brantas does not only develop and repair water resource facilities and infrastructures, but it also has tasks in the operation and maintenance of water resource facilities and infrastructures.

Facilities and infrastructures in Brantas River Basin include the following:

- 1) **Rivers**

The Brantas River consists of one main river and hundreds of tributaries, with a total of 376 rivers.



**Figure 8:
Brantas River**

2) Dams

There are 8 large dams in Brantas River Basin. Some of them are shown in the following figures.



Figure 9: Sutami Dam, Malang Regency



Figure 10: Wonorejo Dam and Selorejo Dam

3) Embung

There are 155 *embung* (traditional reservoir) in the Brantas River Basin which are managed by 3 Contract Executive Officers. Among them are:

- Water Resources Conservation Utilization (PKSDA) *Embung*



Figure 11: J alas Spring, Kediri Regency

- Raw Water *Embung*



Figure 12: Embung Klampok and Embung Pilang Kerep

4) Weirs

There are 349 weirs in the Brantas River Basin, in which some of them are in the form of rubber weirs and barrages.

- Rubber Weirs



Figure 13: Jatimlerek Weir and Menturus Weir

- Barrages



Figure 14: GerakMrican Weir and Lengkong Weir

5) Ship Channels

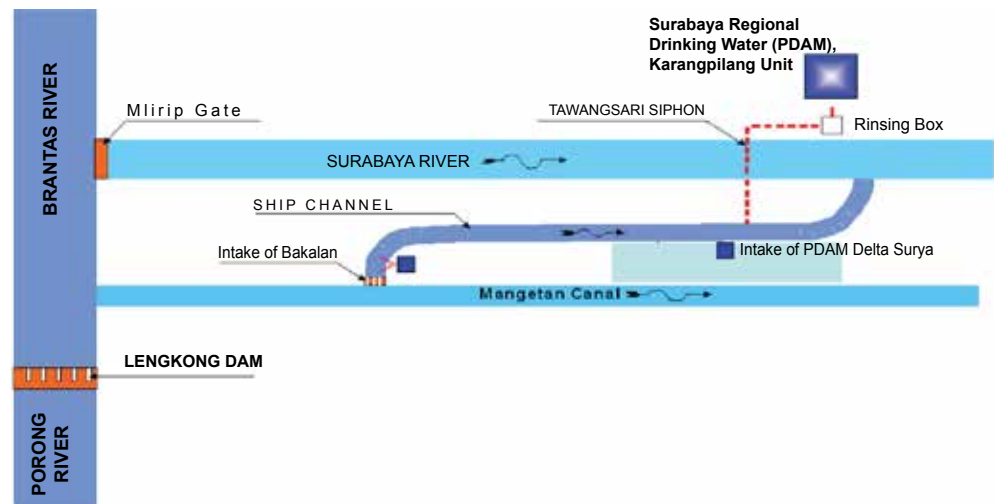


Figure 15: Ship Channel of Surabaya City

6) Irrigation

Irrigation areas that are under the authority of the Central Government are those that extend to more than 3000 ha.

Table 4: Irrigation Areas by Authority

No	IRRIGATION AREA	Extent (Ha)
1	Authority of the Central Government	221,150
2	Authority of the Provincial Government	118,179
3	Authority of the Regency/Municipal Governments	354,275
Total		693,604

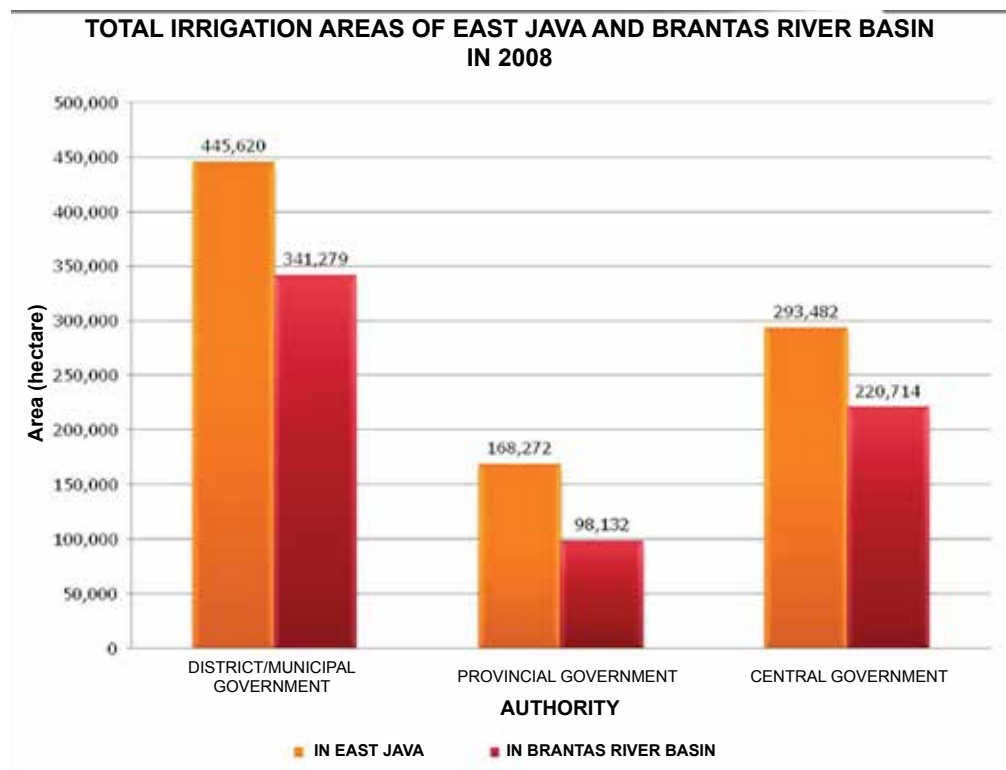
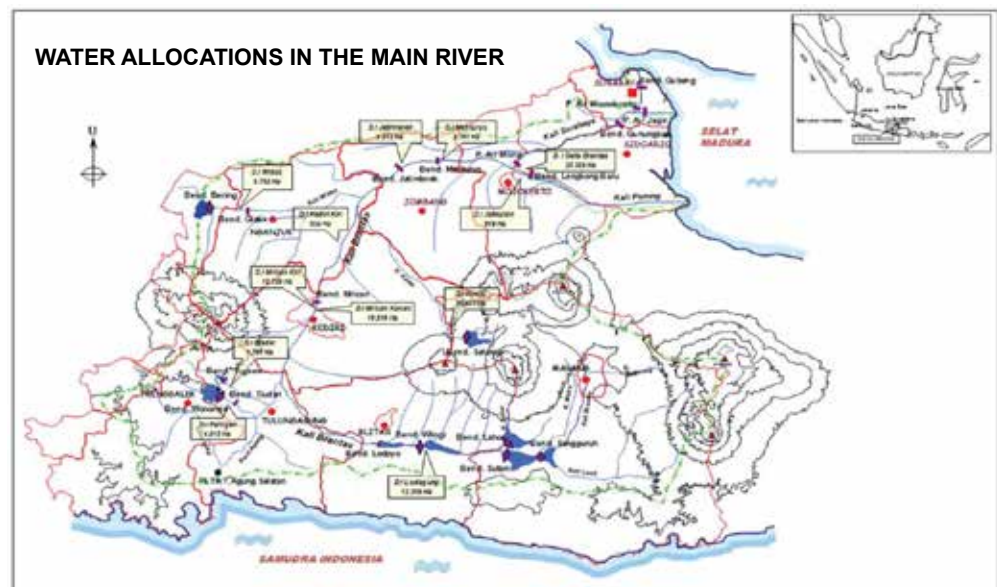
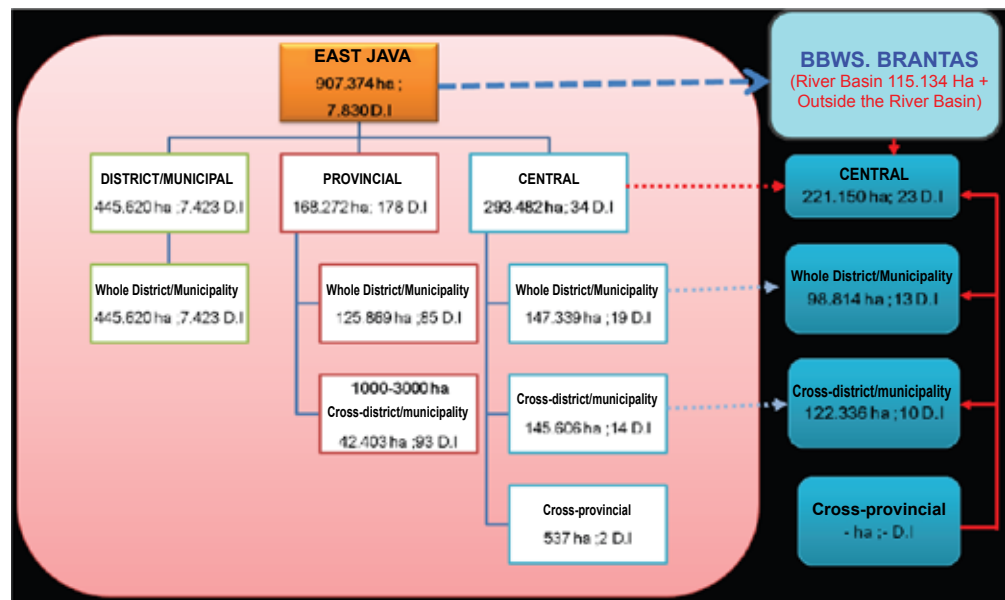


Figure 16: Total Irrigation Areas of East Java and Brantas



Figure 17: Irrigation Infrastructures



7) Groundwater

The Brantas River Basin is an area with high level of groundwater potential. Groundwater recharging in Brantas River Basin amounts to $4,038.84 \times 10^6$ m.

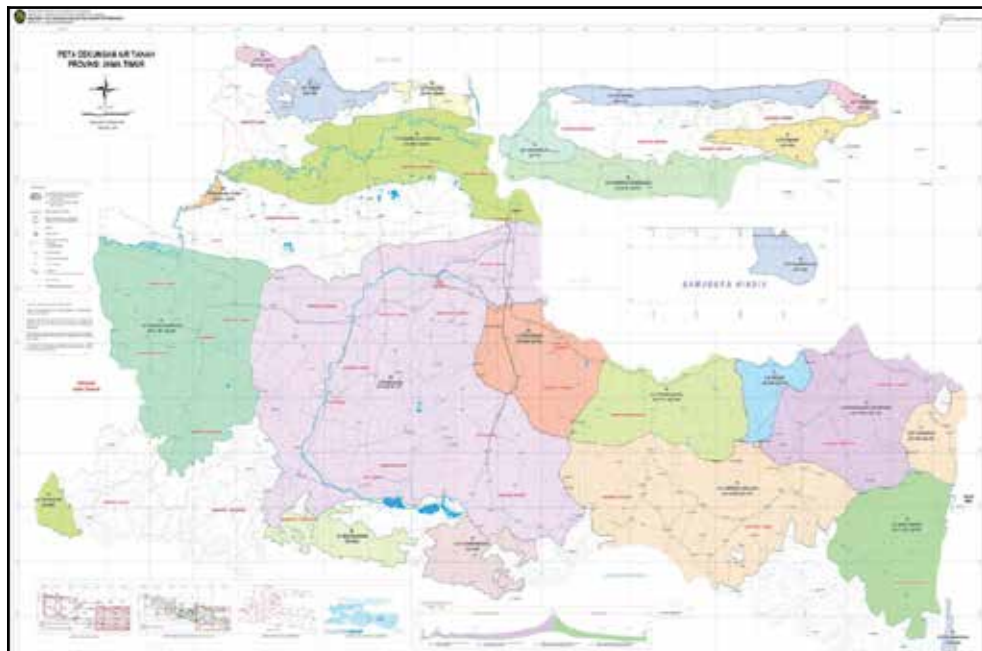


Figure 20: Map of Groundwater in East Java

2.3. Control of water destructive power

Flood Control Principles

- a) Flood control in Brantas River Basin is carried out by using an integrated control principle.
- b) Control starts from the upstream by operating reservoirs for controlling floods. Reservoirs in the Brantas River Basin include the Karangates Dam, Lahor Dam, Selorejo Dam, Wonorejo Dam, and Bening Dam.
- c) In the downstream, the flow of flooding in the river is passed through the Porong River into the sea through the operation of the Lengong Baru Weir and if the discharge of the Surabaya River in Perningstation has reached 150m³/sec, the Mlirip Floodgate will then be closed.
- d) In the City of Surabaya, flooding in Surabaya River will be channeled into the sea through the operation of the Wonokromo Floodgate (to separate the flow into the Mas River) and the Jagir Floodgate (to separate the flow into Wonokromo River).

Analysis on Control of water destructive power, Erosion and Sedimentation Aspects in Brantas River Basin

In Brantas River Basin, erosion and sedimentation are some of the problems that pose a threat to the sustainability of water resources' functions. The volume of sand mining per year amounts to 2.12 million m³, while in 2004, the volume of sand mining amounted to 2.92 million m³.



Figure 21: Illegal Sand Mining in Brantas River

Control of Sediment Resulted From Eruptions of Mount Kelud and Mount Semeru

In order to prevent and reduce hazards caused by sediment, the following combined approach is carried out:

- Structural: preventing sediment hazards through the use of sediment controlling structures
- Non-structural: reducing volcanic sediment hazards

Control of Sediment Resulted From Bank Erosion and Slides

By taking into consideration the condition of erosion and sedimentation that occurs in the Upper Brantas, the WREFR & CIP study suggested the construction of 5 (five) sabo dams in the Upper Brantas, and 1 sabo dam and 2 consolidation dams in Lesti River.

Existing Sediment Controlling Structures

Several sediment controlling structures have been built in 10 (ten) rivers on the slopes of Mount Kelud since the 1970s. Around Mount Kelud, there are 6 sand pockets used for holding up the sediment from the next volcanic eruption.



Figure 22: Location Map of Sand Pockets



Figure 23: Check Dam



Figure 24: Groundsill and Revetment Construction



Figure 25: Sedimentation in Karangates Reservoir



Figure 26: Tulungrejo Check Dam and Jambe Wangi Sabo Dam

Efforts to control water's damaging ability can be done through:

- **Prevention of Water's Damaging Ability**
 - Reforestation and maintenance of river banks
 - Check dam construction
 - Reservoir and weir development and construction
 - Routine inspection on irrigation infrastructures
 - Operation and maintenance of rivers and river channels as well as flood controlling infrastructures
 - Exploring and developing the culture of local communities in controlling flooding.
 - Developing a community-based early warning system
- **Management of Water's Damaging Ability**
 - River bank protection
 - River normalization
 - Retarding basin maintenance
- **Recovery of Water's Damaging Ability**
 - Rehabilitation of reservoirs and other water structures as well as reservoir dredging
 - Rehabilitation of river bank and embankment constructions

2.4. Water Resources Information System

One of the functions of BBWS Brantas is hydrology system management. In order to support the function and responsibility, a hydrology system needs to be implemented, in which this hydrology system should consist of hydrology system facilities and infrastructures as well as their managing units.

Due to this, a Hydrology Unit was established in BBWS Brantas in 2007, and the Head of Operation and Maintenance serves as the person-in-charge of the program.

2.5. Community Empowerment, Monitoring and Participation

Community Empowerment is carried out through:

- 1) The National Movement for Water Safeguard Partnership (GN-KPA)
- 2) Water Resources Management Coordination Team (TKPSDA)
- 3) Empowerment of Water User Farmers Association (HIPPA)
- 4) Community Empowerment in critical areas due to water's damaging ability:
 - Around the Lower Brantas Watershed: Upper Konto River, Batu City
 - Lower Brantas River in Tapen Village, Jombang Regency

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. General

The water potential available in the Brantas River Basin amounts to 13,232 billion m³ per year, in which as much as 3.7 – 4 billion m³ or around 28.24 percent have been used for irrigation, household, urban, and industrial purposes. The remaining potential, amounting to 9,532 billion m³ per year or around 71.7 percent, are still discharged into the sea. Several irrigation infrastructures are required to optimize the existing water potential.

3.2. Comprehensive Management

The management of water resources in Brantas River Basin can still be developed in order to make it more comprehensive by referring to various existing legal provisions and laws, such as article 51, 53, and so forth of Law Number 7 of 2004 regarding Water Resources, Law Number 26 of 2007 regarding Spatial Planning, Government Regulation Number 26 of 2008 regarding National Spatial Plan, particularly article 99 and 106 concerning Zero Delta Q Policy, and article 34, 35, 36, and so forth of Government Regulation Number 38 of 2011 regarding Rivers.

3.3. Implementation Strategy

The establishment of the Water Resources Management Coordination Team (TKPSDA) of Brantas River Basin based on the Decree of Minister of Public Works Number 255/KPTS/2010 dated 2 March 2010 is understood as the mandate stated in Law Number 7 of 2004 regarding Water Resources, which is intended to, among others, accommodate the aspirations of all stakeholders on the management of water resources.

Therefore, the water resources management model recommended to the Minister of Public Works for approval should be able to set forth all management aspects in a comprehensive manner, as well as carry out the mandates of all existing regulations. The Management Plan, as a detail of the Management Model, should naturally be able to be made as reference for the Large River Basin Organization in preparing the Strategic Plan, as well as a reference for the Regional Government in preparing the Regional Long-term/Medium-term Development Plan (RPJPD/RPJMD) and the Regional Government Work Plan (RKPD) in order to realize the implementation of the development.

The comprehensive management implementation strategy in BBWS Brantas' Work Area uses the following approach:

- Conducting a comprehensive and continuous inventorying of hydrological data for various requirements as part of water resources management in BBWS Brantas
- Conducting monitoring and creating a water resource and flood information system, conducting more comprehensive evaluation and studies for future water resources management with regard to climate changes.
- Preparing the BBWS Brantas Comprehensive Management Plan by conducting

conservation, water resources utilization, control of water destructive power, flash flood control, coastal safeguarding against abrasion, implementing water resources information system, empowering, monitoring and involving the community, as well as overcoming river degradation in central Brantas due to uncontrolled sand mining.

In order to implement optimal management, the existing institutions/agencies need to be empowered, such as in seeking input through the Brantas TKPSDA for further policy determination.

The Management Plan, as a detail of the Management Model, which can be made as reference for the Large River Basin Organization in preparing the Strategic Plan, as well as a reference for the Regional Government in preparing the Regional Long-term/Medium-term Development Plan (RPJPD/RPJMD) and the Regional Government Work Plan (RKPD) in order to realize the implementation of water resources development in BBWS Brantas by referring to the Brantas River Basin Management Model prepared in 2010, will be continued with the Brantas River Basin Management Plan according to the mandates in Law Number 7 of 2004 and Government Regulation Number 42 of 2008 and Regulation of Minister of Public Works Number 22 of 2009.

A2. LARGE RIVER BASIN ORGANIZATION OF BENGAWAN SOLO

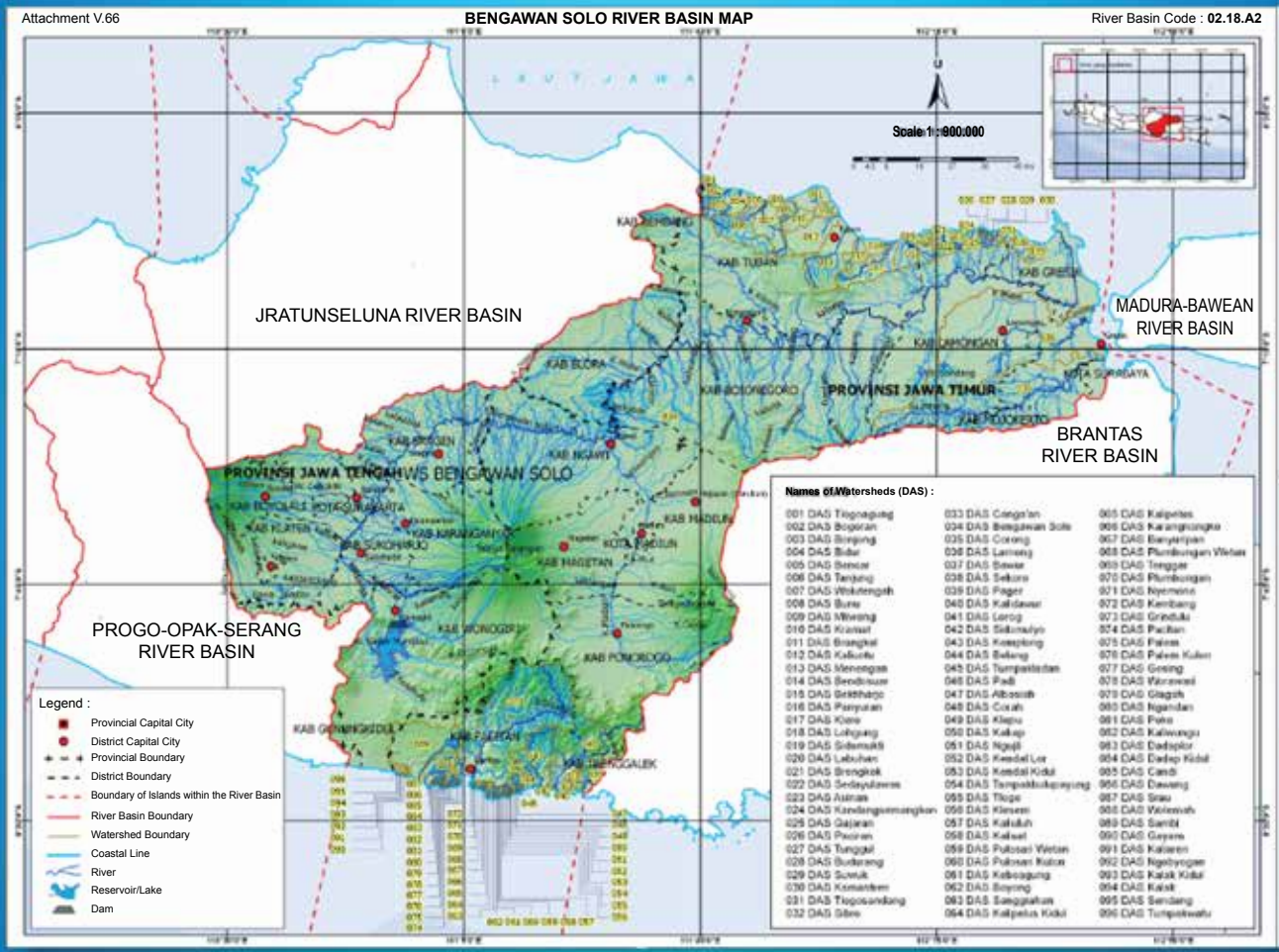


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1. DESCRIPTION OF ORGANIZATION

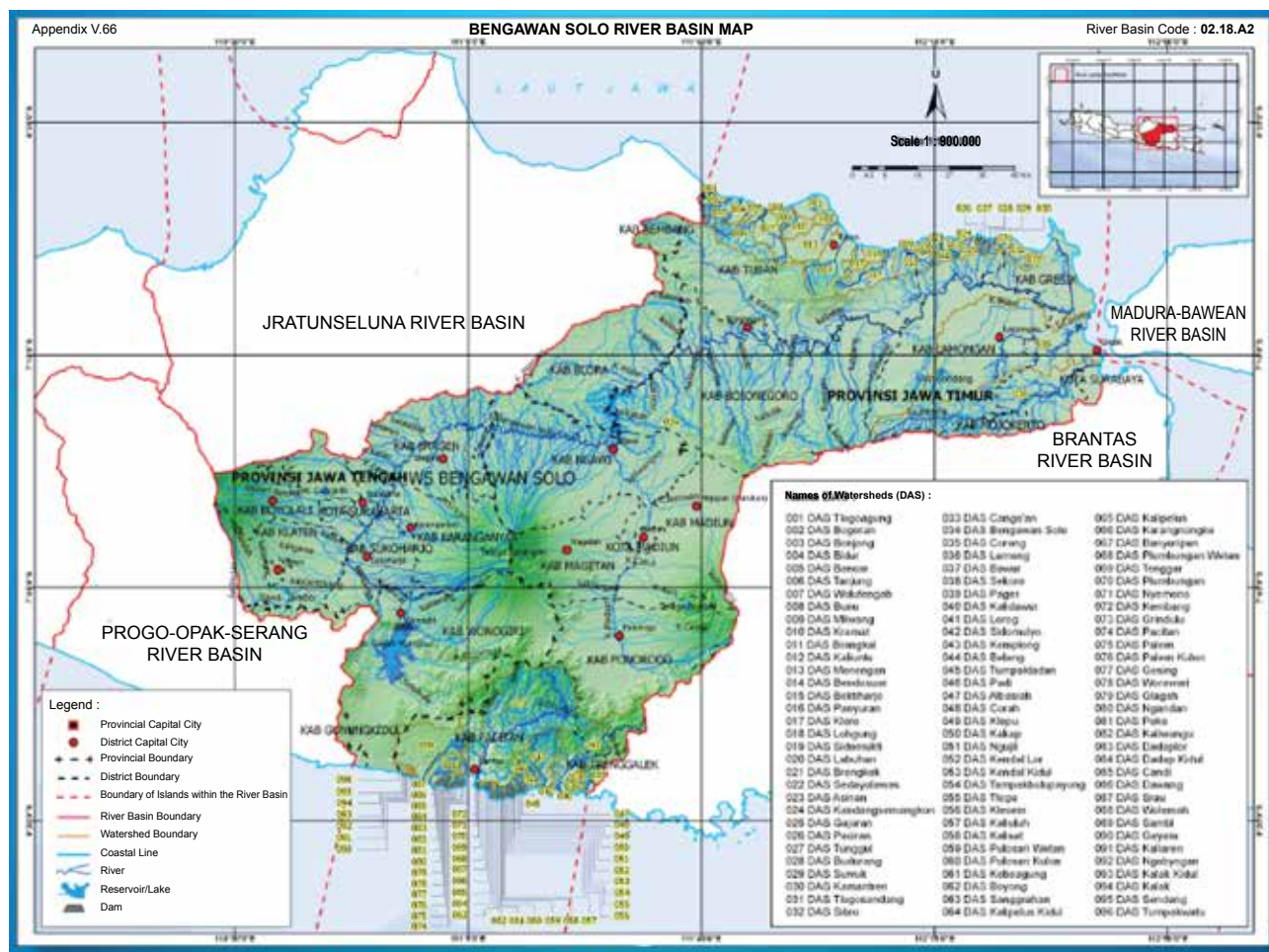


Figure 1: Bengawan Solo River Basin

1.1. General Information

Name	: Balai Besar Wilayah Sungai Bengawan Solo
Address	: Jl. Solo-Kartosura Km 7, PO Box 267
Municipality	: Surakarta, Central Java
Telephone	: (0271) 716428
Facsimile	: (0271) 716428
Website	: www.bbwsolo.pdsda.net
E-mail	:
Legal Basis	: Regulation of Minister of Public Works Number 11A/2006
Work Area	: Bengawan Solo River Basin
River Basin Classification	: Cross-provincial River Basin of West Java-Central Java

1.2. Brief History

1969	: Agency for Bengawan Solo Project Implementation
1977	: Bengawan Solo River Basin Development Project (Proyek Pengembangan Wilayah Sungai Bengawan Solo (PPWSBS))
1990-2004	: Master Plan for Bengawan Solo River Basin Development (PIPWSBS)
2005	: Master Implementer for Bengawan Solo River Basin Development
2006-now	: Balai Besar Wilayah Sungai Bengawan Solo (Large River Basin Organization of Bengawan Solo)

The organizational structure of Balai Besar Wilayah Sungai (BBWS) Bengawan Solo was established by the Regulation of Minister of Public Works Number 11A/PRT/M2006, and in accordance with its category as a type-A large river basin organization, BBWS Bengawan Solo is a structural organization led by a second echelon Head of Organization and assisted by four Heads of Divisions, each of them as third echelon officials, and one Head of Administration, as described below:

- 1) Administration Section
- 2) Program and Evaluation Division
- 3) Water Source Network Implementation Division
- 4) Water Utilization Implementation Division
- 5) Water Resources Operation and Maintenance Division

1.3. Human Resources

Based on the population census in 2005, the number of population in Bengawan Solo Watershed amounted to 16,03 people with a density of 755 people/km².

An adequate number of human resources which include management experts, technical experts, and other supporting workers, are required for the management of river basin and water resources in BBWS Bengawan Solo. Until today, the number of human resources in BBWS Bengawan Solo amount to 696 people, with details as seen in the following Table 1:

Table 1: Human Resources

No	TYPE OF EMPLOYEE	TOTAL
1	Civil Servants	385
2	Non Civil Servants	143
3	Daily Workers	168
Total		696

1.4. General Condition of Work Area



Figure 2: Work Area of BBWS Bengawan Solo

Geographically, the Bengawan Solo Watershed is located at 110°18' East Longitude to 112°45' East Longitude and 6°49' South Latitude to 8°08' South Latitude.

In the past, Bengawan Solo played an important role as a transportation infrastructure for connecting remote areas (upper part) and the harbor at PanturaGresik (lower part), and this gave rise to the development of mining villages which were the forerunner for settlements along the Bengawan Solo River. The Bengawan Solo River becomes an important source of raw water for the people to fulfill various requirements, but almost every year it causes very harmful flooding.

The Bengawan Solo Watershed is an area with tropical climate, where dry season occurs around May until October, while the rainy season occurs in November until April, with an average humidity of 80%, average monthly temperature of 26.7°C, average monthly sunshine duration of 6,3 hours, and an average monthly wind speed of 1.2 m/sec. Water availability in the Bengawan Solo Watershed is approximately 18,61 billion m³ and groundwater potential (groundwater basin) is approximately 3.01 billion m³/year.

The administrative area of the Bengawan Solo Watershed is located in Central Java Province, which includes Boyolali Regency, Klaten Regency, Sukoharjo Regency, Wonogiri Regency, Karanganyar Regency, Sragen Regency, Blora Regency, Rembang Regency, and Surabaya City, and in East Java Province, which includes Pacitan Regency, Ponorogo Regency, Madiun Regency, Magetan Regency, Ngawi Regency, Bojonegoro Regency, Tuban Regency, Lamongan Regency, Gresik Regency, Trenggalek Regency, Mojokerto Regency and Madiun City.

The Bengawan Solo River Basin is located in Central Java Province (23%) and East Java Province (77%), covering an area of 20,125 km², and is established into four work areas that include one or several watersheds as seen in the following Table 2:

Table 2: Watersheds in Bengawan Solo River Basin

No	Work Area	Extent (Km ²)
1	Bengawan Solo Watershed	16,100
2	Lamong River Watershed	720
3	Grindulu, Teleng and Lorog Watersheds	1,520
4	East Java North Coast,	1.440
	Semaeun River, Ungu River,	
	Goneng River and Sondang River Watersheds	
Total		19,780

Grobogan regency, Semarang regency, Trenggalek regency and Mojokerto regency have narrow river areas near the watershed boundary. These narrow areas are not real in relation to physical situation and socio-economic condition compared to other regencies, and these four regencies are therefore not included in the Bengawan Solo River Basin.

In addition, there are narrow areas of the Bengawan Solo River Basin that are located in the Special Region of Yogyakarta, namely Mount Kidul regency and Sleman regency, and these areas are also not included in the Bengawan Solo River Basin.

1.5. Hydrology

The Bengawan Solo Watershed is an area with tropical climate, where dry season occurs around May until October, while the rainy season occurs in November until April, with an average humidity of 80%, average monthly temperature of 26.7°C, average monthly sunshine duration of 6.3 hours, and an average monthly wind speed of 1.2 m/sec.

There are several hydrology stations in the Bengawan Solo River, namely:

- 1) Rain Gauge Stations. There are 26 locations, with 3 types of equipment:
 - 1 unit of Telemetry
 - 8 units of Automatic Rainfall Recorder (ARR)
 - 17 units of manual type
- 2) River Water Surface Observation Stations. There are 17 locations, with 3 types of equipment:
 - 5 units of Telemetry
 - 4 units of Automatic Water Level Recorder (AWLR)
 - 8 units of manual type
- 3) Climatology Stations. There are 7 locations, one of them already uses the telemetric type equipment, and the others still use the manual type.

Some of the equipment is still being repaired and the rest are functioning well. Data from locations to all those stations, including the recording results, can be seen and downloaded from the BBWS Bengawan Solo website.

1.6. Watersheds and Rivers

The Bengawan Solo Watershed is divided into 3 (three) sub-watersheds with fairly extensive coverage areas, namely Upper Bengawan Solo Sub-watershed extending to 6,072 km², Madiun River Sub-watershed extending to 3,255 km², and Lower Bengawan Solo Sub-watershed extending to 6,273 km².

According to Presidential Decree Number 12 of 2012, the Bengawan Solo River Basin has 96 watersheds as seen on the front cover.

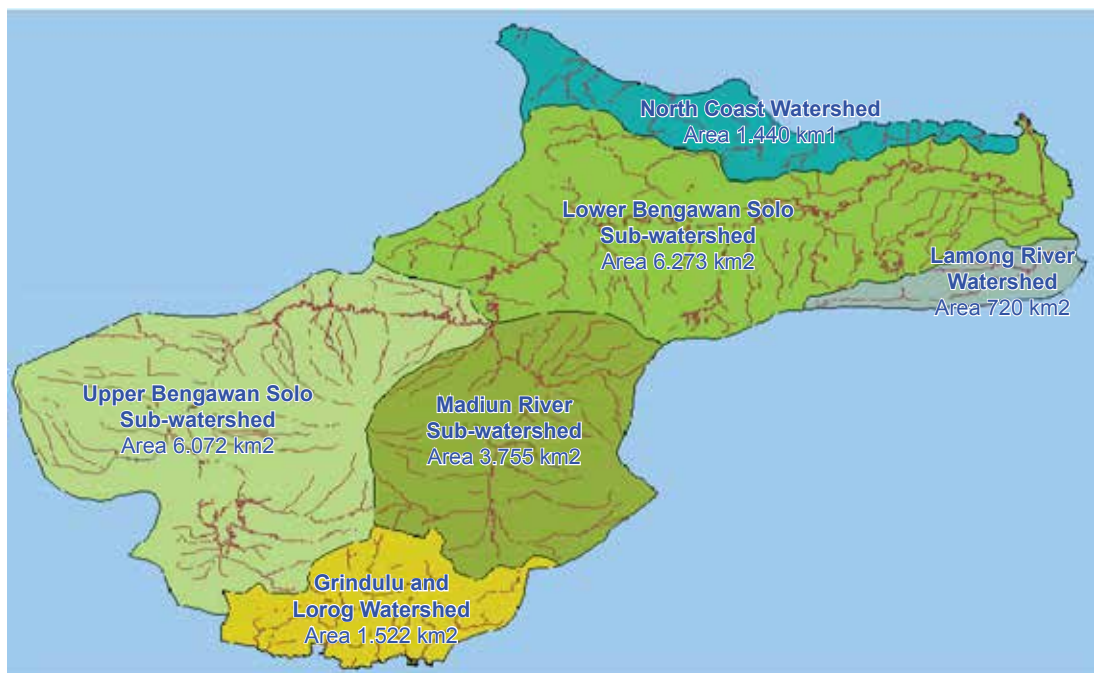


Figure 3: Sub-watersheds in Bengawan Solo

The Bengawan Solo River is the longest river in Java Island, stretches to 600 km and flows from Sewu Mountains (Thousand Mountains) in the southwest of Surakarta in Central Java Province to Java Sea in the northern part of Surabaya through East Java Province.

Water Resources Data Center (WRDC) stated (in 2010) that the number of rivers up to the fourth order located in the Bengawan Solo River Basin amounts to 1,104 rivers, with details as follows:

Table 3: Sub-watersheds and Rivers

No	Name of Sub-watershed	Number of
		Rivers
1	Upper Bengawan Solo Sub-watershed	452
2	Grindulu Sub-watershed	102
3	Teleng Sub-watershed, Lorog Sub-watershed, etc	77
4	Madiun Sub-watershed	235
5	Lower Bengawan Solo Sub-watershed	238
Total		1,104

1.7. Budget

The budget allocations for BBWS Bengawan Solo for the last 3 (three) years are as seen in the following Table 4:

Table 4: National Budget Allocation for BBWS Bengawan Solo

No	Fiscal Year	Total Budget (xRp.1,000.-)
1	2010	569,776,413
2	2011	1,358,491,132
3	2012	1,516,983,925

1.8. Issues

a) Watershed Damages

Some of the watershed damages are:

- Continued decline in the condition of forests
- Illegal logging and land conversation that cause damages to the ecosystem in the watershed arrangement
- Weak law enforcement against illegal logging
- Land cultivation that does not comply with conservation principles as well as land erosion

Watershed damages generally occur at the upper part of Wonogiri Dam, namely the Keduang Sub-watershed, which gives a considerable amount of sediment into the reservoir.

Table 5: Critical Watersheds

Watershed	Class & Area of Land (Ha)					Total
	Very Critical	Critical	Rather Critical	Potentially Critical	Uncritical	
Bengawan Solo	770	48,056	478,754	462,759	604,375	1,594,714
Grinduluds	33	26,565	112,480	24,383	1,613	165,074
Lamongds	2	120	15,290	23,063	43,493	81,968
Prumpung Klerods		2,862	25,453	40,630	33,634	102,579
Total	805	77,603	631,977	550,835	683,115	1,944,335
	0.04%	4%	33%	28%	35%	100.00%



Figure 4: Watershed damages in Upper Bengawan Solo

b) Reservoir Sedimentation

The increase of sediment in Wonogiri Dam is caused by, among others, the high level of sediment that enters into the reservoir, in which this is due to the level of erosion at the upper part of the reservoir, namely the Keduang sub-watershed. Various operations are carried out to manage the erosion at the upper part of the reservoir.

Table 6: Damages in the Watersheds of Upper Bengawan Solo River

Watershed	Class of Erosion				Total
	Heavy	Moderate	Mild	Very Mild	
Bengawan Solo	2,472	17,002	310,795	1,256,539	1,586,808
Grindulu, ds	5,063	15,787	19,776	25,214	65,840
Lamong, ds			5,433	28,200	33,633
Prumpung Klero, ds			1,370	20,946	22,316
Jumlah	7,535	32,789	337,374	1,330,899	1,708,597
	0.39%	2%	17%	68%	100%



Figure 5: Sedimentation in Gajah Mungkur Reservoir

c) Riverbed Degradation and Erosion

One of the main causes of riverbed degradation and erosion is sand mining that does not take the river's condition into consideration.



Figure 6: River channel damage

d) Seawater Intrusion

Seawater intrusion is caused by, among others, excessive use of groundwater by the people, which leads to reduced level of groundwater and then causes seawater to enter and fill in the soil layer (intrusion).

e) Floods and Droughts

Flood occurrences in the Bengawan Solo River Basin are as follows:

- 1966 Inundation: 106,000 ha & 2,400 houses
- 1987 Inundation: 78,000 ha & 24,895 houses
- 2007-2008 Inundation:
 - Upper Bengawan Solo : 8,500 ha & 18,722 houses
 - Madiun River : 4,300 ha & 24,895 houses
 - Lower Bengawan Solo : 47,200 ha & 121,500 houses
 - Total : 60,000 ha & 165,117 houses
- 2010-2011 Inundation: 10,074 ha & 28,872 houses

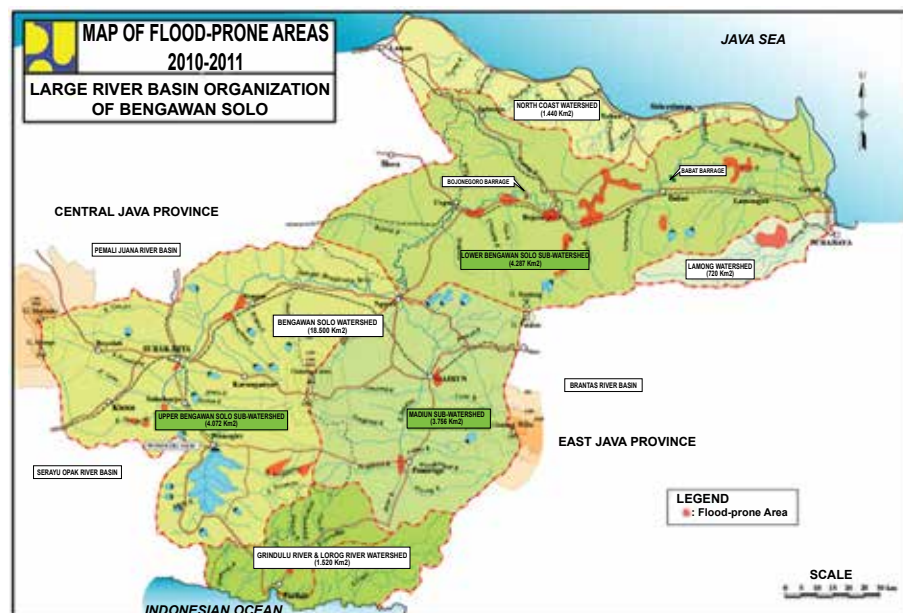


Figure 7: Flood-prone areas in 2010-2011



Figure 8: Floods and droughts

Based on the data recorded since 1996 to 2011, there has been a decline in the extent of flood inundations that occurred.

f) **Settlements on river banks**

The large number of people who occupy the river banks prevents the river from functioning properly. In addition, people often throw garbage into the river, which later will pollutes the river itself.



Figure 9: Squatter settlements on river banks

g) **Waste and garbage disposal into rivers**



Figure 10: Garbage in a river

Disposal of waste and garbage into the river is done due to the lack of awareness of the people to keep the river clean. Many people throw garbage into rivers, and even factories around rivers also dispose their waste into rivers. This causes pollution and decline in river water quality.

h) Gelangban beach abrasion

Coastal abrasion results from natural events caused by wind currents. On the one hand, wind causes an accumulation of sediment (Gresik regency) and on the other hand (Lamongan regency and Tuban regency) wind results in reduced sediments, which then leads to abrasion.



Figure 11: Abrasion of Gelangban Beach

2. WATER RESOURCES MANAGEMENT

2.1. Water Resources Conservation

Water resources conservation, especially run off arrangement, is carried out in the Bengawan Solo Watershed and the sub-watersheds of its tributaries. The water resources conservation program is prioritized for the slopes of Mount Merapi, Mount Lawu and the slopes of Mount Wilis, Wonogiri Reservoir (Gajah Mungkur) and Wonogiri Reservoir watershed, Pacal Reservoir and Pacal Reservoir watershed as well as Grindulu watershed.

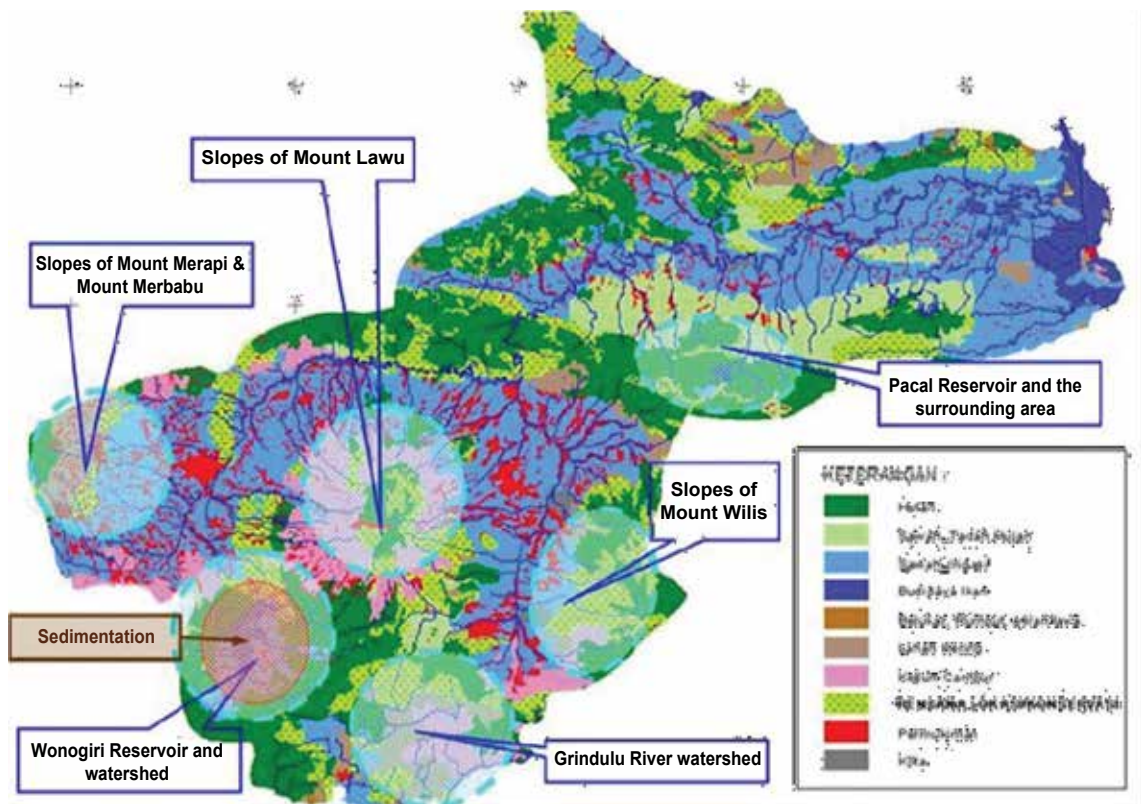
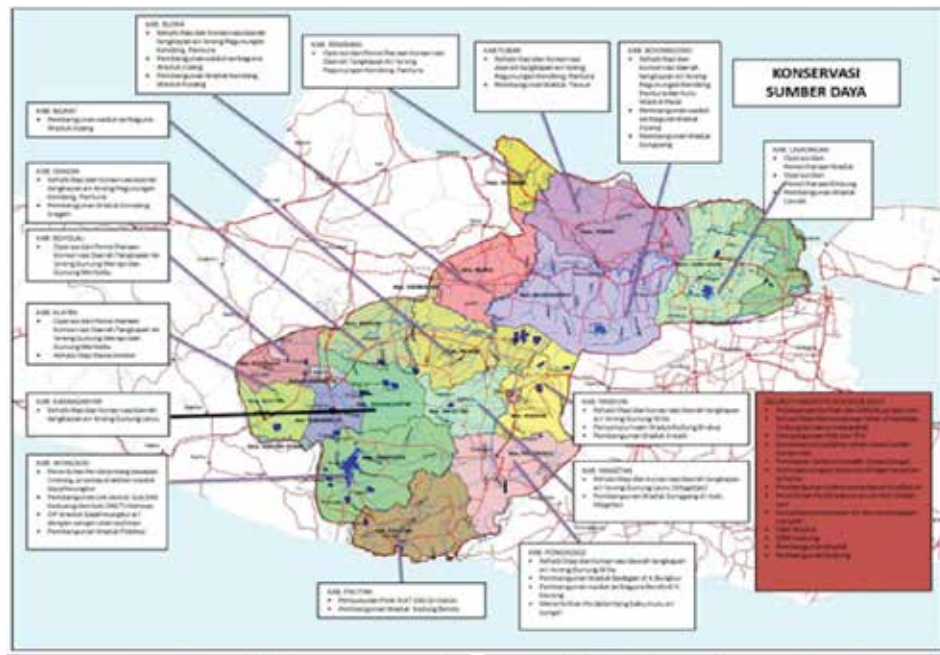


Figure 12: Locations of Run-off Arrangement Program

Water resources conservation is also carried out by building check dams in the channels of river that experience critical erosion and especially those that can lead to reservoir siltation. In order to manage the impacts of sedimentation, reservoir operation and maintenance are done by dredging sediment from reservoirs.

Water resources conservation is carried out in all regencies and cities in the Bengawan Solo River Basin through several activities as follows:

- Routine implementation of the National Movement for Forest and Land Rehabilitation (Gerhan) and the National Movement for Water Safeguard Partnership (GNKPA).
- Land rehabilitation and conservation in protected areas together with the community.
- Construction of Waste Water Treatment Installations (IPAL) and Solid Waste Disposal Sites (TPS).
- Socialization of land cultivation that is in accordance with the principles of conservation.
- Establishment of lake/river riparian boundaries.
- Anticipation against landslides and erosion by using certain plants.
- Development of water quality monitoring system.
- Issuance of regional government regulations on the standard qualities of water and liquid waste.
- Socialization of water pollution and garbage disposal.
- Reservoir Operation and Maintenance.
- *Embung* Operation and Maintenance.
- Reservoir Construction.
- *Embung* Construction.



2.2. Water Resources Utilization

The water resources utilization or development program in the work area of BBWS Bengawan Solo is spread over all river basins located in the regency/municipal administrative areas in Central Java Province and East Java Province as presented in the following figure:

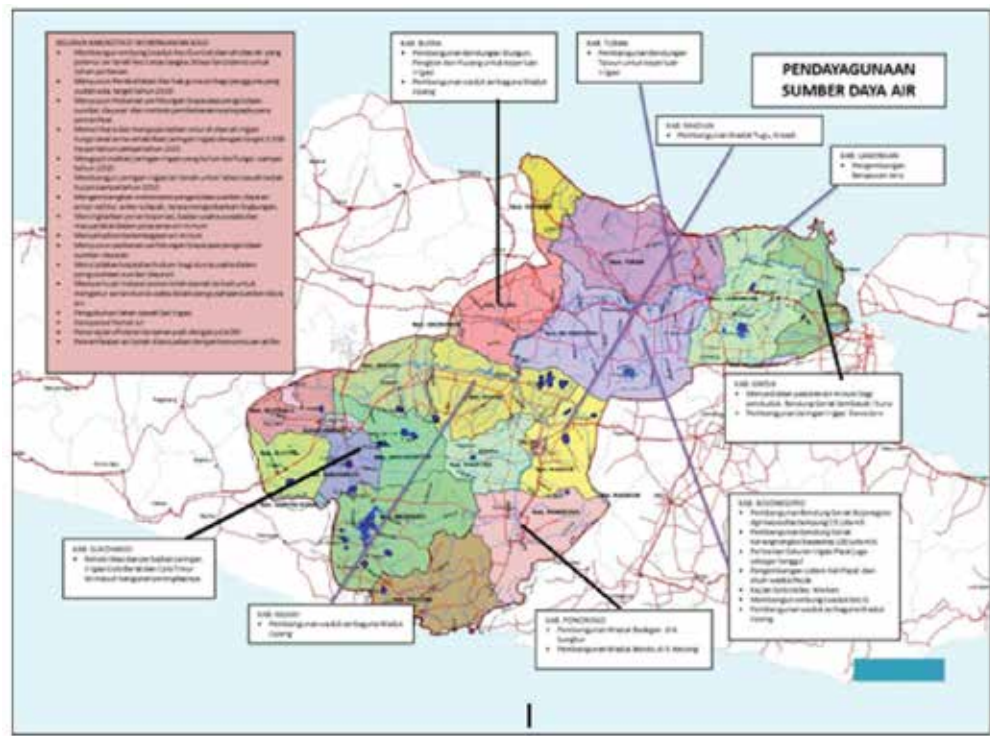


Figure 15: Water Resource Utilization Program

The water resources utilization program in the work area of BBWS Bengawan Solo which is beneficial for controlling water's damaging ability as well as able to stimulate regional development refers to the construction of dams and construction plan of dams in Bengawan Solo watershed as presented in the following table.

Table 7: Reservoir Construction Plan

No	REGENCY/ MUNICIPALITY	WATERSHED/ SUB- WATERSHED	NAME OF DAM
1	Wonogiri	Upper Bengawan Solo	Pidekso Dam
2	Sragen	Upper Bengawan Solo	Gondang Dam
3	Ponorogo	Madiun River	Bendo Multipurpose Dam in Keyang River
			Badegan Dam in Bungkur River
4	Magetan	Madiun River	Gonggang Dam
5	Madiun	Madiun River	Improvement of KedungBrubus Dam
			Kresek Dam
6	Blora	Lower Bengawan Solo	Jipang Multipurpose Dam
			Pucang Dam
7	Bojonegoro	Lower Bengawan Solo	Jipang Multipurpose Dam
			Gongseng Dam
8	Tuban	Lower Bengawan Solo	Tawun Dam
9	Lamongan	Lower Bengawan Solo	Cawak Dam

The functions of Kedung brubus Dam in Madiun regency and Kedung Bendo Dam in Pacitan regency in East Java Province are to overcome the problem of flooding, provide agricultural water, raw water, industrial water, domestic water, and the possibility of hydroelectric power plant.

The construction of these dams provides benefits of overcoming the problem of water shortage, which is to increase agricultural production, particularly rice, through the construction of irrigation area extending to 1000ha, to increase the supply of clean/raw water in an amount of 500 million/l/sec, freshwater fishery, tourism, overcoming the flooding problems that occur almost every year, through the construction of dams and the development of a 7.5MW Micro Hydro Power Plant.



Figure 16: Kedung Brubus Reservoir, Madiun

The utilization of water resources for irrigation water supply through global construction of water resource facilities and infrastructures building is presented in Table 8.

Table 8: Irrigation Areas

No	Irrigation Area	Extent of Service (Ha)	Remark/Location
1	Colo Irrigation Area, Wonogiri	24,961	Service in Central Java, Ngawi Regency, 500 Ha
2	Gombal / Dupok Irrigation Area	6,741	Madiun Ponorogo
3	SIM Irrigation Area	10,859	Madiun, Magetan Ngawi
4	Jejeruk Irrigation Area	5,107	Madiun, Magetan
5	Pacal Irrigation Area	16,688	Bojonegoro
6	Sungkur Irrigation Area	3,065	Ponorogo
7	Pondok Irrigation Area	3,128	Ngawi
8	Beron Irrigation Area	4,834	Tuban
9	Bengawan Jero Irrigation Area	8,230	Lamongan
10	Waduk Prijeta Irrigation Area	4,513	Lamongan
11	Kedung Brubus Irrigation Area	1,400	Madiun
12	Semen Krinjo Irrigation Area	929	Tuban
	TOTAL	90,455	Central Java & East Java

Water resource facilities and infrastructures that have been built until 2012 are as follows:

- Dams and *embungs* as presented in Table 10.
- Barrages (long storage) in Babat with a storage capacity of 30 million m³ and in Bojonegoro with a holding capacity of 13 million m³.
- Plangwot-Sedayu-Lawas Floodway, which stretches 12.4 km with discharge capacity Q=640m³/second.
- River safety and regulation embankments in several Bengawan Solo sub-watersheds as presented in Table 9.

Table 9: Implementation of Dike Construction

No	Name of River	Length of River	Length of Embankment (Km)		
			Left	Right	Total
1	Upper Bengawan Solo	200	20	19	39
2	Madiun River	78	21	21	42
3	Lower Bengawan Solo	299	99	109	208
4	Grindulu River	56	6.5	7.5	14
5	Lamong River	92	7	0	7
Total		725	153.5	156.5	310

Note:

- *1 : Upper Bengawan Solo : Convergence with Madiun River – Wonogiri Dam
 Lower Bengawan Solo : Estuary –Convergence with Madiun River
 Madiun River : Convergence with Bengawan Solo – Sekayu Bridge
- *2 : Total length of piled, concrete parapet or masonry embankments along the main river.

Table 10 Construction of Dams and *Embung* up to 2012

No	Watershed	Dam	Embung
1	Upper Bengawan Solo	17	68
2	Madiun River	10	14
3	Lower Bengawan Solo	18	141
4	Grindulu River	1	11
5	Lamong River	0	103
Total		46	337

2.3. Control of Water Destructive Power

Control of water destructive power is carried out through the Bengawan Solo River Improvement and Arrangement Program and construction of Physical Infrastructures for Flood Control and Management, which function is, among others, to utilize water resources for the people's welfare.

The control of water destructive power program is carried out in Upper Bengawan Solo sub-watershed, Madiun River sub-watershed, Lower Bengawan Solo sub-watershed and other watersheds within the work area of BBWS Bengawan Solo.

The control of water destructive power program is also carried out in regencies and cities within the Bengawan Solo River Basin through a variety of activities as seen in the figure below.

- Establishment of flood-prone regions and compilation of flood-prone area map of flood-prone regencies and cities, included in the Spatial Planning.
- Improvement/strengthening of embankments in flood-prone locations.
- Community training for coping with floods.
- Preparation of flood materials, including bamboo gabions.
- Increasing river channel retention by naturalizing damaged riparian areas.
- Socialization on the dangers of garbage disposal into rivers.
- Construction of demonstration plots for flood prevention.

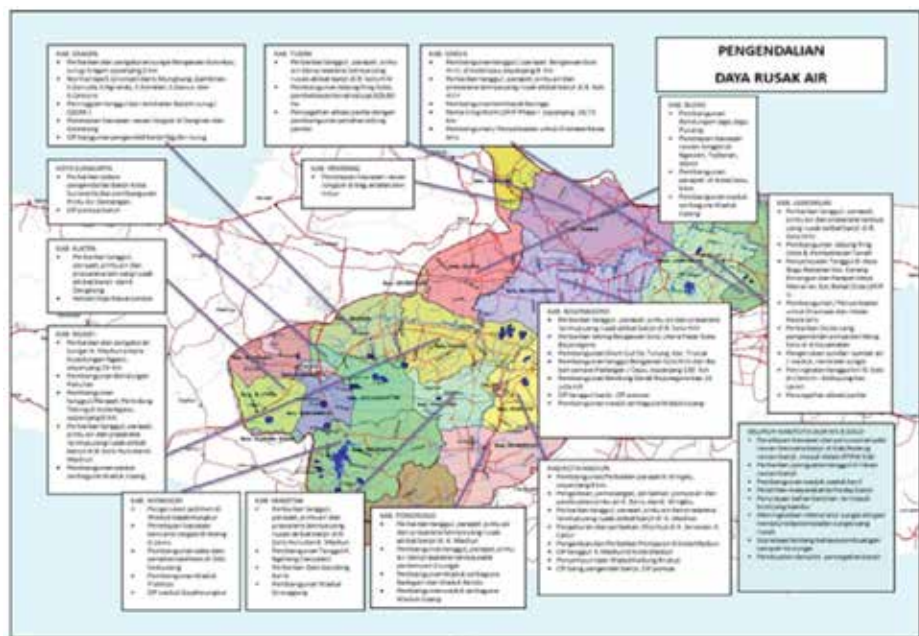


Figure 17: Control of water destructive power Program

2.4. Water Resources Information System

Water resources information system, especially that is concerned with hydrological data collection (rainfall and flood), flood forecasting and flood warning system, is greatly required in order to prepare programs and operations of water resources management already requires an information system that uses a telemetering system.

The Water Resources Information System (SISDA) is made to provide explanations, starting from technical data of water resources, activities related to water resources utilization, to operation and maintenance of water resources. However, a problem that is often encountered is how data/information is difficult to obtain or not easy to access and data/information is not yet complete or not yet available.

Hydrological data/information obtained from water observation stations, climatological stations and rain gauge stations are recorded well and can be downloaded from the BBWS Bengawan Solo website.

The management of flood information or warning for the people has already started to run, especially in flood-prone areas. Equipment is set up at flood inundation locations and if the flood surface elevation reaches a certain height, the equipment (siren) will go off immediately as a sign or warning for people that flood is coming and they can prepare themselves to take the best measures in order to be safe from the flood.

In the condition at locations equipped with a water pump, the Standard Operational Procedures require the pump to be turned on in order to reduce flood inundations and the water is to be pumped into the intercepting river channel.



Figure 18: Water Resources Information System (SISDA) training

The Balai Besar Wilayah Sungai Bengawan Solo also conducts the Water Resources Information System (SISDA) training which purpose is to improve the competency of the human resources in the Balai Besar Wilayah Sungai Bengawan Solo (BBWSBS) in the implementation of the Water Resources Information System or better known as SISDA. This training is attended by all delegates from the Divisions and Contract Executive Officers in BBWSBS. The material presented is the procedure in the entering of the required data into the website in order to produce continuously updated information on the BBWSBS website.

2.5. Community Empowerment, Monitoring and Participation

The community is involved in the making of decisions related to water resources management in order for them to participate as well as to preserve and maintain the continuity of water resources for our benefits.

Community empowerment as part of the management of Bengawan Solo Watershed has already involved the community which is represented by the Non-Governmental Organizations chosen to represent Non-Governmental Organizations in the Water Resources Management Coordination Team (TPKSDA) of Bengawan Solo Watershed.

The Water Resources Management Coordination Team (TPKSDA) of Bengawan Solo Watershed was established based on the Regulation of Minister of Public Works on the Establishment of Water Resources Management Coordination Team (TPKSDA) of Bengawan Solo Watershed.

The empowerment, monitoring and involvement in water resources management is also carried out through the forum of National Movement for Water Conservation Awareness.

The activity and participation programs of the Water Resources Management Coordination Team (TPKSDA) of Bengawan Solo Watershed and the community need to be empowered and monitored in order to optimize the purpose of the utilization of water resources in BBWS Bengawan Solo.

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. General

In principle, the future water resources management in the Bengawan Solo River Basin is carried out by conducting conservation activities in watersheds in the form of various physical activities to manage runoff, water saving, management of the damaging ability of flood water and water resources utilization for public welfare with a comprehensive management.

The implementation of activity programs needs to refer to results of studies that are comprehensive, sustainable and takes into consideration the climate change and environmental factors.

3.2. Comprehensive Management

The comprehensive water resources management in the Bengawan Solo River Basin is carried out with the following approach:

- Implementing runoff management in watersheds by using various efficient methods in the effort of water resources conservation.
- Reducing the damaging ability of flood by reducing or controlling floods through the construction of adequate flood controlling infrastructures and managing floods in order to reduce the damaging potential on the environment.
- Using water resources in a sustainable manner for various interests; provision of water for irrigation (agricultural), provision of raw water, provision of water for industries, hydroelectric power plants, micro hydro power plants and so on through a comprehensive management as part of the effort to realize public welfare.

A more comprehensive management of water resources in BBWS Bengawan Solo is implemented with reference to various existing legal provisions and laws, such as article 51, 53, and so forth of Law Number 7 of 2004 regarding Water Resources, Law Number 26 of 2007 regarding Spatial Planning, Government Regulation Number 26 of 2008 regarding National Spatial Plan, particularly article 99 and 106 concerning Zero Delta Q Policy, and article 34, 35, 36, and so forth of Government Regulation Number 38 of 2011 regarding Rivers.

Comprehensive Development Master Plan

The Comprehensive Development Master Plan (CDMP/Review Master Plan) covers 5 (five) planning components, namely:

- 1) Promoting Water Resources Development
- 2) Strengthening Water Catchment Area Management
- 3) Strengthening Water Quality Management Framework
- 4) Strengthening Flood Control Management
- 5) Strengthening Institutional Framework for Water Resources Management

The first component includes the following activities:

- a) Long-Channel Storage of Lower Bengawan Solo
- b) Water provision for Drinking Water Companies (PDAM) in Surakarta
- c) Water provision for PDAM development system
- d) Water provision for Rembang
- e) Solo ValleiWerken
- f) Nine irrigation reservoirs in Upper Bengawan Solo's tributaries
- g) Three irrigation reservoirs in Madiun River's tributaries
- h) Sixteen irrigation reservoirs in Lower Bengawan Solo's tributaries
- i) Irrigation reservoir of KedungBendo
- j) Rehabilitation and improvement of irrigation system
- k) Bendo multipurpose reservoir
- l) Badegan multipurpose reservoir
- m) Rehabilitation of Lake Ngebel

The second component includes the following activities:

- a) Urgent handling of sedimentation in Wonogiri Reservoir
- b) Reservoir rehabilitation and water catchment area management in Wonogiri Reservoir
- c) Rehabilitation and management of critical lands in six water catchment locations

The third component includes the following activities:

- a) Improvement of water quality management framework in Bengawan Solo River Basin
- b) Studies on waste water disposal in Bengawan Solo River Basin

The fourth component includes the following activities:

- a) Stage 2 improvement of Lower Bengawan Solo River
- b) Stage 2 improvement of Upper Bengawan Solo River
- c) Stage 2 and 3 improvement of Madiun River
- d) Studies on Grindulu River improvement
- e) Studies on Lamong River improvement
- f) Rehabilitation of existing river structures
- g) Flood Forecasting Warning System of Bengawan Solo River Basin

The fifth component includes the following activities:

Empowerment of Water Resources Management Centers in Bengawan Solo River Basin

Water Resources Management Model of Bengawan Solo River Basin

The model is a basic framework, guidance, strategy and policy of the Water Resources Management and it is also a statutory mandate contained in Law Number 7 of 2004 regarding Water Resources and the Regulation of Minister of Public Works regarding 266/KPTS/M/2010Models. There are 3 (three) pillars in water resources management that need to be addressed, such as water resources utilization, water resources conservation and control of water destructive power.

There are 4 (four) options of water resources management model in BBWS Bengawan Solo, namely:

- 1) Water Resources Management Scheme of Upper Bengawan Solo
- 2) Water Resources Management Scheme of Madiun River
- 3) Water Resources Management Scheme of Lower Bengawan Solo with Jipang Reservoir, and
- 4) Water Resources Management Scheme of Lower Bengawan Solo without Jipang Reservoir

In line with the Management Models mentioned above, the water fulfillment plan in BBWS Bengawan Solo can be presented as in the following figure.

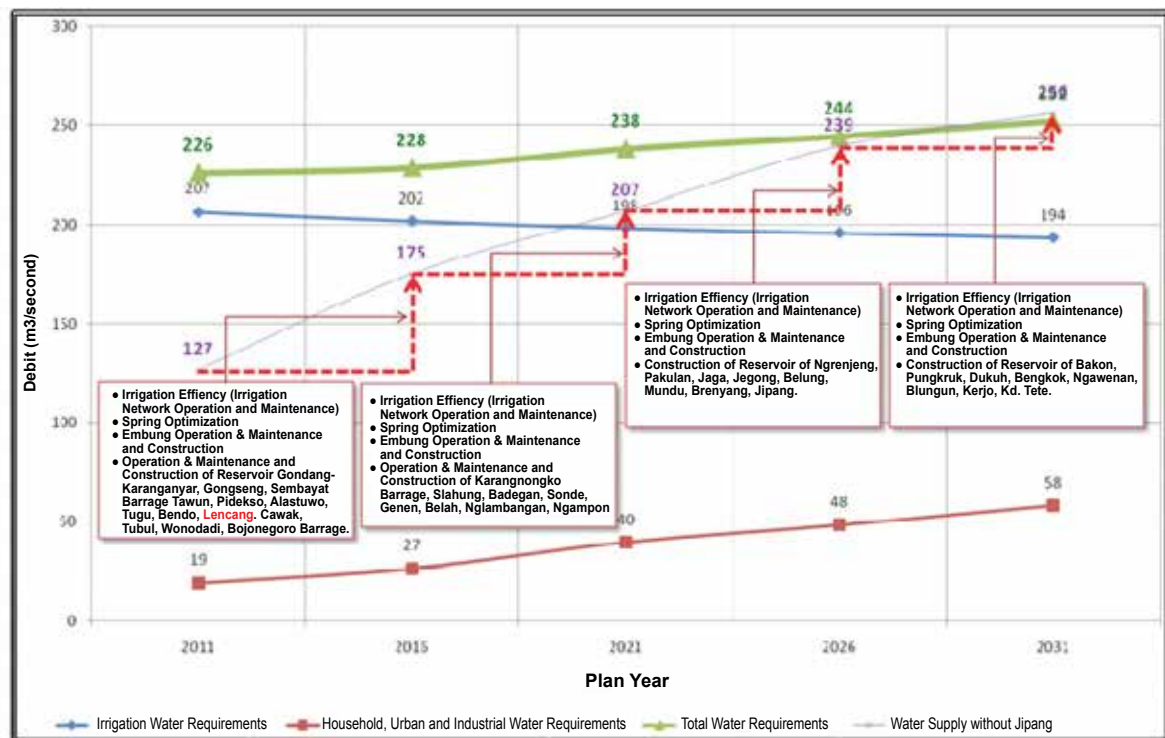


Figure 19: Scenario of Water Requirement Fulfillment by Karangnongko Barrage

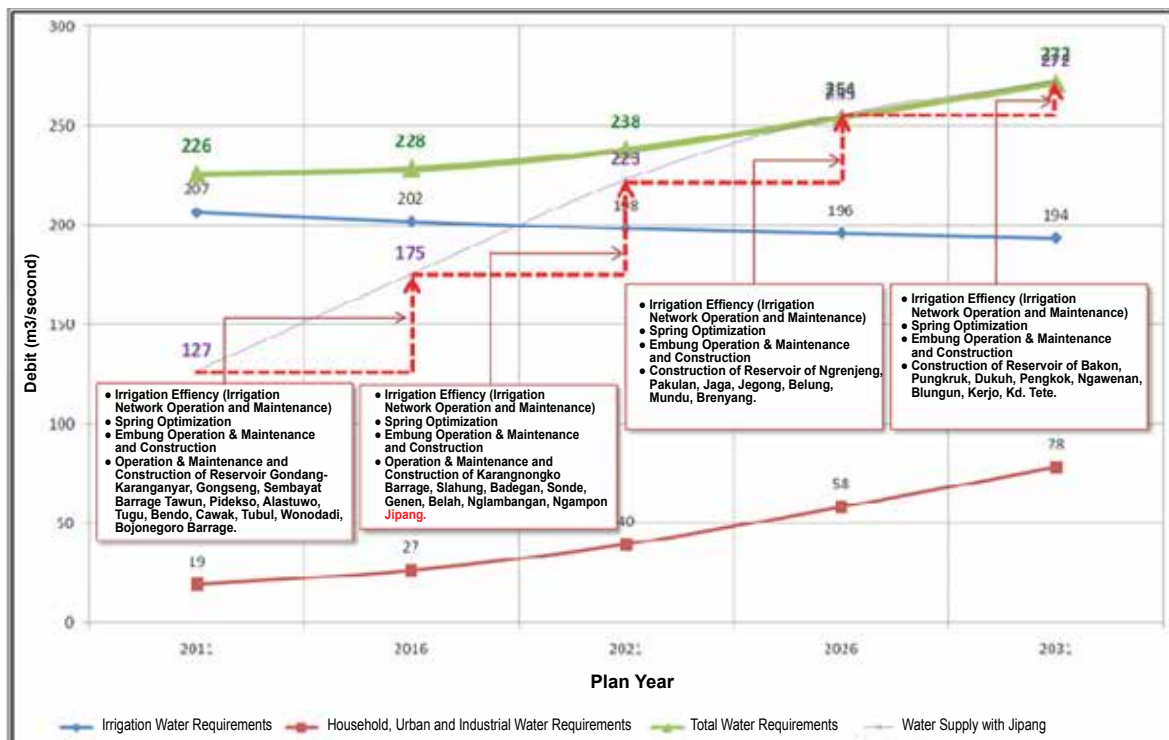


Figure 20: Scenario of Water Requirement Fulfillment by Jipang Reservoir

3.3. Implementation Strategy

To date, the implementation for CDMP is as follows:

- 1) Babat Barrage, Floodway (Phase 1 LSRP)
- 2) Rehabilitation of irrigation infrastructures (USRIP)
- 3) Rehabilitation of *embung* construction
- 4) Development of Sumber Maron raw water infrastructures
- 5) Irrigation, River and Reservoir Operation and Maintenance
- 6) Urgent Countermeasure for Wonogiri Reservoir (Grant from Japan)
- 7) Study on Countermeasure of Sedimentation in Wonogiri Multipurpose Reservoir (Grant from Japan)
- 8) Preparation of Draft Water Resources Management Model of Bengawan Solo River Basin (in process)
- 9) Establishment of Water Resources Management Coordination Team of Bengawan Solo River Basin (in process)
- 10) Implementation of GNKPA

Furthermore, other activities are scheduled to be implemented until 2014, involving 7 groups with 30 activity packages and costs amounting to 11.860 billion rupiahs, as seen in the following table.

**Table 11: National Medium-term Development Plans of 2010-2014 for
BBWS Bengawan Solo**

No	Program	2010-2014 RPJMN Scenario (Rp. 1 Billion)					Total
		2010	2011	2012	2013	2014	
1	Construction of 7 reservoirs in Bengawan Solo Watershed (7 packages)	28	556	56	103	1.050	1.793
2	Rehabilitation of water resource infrastructures in Bengawan Solo Watershed (3 packages)	31	345	45	350	100	871
3	Bengawan Solo River Basin Operation and Water Resource Infrastructures Maintenance (1 package)	25	30	35	40	50	180
4	Conservation in Bengawan Solo Watershed (2 packages)	-	10	85	85	10	190
5	Development of Irrigation Area & Drainage Of Bengawan Jero/RawaJero (1 package)	-	100	105	90	85	380
6	Construction of flood controlling infrastructures in Bengawan Solo Watershed (10 packages)	4	426	16	475	361	1,282
7	Rehabilitation of flood controlling infrastructures in Bengawan Solo Watershed (6 packages)	70	970	1,050	975	800	3,865
Total		158	2,437	1,392	2,118	2,456	8,561

A3. LARGE RIVER BASIN ORGANIZATION OF PEMALI-JUANA

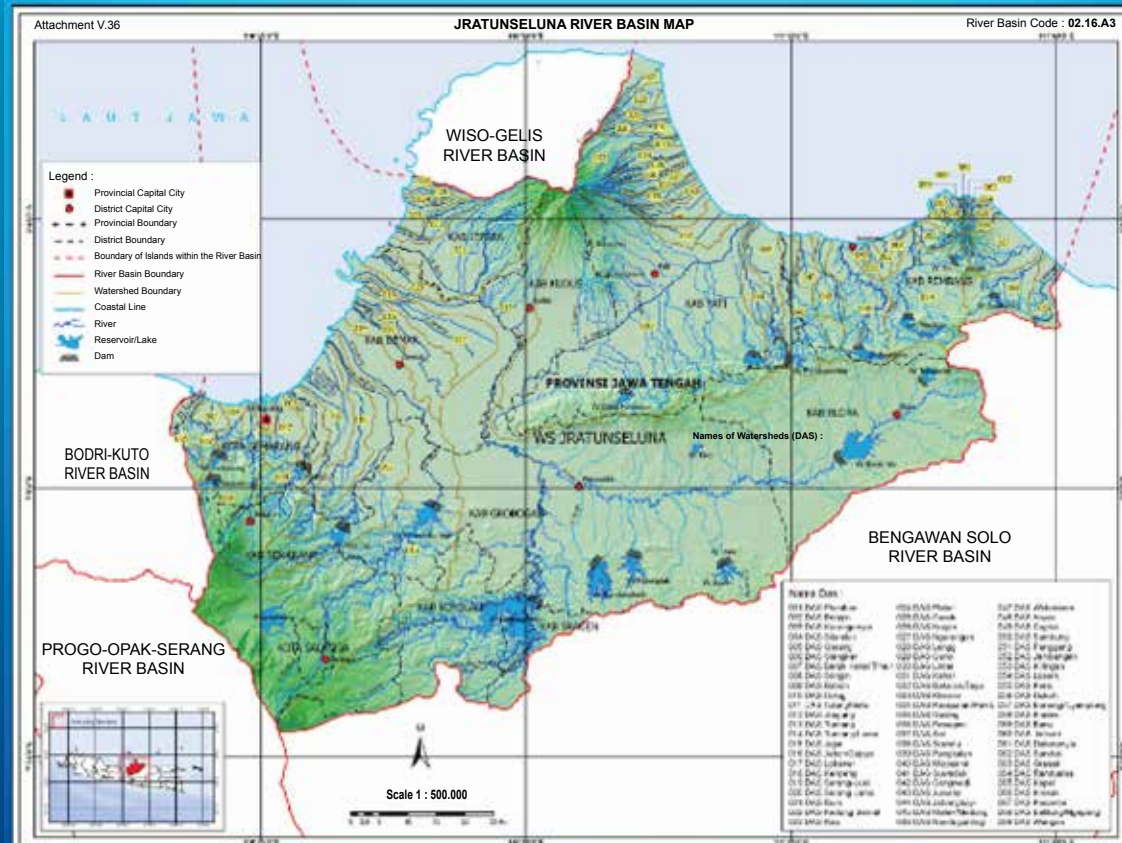
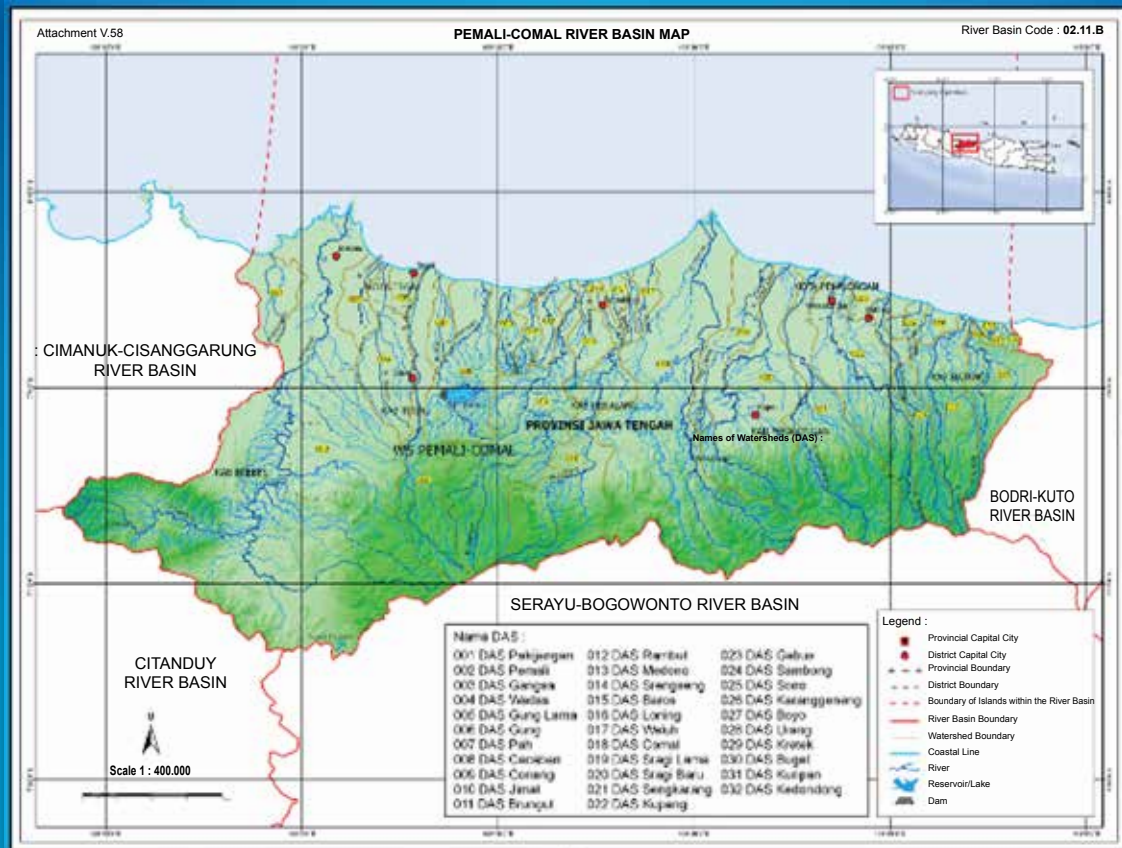


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1. DESCRIPTION OF ORGANIZATION

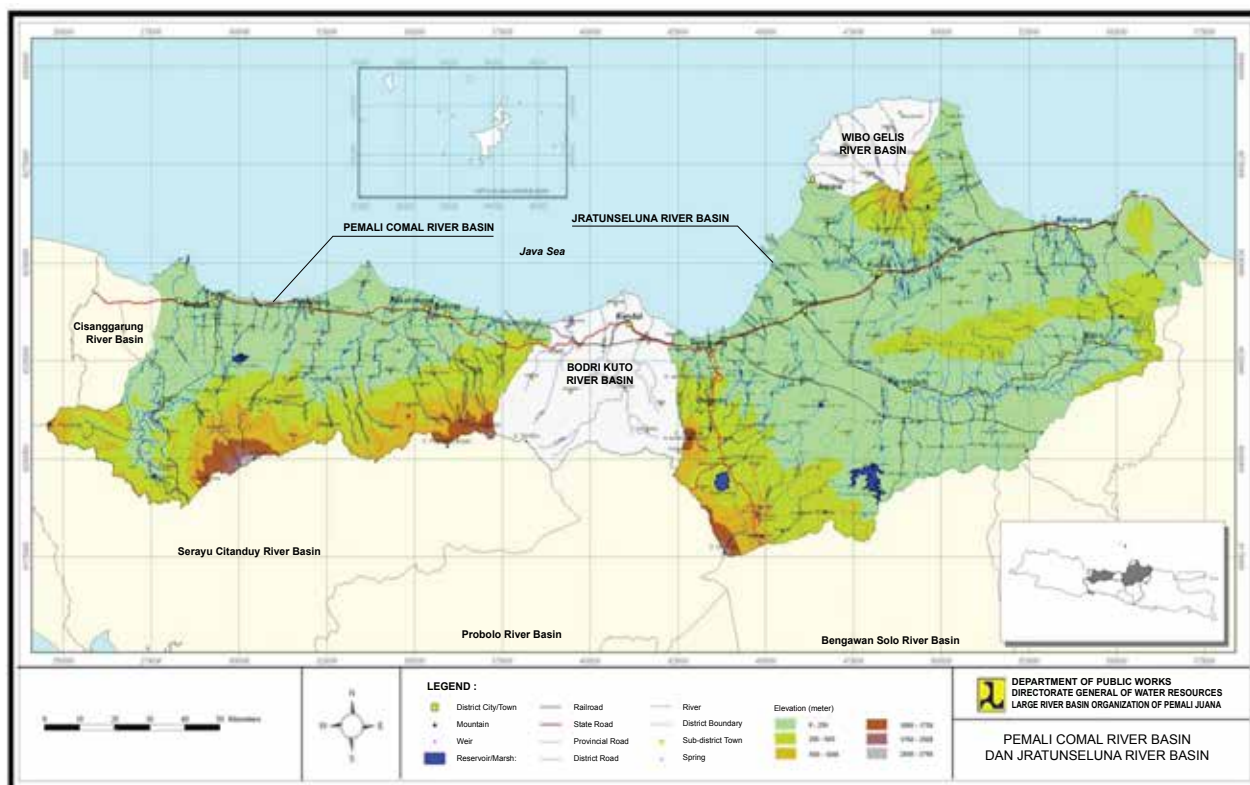


Figure 1: Work Area of BBWS Pemali-Juana

1.1. General Information

Name	: Balai Besar Wilayah Sungai Pemali-Juana
Address	: Jl. BrigjenSudiarto 375
Municipality	: Semarang
Telephone	: (024) 6723212
Facsimile	: (024) 6722239
Website	: http://www.bbwspemali.pdsda.net
E-mail	: procanbbwspj@yahoo.co.id
Legal Basis	: Regulation of Minister of Public Works Number 12/PRT/M/2006
Work Area	: Pemali Comal River Basin and Jratunseluna River Basin
River Basin Code	: 02.09.B and 02.14.A3
River Basin Classification	: Cross-provincial River Basin and National Strategic River Basin

1.2. Brief History

1969	: Sub-project of GlapanSedadi IDA-financed Irrigation Project Sub-project of Pemali Comal IDA-financed Irrigation Project GlapanSedadi IDA-financed Irrigation Project Pemali Comal IDA-financed Irrigation Project Semarang Demak Kudus Irrigation Project Jratunseluna Spring Development Planning Project Jragung Irrigation Project and RawaPening Project
1977	: JratunselunaRiver Basin Development Project
1994	: Master Plan for Jratunseluna River Basin Development
2005	: Master Implementer for Jratunseluna River Basin Development
2007	: Balai Besar Wilayah Sungai Pemali-Juana (Large River Basin Organization of Pemali Juana)

The Balai Besar Wilayah Sungai (BBWS) Pemali Juana is categorized as a type-A large river basin organization, which organizational structure consists of:

- 1) Administration Division
- 2) Program and Planning Division
- 3) Water Source Network Implementation Division
- 4) Water Utilization Network Implementation Division
- 5) Water Resources Operation and Maintenance Division

The organizational structure of BBWS Pemali Juana was established by the Regulation of Minister of Public Works Number 12/PRT/M2006, and in accordance with its category as a type-A large river basin organization, BBWS Pemali Juana is a structural organization led by a second echelon Head of Organization and assisted by four Heads of Divisions, each of them as third echelon officials.

In addition to the organizational structure, BBWS Pemali Juana is also equipped with four organizational functionaries, namely:

- 1) BBWS Pemali Juana Work Unit
- 2) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Source Network Implementation
- 3) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Utilization Network Implementation
- 4) Non-Vertical Work Unit for Particular Purpose (SNVT) for Jatibarang Reservoir Development

1.3. Human Resources

The Work Units of *Balai Besar Wilayah Sungai Pemali Juana* cover the Jratunseluna River Basin and Pemali Comal River Basin in the North Coast of Central Java, consisting of 528 personnel as seen in the following Table 1.

Table 1: Human Resources

Human Resource	Administration	Program and Planning	Water Source Network Implementation	Water Utilization Network Implementation	Water Resources Operation and Maintenance	Total
Engineer	9	18	77	63	38	205
Non Engineer	91	9	87	65	71	323
Total	100	27	164	128	109	528

1.4. General Condition of Work Area

The authority of BBWS Pemali Juana covers 2 (two) river basins, namely the Pemali-Comal River Basin (4,794.96 km²) and Jratunseluna River Basin (9,290.23 km²) with a total area of 14,085.19 km².

Administratively, the areas within the Pemali Juana River Basin cover some areas of the Central Java Province, with 16 regencies and 4 cities.

This river basin is located at 108°40'48" East Longitude to 111°42'00" East Longitude and between 6°24' 00" South Latitude to 7°28'12" South Latitude.

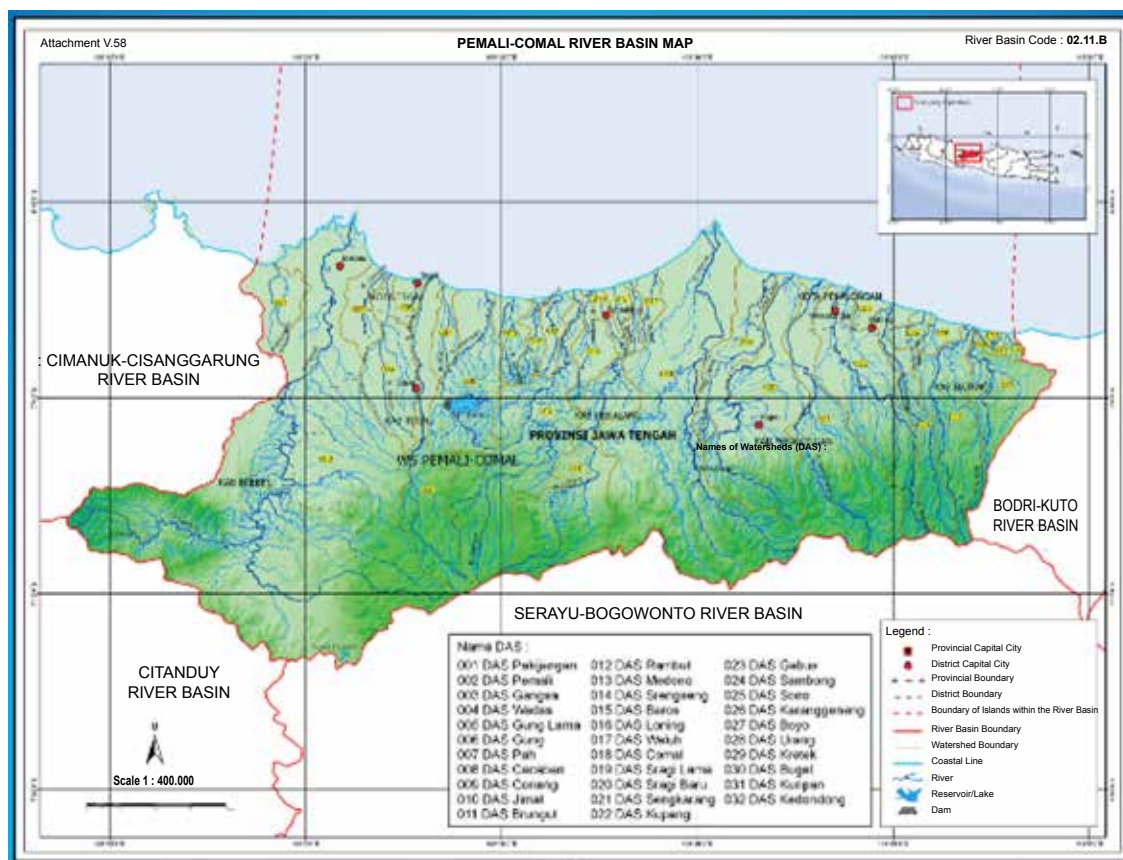


Figure 2: Pemali-Comal River Basin

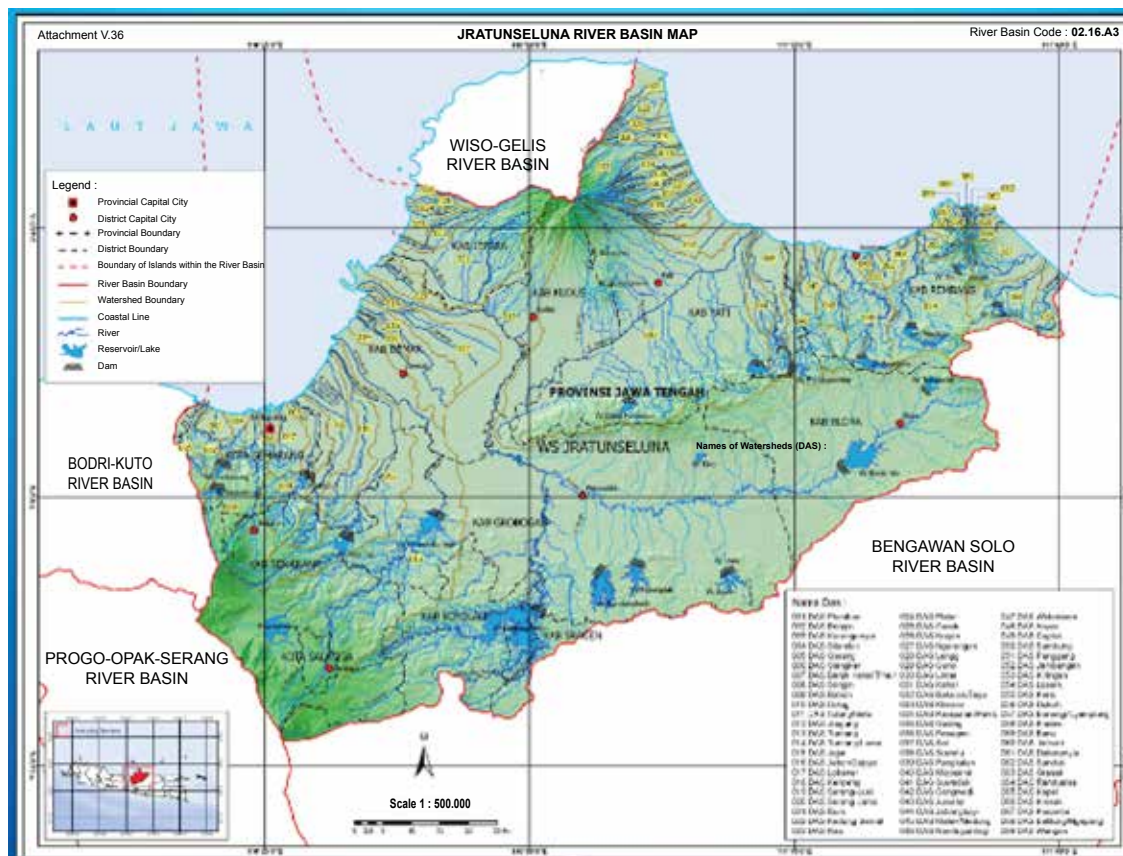


Figure 3: Jratunseluna River Basin

The Integrated Water Resources and Flood Management Project for Semarang (Dam Reconstruction, River Improvement and Non-Structural Measures) LOAN IP.534 has been carried out since 2009 and is due to finish in 2014. The project consists of 3 components, namely:

- Component A: Garang River/West Flood Canal Normalization
- Component B: Jatibarang Reservoir Construction
- Component C: Semarang City Drainage Improvement

The purposes of the Integrated Water Resources and Flood Management Project for Semarang are as follows:

- 1) To reduce damages caused by flooding along the Garang River/West Flood Canal.
- 2) To develop water resource potentials in order to meet the requirements for raw water, especially in the western part of Semarang City.
- 3) To reduce damages caused by intrusion, subsidence and seawater flooding.
- 4) To improve the environmental quality along rivers and settlement areas
- 5) To increase the preservation of conservation functions at the upper part of Garang River and Kreo River.

Availability of surface water in Pemali-Juana River Basin is recorded to be 42,764 m³/year.

The number of population is approximately 16,6 million people with a growth rate of 0,83 percent/year.

The topographic condition is dominated by lowlands, while the southern part is dominated by hills and rugged mountains.

1.5. Hydrology

The temperature in the Pemali-Juana River Basin ranges from 24°C to 29°C, with humidity ranging from 71% to 95%.

The average annual rainfall ranges from 1,700 – 3,000 mm/year.

There are approximately 136 rainfall stations in the Pemali-Juana River Basin (from 1991 to 2005). The annual mean rainfall ranges from 2,000 – 2,800 mm/year. Rainy season begins in October and lasts until March, while the dry season begins in April and lasts until September.

There are approximately 89 rainfall stations in the Pemali-Juana River Basin (from 1990 to 2004).

The average annual rainfall in Jratun Watershed ranges from 900 mm – 3,700 mm/year.

1.6. Watersheds and Rivers

Based on the Regulation of Minister of Public Works Number 11A of 2006, the work area of the *Balai Besar Wilayah Sungai Pemali-Juana* covers the Jratunseluna River Basin and Pemali Comal River Basin.

The Jratunseluna River Basin includes Garang, Jragung, Tuntang, Serang, Lusi, Juwana, Bodri, Anyar, Klampok, Semarang, and Randugunting watersheds.

The Pemali Comal River Basin includes Pemali, Notog, Cacaban, Waluh, Comal, Sragi, Sengkarang, and Sambong watersheds.

However, based on the Presidential Decree Number 12 of 2012, the Jratunseluna River Basin consists of 69 watersheds and the Pemali Comal River Basin consists of 32 watersheds, as shown by the River Basin Maps on the cover.

River discharges in the Pemali Comal River Basin are as follows:

- Lowest discharge is found in Loning/Waluh River, at 1 m³/sec.
- Highest discharge is found in Comal River, at 130 m³/sec.

River discharges in the Jratunseluna River Basin are as follows:

- Lowest discharge is found in Gardu River and Suwatu River, at 0.70m³/sec.
- Highest discharge is found in Lusi River, at 123,70 m³/sec

1.7. Budget Allocations of 2010, 2011 and 2012

The budget allocation of BBWS Pemali-Juana during the past three years (2010-2012) are relatively not much different, as seen in the following Table 2:

Table 2: Budget Allocation of BBWS Pemali-Juana

No	WORK UNIT/NON VERTICAL WORK UNIT FOR PARTICULAR PURPOSE (SNVT)	2010 (Rp1,000)	2011 (Rp1,000)	2012 (Rp1,000)
1	BBWS Pemali Juana Work Units	52,472,052	73,901,377	110,245,149
2	SNVT for Water Resources Management of Pemali Juana	197,120,900	-	-
3	SNVT for Water Source Network Implementation	-	71,112,307	61,777,418
4	SNVT for Water Utilization Network Implementation	-	162,708,330	116,101,380
5	SNVT for Jatibarang Reservoir Construction	333,409,303	231,875,000	295,315,000
	Total	583,002,255	539,597,014	583,438,947

1.8. Issues

a) Conservation

A variety of conservation issues arose due to the following matters:

- Decreased forest areas
- Conditions of critical watersheds
- Water resources protection is not yet optimal
- Water pollution (industries, domestic waste, etc)

b) Water Resources Utilization

Some of the issues on water resources utilization are:

- Spatial plan is not yet detailed in relation to water resources management land use.
- Excessive water uptake
- Imbalance between water availability and water requirements
- Population increase
- Farmers are not disciplined in cropping pattern
- A lot of water discharges have not been utilized and only thrown away into the sea.

c) Control of Water Destructive Power

Control of water's damaging ability has not been maximized due to several matters as follows:

- Inadequate capacities of rivers and infrastructures
- Sea water flooding and sea water intrusion
- Sedimentation in estuaries
- Settlements on river banks

d) Data Availability and Water Resources Information System (SISDA)

Data management and Water Resources Information System have not been able to be implemented due to the following:

- Data on water resources are not yet available in one information system
- There is not yet a standard format for water resources data
- Lack of facilities, infrastructures, and human resources

e) Community Empowerment and Increased Participation

Efforts to empower and increase the participation of the community need to be made due to the following:

- The community and private sector participations are not yet optimal
- The government performance is not yet optimal

2. WATER RESOURCES MANAGEMENT

The management of water resources in the Pemali-Juana River Basin was initially carried out primarily as an attempt to utilize water for irrigation and flood control.

In the past, the agricultural area in the North Coast of Central Java, which was known as the JRATUN SELUNA (Jragung, Tuntang, Serang, Lusi and Juana) Region, was one of the national rice barns used for the Central Java Province.

Such condition was possible due to sufficient availability of water resources and land, supported by good irrigation built since the 19th century and relatively low number of population.

The Glapan Wier was built in 1859, Sedadi Weir in 1867, and the Wilalung Flood Gate in 1918.

From 1942 until about the beginning of the First Five-Year Development (Pelita I) in 1966, constructions and maintenance of irrigation networks and water structures in this region received little attention (available exploitation costs were only 15% of the plan), which was caused by the limited funds available, as well as the political situation at the time.

As a result, the conditions of irrigation and drainage networks or other irrigation structures declined sharply, leading to a great amount of siltation and a decrease in rice production from a high level of 127,000 tons/year to only 10,000 tons/year. In addition to this, flooding occurred in the rainy season on the lands in Semarang, Demak, Kudus and Juana, covering an area of 30,000 ha. In contrast, in the dry season, with the population that also increased in size, the available water sources no longer could meet the people's daily requirements, which condition created a proverb that says "*nek rendeng ora biso ndodok, nek ketigo ora biso cewok*" [when it's the rainy season, one cannot squat (for defecation/urinating) and when it's the dry season, one cannot clean himself (after defecation/urinating)].

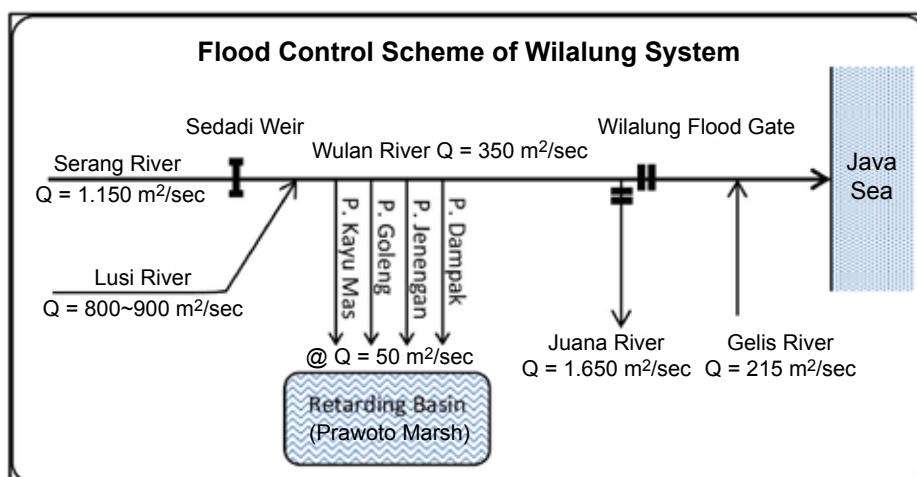


Figure 4: Flood Control Scheme of Wilalung System

CIWA (Controlled Inundation Welahan Area) SCHEME and KedungOmbo Dam

The principles and concept as well as the paradigm in handling and solving flooding problems in SerangLusi Juana areas use the upstream approach and downstream approach.

The upstream approach refers to a principle of reducing flood hazards in the upstream area by constructing *embung*/reservoirs such as the construction of Kedung Ombo Weir in Serang River and the discourse on constructing reservoirs in the Lusi River such as the Banjarejo Reservoir, Sapen Reservoir, Ngemplak Reservoir, Bandungharjo Reservoir, Tirlo Reservoir, and KedungWaru Reservoir. However, this has not been realized until today even by way of reforestation in the upstream area.

The downstream approach refers to an approach to flooding issue in downstream area by means of improving, normalizing, as well as developing existing drainage/river channels, constructing new drainage/river, such as the construction/development of SWD 2 river to overcome flooding in Welahan, Jepara.

The CIWA (Controlled Inundation Welahan Area) Scheme was chosen to control flooding in the SerangLusi Juana region, especially for the problem of Serang River. This relationship between the Kedung Ombo Dam and the Ciwa Scheme is very close because it can mitigate/reduce flooding by 20%.

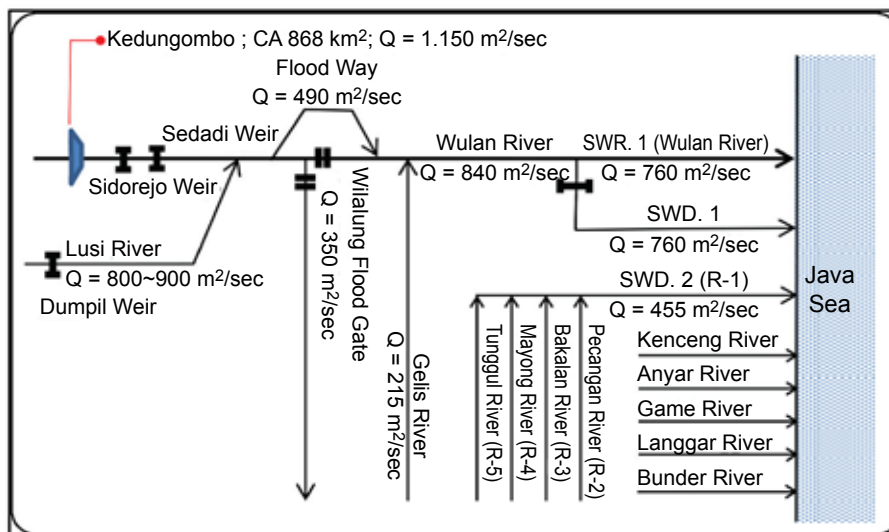


Figure 5: CIWA Scheme

The BBWS Pemali-Juana has compiled a strategic plan which includes priority programs as follows:

2.1. Water Resource Conservation

- There are 4 potential locations for reservoir and 12 potential locations for embung spread throughout the Pemali Comal River Basin and Pemali Juana River Basin.
- In the 2010-2014 Strategic Plan of BBWS Pemali Juana, there are 4 reservoirs and 12 *embungs* programmed to be constructed.
- Conservation and Rehabilitation of Serang River Watershed, Lusi River, Grawan *Embung*, Kedung Ombo Reservoir, and Pening Swamp.

2.2. Water Resources Utilization

Water resources utilization is carried out by means of developing the management of irrigation network, swamps and other kinds of irrigation networks, which includes:

- Irrigation Area Rehabilitation with a total area of 14,143 ha.

- Rehabilitation/Improvement of Reservoirs/*Embungs*, with a total of 37 reservoirs (Embung Tawangrejo; Embung Rowo Baladewo; Embung Bentolo; Embung Ngampon; Tempuran Reservoir; EmbungB. SK. 3; EmbungB.kdb.2; EmbungB.Wn.5.A; Embung Setampah; Embung Sekarsari; Lodan Reservoir; Panohan Reservoir; Embung Tempel; Embung Rondo Kuning; Embung Ngampon; Embung Jurangjero; Embung Kajengan; Embung Patujungan; Embung Pakijangan; Embung Rawa 3 Kanan; Embung Sumbreng; Embung Rowo Bolodewo; EmbungKedungrejo; Embung Bogem; Embung Karang Geneng; Cacaban Reservoir; Penjalin Reservoir; Gunung Rowo Reservoir; Gembong Reservoir; Greneng Reservoir; Simo Reservoir; Butak Reservoir; Nglangon Reservoir; Panohan Reservoir).
- Operation and Maintenance of Irrigation Areas and Reservoirs.
- Groundwater Exploitation.
- Raw Water Provision and Management, including:
 - Continued development of Bregas regional raw water pipelines
 - Construction of water storages in 31 locations
 - Provision of rural raw water pipelines in 1 location with a capacity of 10 l/sec

Table 3: Irrigation Areas until 2012

No	River Basin/Watershed	Name of Weir	Total Area (Ha)
PEMALI COMAL RIVER BASIN			101,218
1	Pemali Irrigation Area	Notog Weir	27,482
2	Kumisik Irrigation Area	Kumisik Weir	4,142
		Krupak Weir	
		Rekot Weir	
3	Gung Irrigation Area	Danawarih Weir	12,504
4	Cacaban Irrigation Area	Dukuh Jati Weir	9,179
5	Comal Irrigation Area	Sukowati Weir	9,005
6	Sungapan Irrigation Area	Sungapan Weir	7,064
7	Kaliwadas Irrigation Area	Kaliwadas Weir	7,223
8	Pesantren Klethak Irrigation Area	Pesantren Klethak Weir	3,159
9	Sragi Irrigation Area	Sragi Weir	3,399
		Gembiro Weir	
		Brondong Weir	
10	Kupang Krompeng Irrigation Area	Kupang Krompeng Weir	3,150
11	Rambut Irrigation Area	Cipero Weir	7,634
12	Grogek Irrigation Area	Sungapan Weir	7,277
BODRI KUTO RIVER BASIN			13,292
1	Kedung Asem Irrigation Area	Kedung Asem Weir	4,353
2	Bodri Irrigation Area	Bodri Weir	8,939
SERANG LUSI JUANA RIVER BASIN			92,827
1	Jragung Irrigation Area	Jragung Weir	4,053
2	Glapan Irrigation Area	Glapan Weir	18,740
3	Sidorejo Irrigation Area	Sidorejo Weir	6,038

4	Lanang/Sidorejo Kiri Irrigation Area	Lanang Weir	1,900
5	Klambu Irrigation Area	Klambu Weir	37,451
6	Sedadi Irrigation Area	Sedadi Weir	16,055
7	Dumpil Irrigation Area	Dumpil Weir	4,669
8	Gunung Rowo Irrigation Area	Gunung Rowo Reservoir	3,921
		Kedawung Weir	
		Bendoroto Weir	

Technical Irrigation Areas extend to 293,422 ha. Semi-technical Irrigation Areas extend to 15,721 ha. Simple Irrigation Areas extend to 37,547 ha. The irrigation areas of the Pemali Comal River Basin and Jratunseluna River Basin extend to 346,690 ha in total, with details as seen in Table 3.

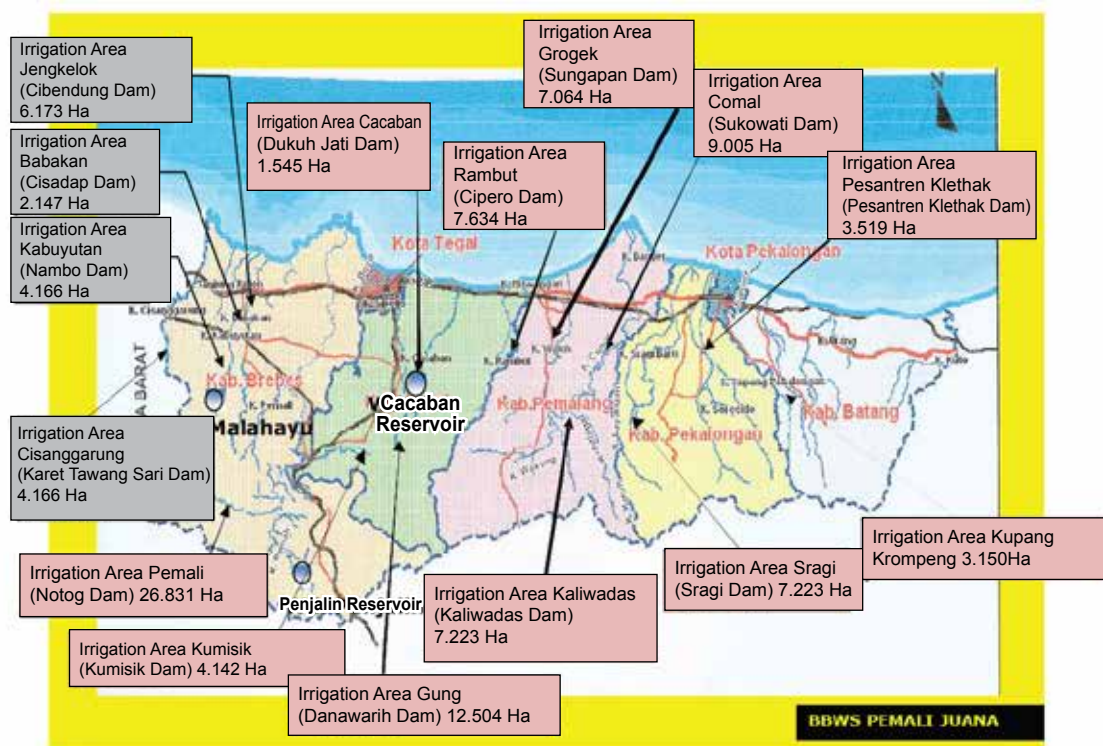


Figure 6: Irrigation Areas in Pemali Comal River Basin

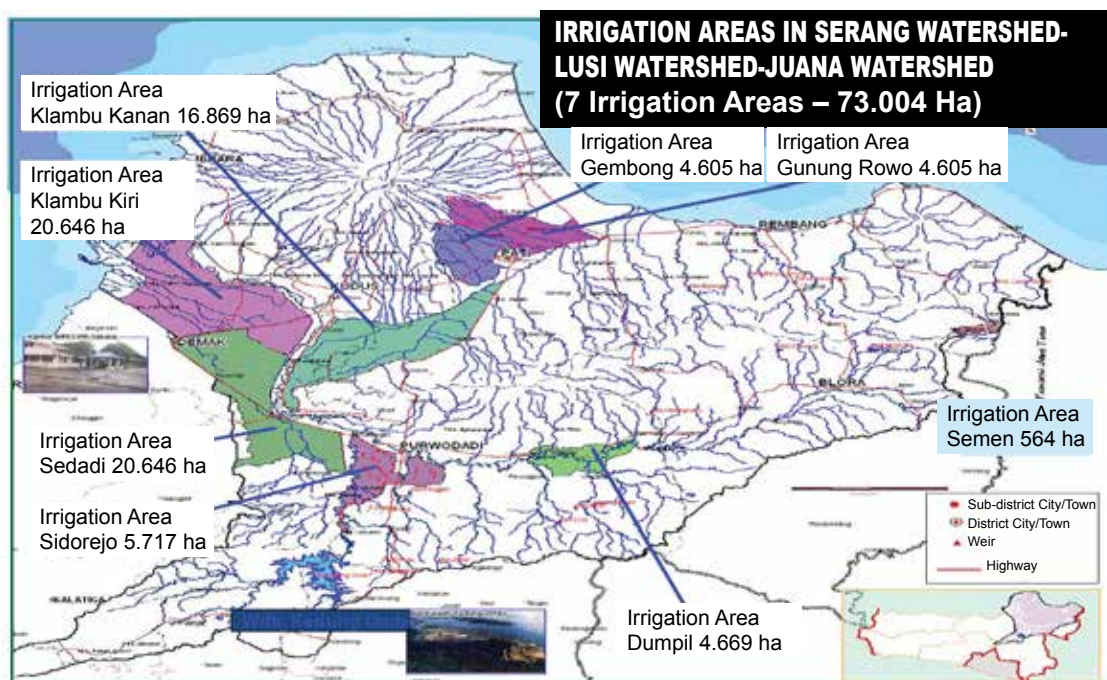


Figure 7: Irrigation Areas in Jratunseluna River Basin

Table 4: List of Dams until 2012

No	Name of Reservoir	Volume (Million m³)	Benefit		
DAMS/RESERVOIRS IN PEMALI COMAL RIVER BASIN					
1	Cacaban	55	√		
2	Penialin	9.5	√		
DAMS/RESERVOIRS IN JRATUNSELUNA RIVER BASIN					
1	Kedungombo (2003)	703	√	√	√
2	Gembong	9.5	√		
3	Lodan	5.05/5.39	√	√	
4	GunungRowo	5.16	√		
5	Klego	2.74	√		
6	Banyukuwung	2.416	√	√	
7	Greneng	2.3	√		
8	Nglangon	2.18	√		
9	Tempuran	2.14	√		
10	Butak	1.6	√		
11	Panohan	0.813	√	√	
12	Grawan	0.474	√	√	
13	Simo	0.44	√		
14	Sanggeh	0.225	√		

There are 6 *embungs* in the Pemali Comal River Basin and 30 *embungs* in the Jratunseluna River Basin.



Figure 8: Construction of Jatibarang Dam



Figure 9: Penjalin Reservoir and Cacaban Reservoir



Figure 10: Kedungombo Dam



Figure 11: Jelok Weir and Klambu Weir

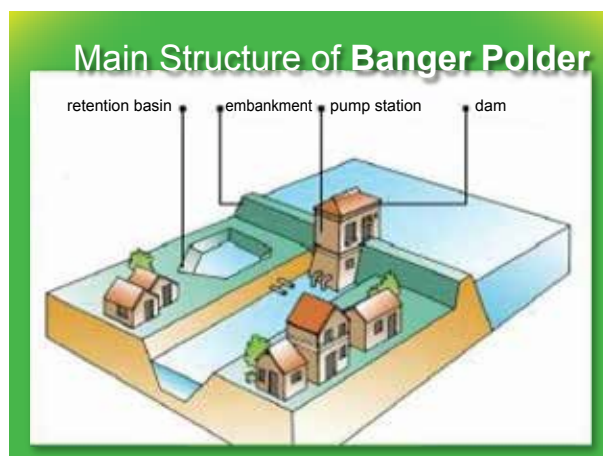


Figure 14: Banger Polder

2.4. Water Resources Information System

Regulation in water resources data and information management is still required so that there is no overlapping of authorities and responsibilities among institutions/sectors.

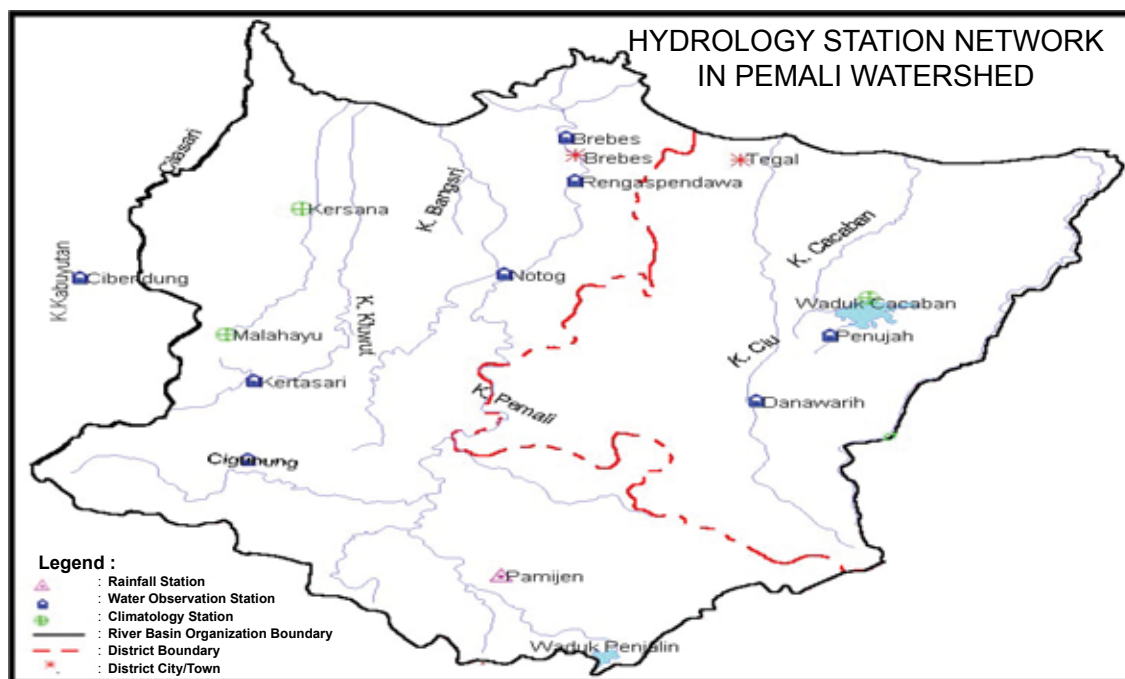


Figure 15: Pemali-Comal Hydrology Station

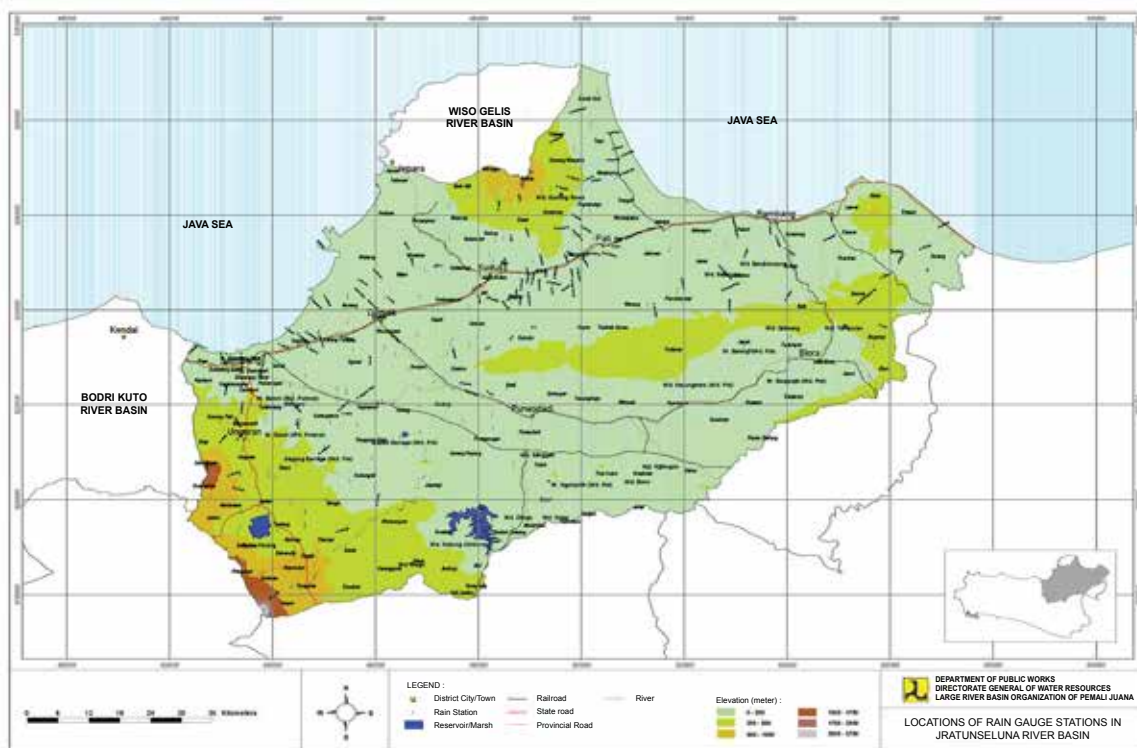


Figure 16: Jratunseluna Rain Gauge Stations

2.5. Community Empowerment, Monitoring and Participation

- The need for alignment and compliance duties and functions among agencies/sectors.
- The need for coordination in determining the licensing and supervision of the use of ground water and springs.
- The need for agreement in policies related to regional autonomy.
- The need for institutions that include capacity; institutions, human resources; authority coordination mechanism; regulations; participation of shareholders; funding and locations for implementations/pilot projects.

Water Resources Management Coordination Team (TPKSDA)

The Large River Basin Organization of Pemali Juana facilitates 2 (two) TPKSDAs, namely the TKPSDA of Pemali Comal River Basin and the TKPSDA of Jratunseluna River Basin. In Fiscal Year 2011, a TKPSDA meeting was held for the Jratunseluna River Basin which discussed the roles and functions of TKPSDA as well as the plan for delivering the data on issues in every regency in the Jratunseluna River Basin.

National Movement for Water Safeguard Partnership (GN-KPA)

The activities of the National Movement for Water Safeguard Partnership (GN-KPA) in Fiscal Year 2011 included 2 (two) activity components, namely: Facilitation for GN-KPA Community Establishment in watersheds which GN-KPA Teams have been established and facilitation as part of the Rural Soil Conservation Plan (RKTD) in 9 (nine) regencies, including: Brebes; Pamulang; Pekalongan; Batang; Kendal; Jepara; Pati; Rembang and Blora.



Figure 17: GN-KPA Meeting

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. Implementation Strategy

3.1.1. Water Resources Conservation

- a) Water Resources Protection and Preservation
Efforts of water resources protection and preservation are made as the basis in land use. In order to meet the purpose of water resources conservation, the following activities are carried out:
 - a. Vegetative and or mechanical conservation, carried out through conservation activities for each regency/town in Jratunseluna River Basin and Pemali Comal River Basin.
 - b. Restoration of the holding capacities of existing reservoirs/*embungs*.
To restore the holding capacities of existing reservoirs/*embungs* as much as possible, the following activities are carried out:
 - Clearing off water hyacinth which causes sedimentation in RawaPening Lake (Salatiga City).
 - Reservoir/*embung* operation and maintenance to reduce sediment in Jratunseluna River Basin
 - *Embung*/water storage repair to reduce sediment in Jratunseluna River Basin and Pemali Comal River Basin
 - c. Land rehabilitation
Land rehabilitation is carried out through reclamation and technical guidance for type C (sand and gravel) mining in Jratunseluna River Basin and Pemali Comal River Basin

- b) **Water Preservation**
Water preservation is carried out to maintain the existence and availability of water or quantity of water according to its function and benefit, which is done by way of:
 - Increasing raw water supply by utilizing excess water obtained during the rainy season, such as the utilization of flood water in upper Kupang River as raw water for Pekalongan Regency.
 - Water use efficiency by minimizing leakage in Jratunseluna River Basin and Pemali Comal River Basin
- c) **Water Quality Management and Water Pollution Control**
Water quality management is carried out through routine monitoring of water quality in water bodies located within the Jratunseluna River Basin and Pemali Comal River Basin as well as through socialization to the people in Rembang Regency on the use of fertilizers that do not pollute the environment.

3.1.2. **Water Resources Utilization**

- a) **Water Resources Administration**
 - **Water Resources Utilization Zone**
Establishment of water resources utilization zones by adjusting the regional spatial plan with water spatial plan as well as the establishment of riparian areas in Jratunseluna River Basin and Pemali Comal River Basin
 - **Water Allocation**
Establishment of water allocations in water sources by minimizing conflicts between the use of water for raw water and irrigation water.
- b) **Water Resources Provision**
The following activities are carried out to meet the shortage of raw water according to its quantity and quality:
 - Utilization of groundwater for raw water in Jepara, Tegal, Brebes and Pekalongan regencies.
 - Utilization of new reservoir water for raw water in Semarang, Grobogan, Pemalang and Pekalongan regencies.
 - Construction of water intake structures by constructing a barrage in Pemali River, Brebes Regency.
 - Increasing the efficiency of irrigation water use by rehabilitating/improving irrigation networks in Jratunseluna River Basin and Pemali Comal River Basin
- c) **Water Resources Use**
In order for the use of water resources to be implemented according to the water resources administration and provision that have been determined for meeting water requirements, the following activities are carried out:
 - Socialization on the functions of *embung* and irrigation network in Rembang Regency.
 - Addition of alternative raw water by utilizing the springs in Kendal Regency, and utilizing the water from the Pager Ukir Dam in Pekalongan Regency for Drinking Water Company's raw water.
- d) **Water Resources Development**
Water resources development is carried out to increase the benefits of water resource functions in order to meet raw water requirements. The development

is planned to implement by preparing a master plan for the development and maintenance of water resources in Jratunseluna River Basin and Pemali Comal River Basin.

- e) **Water Resources Exploitation**
Water resources exploitation is regulated by issuing regional government regulations on the use of water for industries and regulating the licensing for packaged water industry with regard to the social function and sustainability of the environment.

3.2. Control of Water Destructive Power

3.2.1. Prevention

Flood prevention efforts are done through control of water destructive power planning prepared in an integrated and comprehensive water resources management model, which is implemented by involving the community, as follows:

- Flood management by way of establishing flood-prone zones in locations where flood occurs almost every year.
- Restoring the function of bottomlands and riparian areas as conservation areas by limiting constructions in bottomlands.
- Increasing river capacity at river mouths through improvement/normalization of rivers from the upper part to the lower part.
- Constructing retention basins/polders.
- Maintaining coastal lines by constructing abrasion retaining embankments or by planting mangroves on the coasts of Semarang City and Demak Regency.
- Preparing flood evacuation system and conducting an annual simulation for dealing with floods.
- Minimizing land conversion through regional government regulations.
- Developing an early warning system by using telemetry station/Flood Warning System (FWS).
- Harmonization between conservation efforts in the upstream and utilization efforts in the downstream.

3.2.2. Mitigation

Flood mitigation efforts are done by arranging land use in Jratunseluna River Basin and Pemali Comal River Basin through the relocation of inhabitants from flood-prone locations and conversing land into protected area.

3.2.3. Restoration

Efforts of restoration due to flooding are done by restoring flood controlling facilities and infrastructures through rehabilitation/repair of flood controlling infrastructures, river normalization, as well as river and drainage network maintenance.

3.3. Transparency and Availability of Water Resources Data and Information

Water resources management requires the provision of water resources data and information that are accurate, timely, continuous and easy to access by developing an integrated provincial or regency/municipal water resources information system network for Jratunseluna River Basin and Pemali Comal River Basin that is supported by strong institutions, developing community participation in providing information on water resources as well as managing and developing a database system for Jratunseluna River Basin and Pemali Comal River Basin.

3.4. Empowerment and Participation Improvement of the Community, Private Sector and Regional Government

Efforts for empowering and improving the participation of community, private sector and regional government are carried out by:

- Conducting socialization to increase the community's awareness of water resources management.
- Establishing Water Resources Councils.
- Conducting law enforcement against illegal logging.
- Empowering the community living around forests in order for them to participate in maintaining and protecting the forests.
- Making policies on water use by arranging policies for overcoming water scarcity.
- Increasing community capacity and participation by improving the capacity of organizations in dealing with environmental issues through assistance programs provided by the government, empowering the community and the private sector by way of socialization, training, assistance, guidance, in order for them to be concerned, participate and take responsibility in a sustainable water resources management.

A4. LARGE RIVER BASIN ORGANIZATION OF SERAYU-OPAK

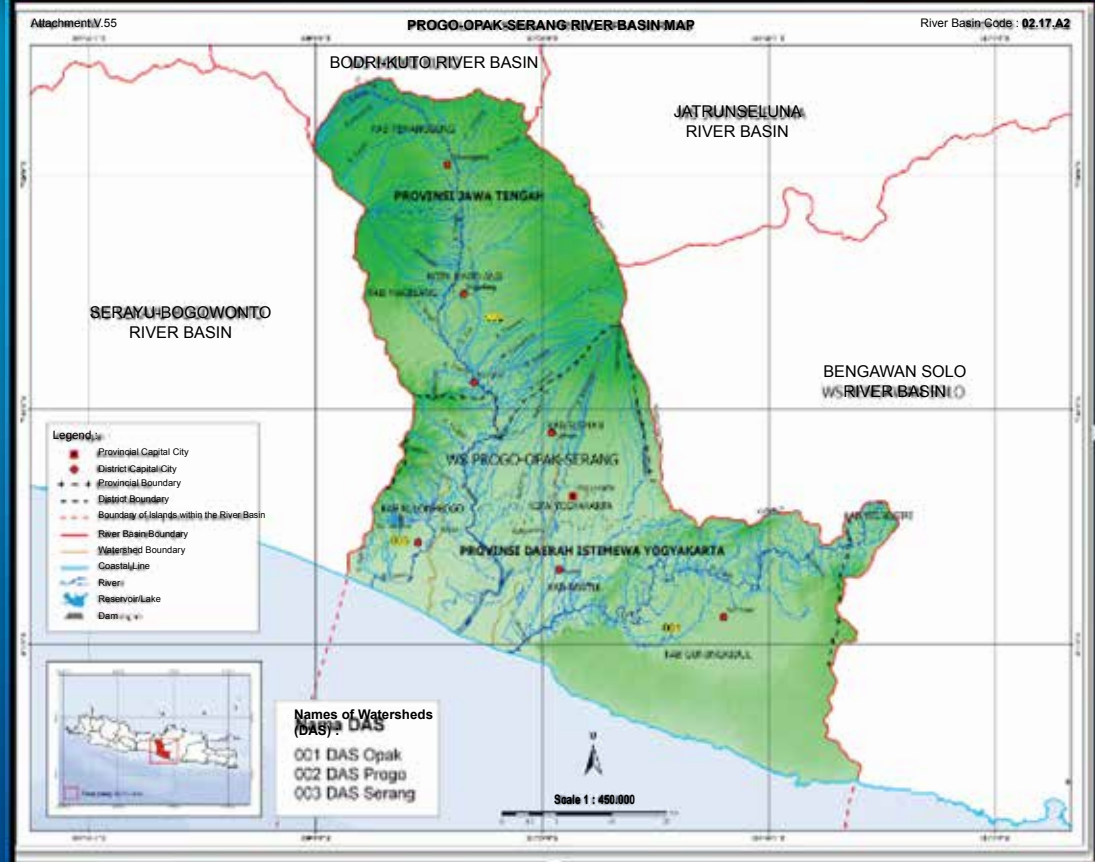
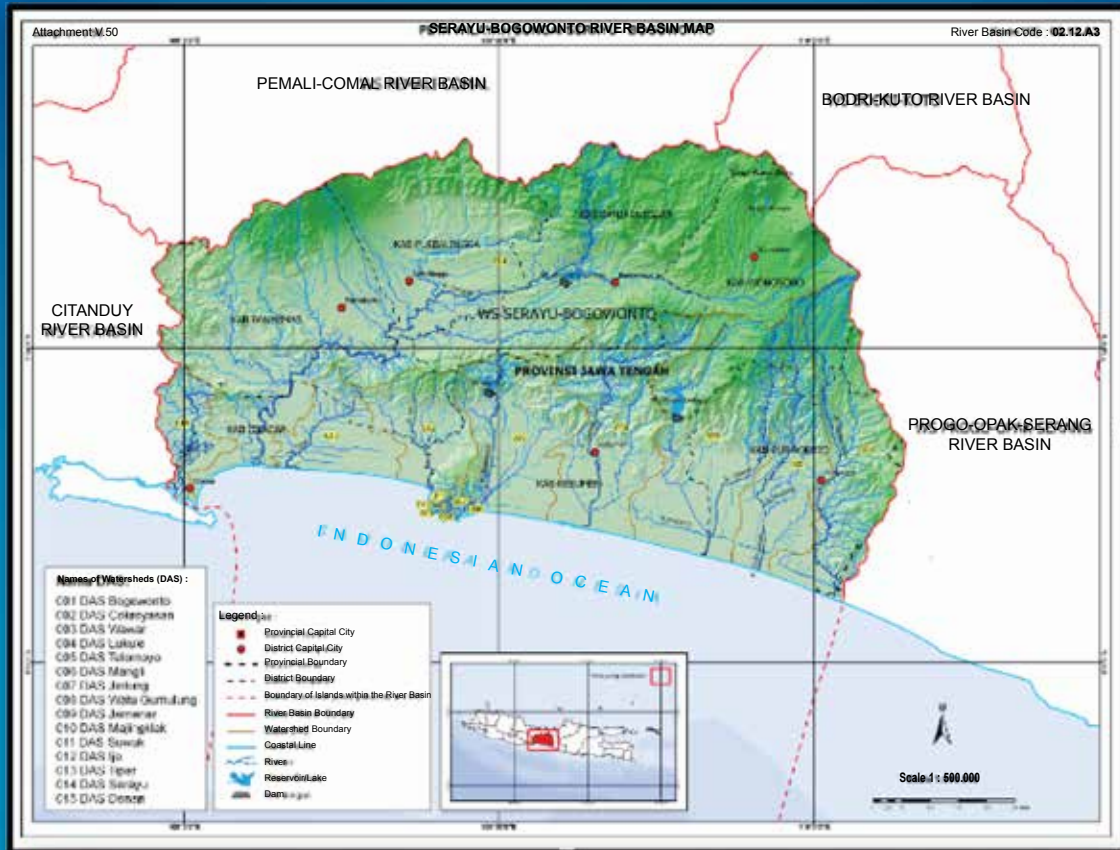


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1. DESCRIPTION OF ORGANIZATION



Figure 1: Work Area of BBWS Serayu-Opak

1.1. General Information

Name	: Balai Besar Wilayah Sungai Serayu-Opak
Address	: Jl. Solo Km 6
Municipality	: Yogyakarta
Telephone	: (0274) 489172
Facsimile	: (0274) 489552
Website	: http://www.bbws-so.net
E-mail	: so.prog@gmail.com
Legal Basis	: Regulation of Minister of Public Works Number 12/PRT/M/2006
Work Area	: Serayu Bogowonto River Basin (Code: 02-12-A3) and Progo Opak Serang River Basin (Code: 02-17-A2)
River Basin Classification	: National Strategic River Basin (Central Java) and Cross-provincial River Basin (Special Region of Yogyakarta and Central Java)

1.2. Brief History

The embryo of the Large River Basin Organization of Serayu Opak consists of former Non-Vertical Work Units for Particular Purpose (SNVT), namely:

- Flood Control and Coastal Protection Project for Serayu Bogowonto
- Water Resources Development and Management Project for Serayu Bogowonto
- Flood Control and Coastal Protection Project for the Special Region of Yogyakarta
- Water Resources Development and Management Project for the Special Region of Yogyakarta
- Raw Water Supply Project for the Special Region of Yogyakarta
- Mainstay Irrigation Project for the Special Region of Yogyakarta, and
- Mount Merapi Debris Flow Control Project

1969	South Kedu Project (Sempor Reservoir)
1994	Gambarsari Irrigation Project (Serayu Barrage)
1994	PIP of Serayu Bogowonto River Basin
	Master Implementer of Serayu Bogowonto River Basin Development
	Flood Control and Coastal Protection Project for the Special Region of Yogyakarta
	Mount Merapi Eruption Disaster Management Project
	Mainstay Irrigation Project for the Special Region of Yogyakarta
	Water Resources Conservation Project for the Special Region of Yogyakarta
	Raw Water Supply Project for the Special Region of Yogyakarta
2006	Balai Besar Wilayah Sungai Serayu-Opak (Large River Basin Organization of Serayu-Opak)

1.3. Human Resources

The Balai Besar Wilayah Sungai (BBWS) Serayu-Opak is categorized as a type-B large river basin organization, which organizational structure consists of:

- 1) Administration Division
- 2) General Program and Planning Division
- 3) Implementation Division
- 4) Operation and Maintenance Division

A number of human resources required to implement the management of BBWS Serayu-Opak consist of technical workers and non-technical workers who serve to support according to the needs of the organization. The number of human resources and their employment status are as seen in the following Table 1.

Table 1: Human Resources in BBWS Serayu-Opak

Status	Qualification	Total Employees by Employment Status	Sub Total Employees	Total Employees
Civil Servant	S2 Technical	32	334	631
	S2 Non Technical	8		
	S1 Technical	43		
	S1 Non Technical	48		
	D IV	8		
	D III	20		
	Senior High School	127		
	Junior High School	30		
	Elementary School	18		
Non-Civil Servant	Honorary	241	297	
	Office Boy/ Girl	12		
	Driver	15		
	Security Guard	29		

Budget implementation activities are carried out by 3 (three) Work Units, namely:

- 1) BBWS Serayu Opak Work Unit, consisting of 4 Contract Executive Officers.
- 2) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Utilization Network Implementation of Large River Basin Organization of Serayu Opak, consisting of 3 Contract Executive Officers.
- 3) Non-Vertical Work Unit for Particular Purpose (SNVT) for Water Source Network Implementation of Large River Basin Organization of Serayu Opak, consisting of 4 Contract Executive Officers.



Figure 2: Human Resources Training

Several trainings such as trainings on HEC-RAS and HEC-HMS are carried out with a purpose of increasing the capacity of high-quality human resources (personnel) in operating government application softwares and irrigation technique softwares in order to support the implementation of BBWS Serayu Opak's duties and functions.

1.4. General Condition of Work Area

The work area of BBWS Serayu Opak consists of 14 regencies/municipalities, namely Cilacap, Banyumas, Purbalingga, Banjarnegara, Wonosobo, Temanggung, Magelang, Purworejo, Kebumen, Municipality of Jogjakarta, Sleman, Bantul and Gunung Kidul, and 15 watersheds in Serayu-Bogowonto River Basin, namely Bogowonto, Cokroyasan, Wawar, Luk Ulo, Telomoyo, mangli, Jintung, Watu Gumulung, Jemenar, Malingklak, Suwuk, Ijo, Tipar, Serayu, Donan. In Progo-Opak-Serang there are 3 watersheds, namely Progo, Opak and Serang.

BBWS Serayu Opak has a total area extending to 12,337.85 km², consisting of Serayu Bogowonto River Basin (7,344 km²) and Progo-Opak-Serang River Basin (4,993,85 km²). (Source: *Profil BBWS Serayu Opak*, 2008)

Table 2: Large Dams in BBWS Serayu Opak

No	NAME & LOCATION	YEAR OF COMPLETION	TYPE OF DAM	HOLDING CAPACITY (10.000 m ³)	FUNCTION
1	Sermo, Kulonprogo	1996	Rockfill with soil core	25,000	Irrigation 3.550 Ha
2	Mrica, Banjarnegara	1989	Rockfill with soil core	47,000	Electricity 580 GWH/year
3	Garung, Wonosobo	1983	Concrete Gravity	14,900	Electricity 48 GWH/year
4	Sempor, Kebumen	1978	Rockfill with soil core	47,000	Irrigation 17.000 Ha and Electricity 6 GWH/ year
5	Wadaslintang,	1997	Rockfill with soil core	408,000	Irrigation 31.634 Ha and Electricity 92 GWH/year
6	Pajengkolan, Kebumen	1986	Concrete Gravity	130	Wadaslintang Regulator Electricity 9.3 GWH/ year

In the work area of BBWS Serayu-Opak, there are 6 large dams which constructions have been completed in 1978 as seen in Table 2 above.

The number of watersheds in Serayu-Bogowonto River Basin and Progo-Opak-Serang River Basin is exactly the same as the number of watersheds stated in the Presidential Decree Number 12 of 2012.

- **Serayu-Bogowonto River Basin**

The Serayu-Bogowonto River Basin covers a total area of 7,344 km² (including sandy land), consisting of the areas in Serayu Watershed ($\pm 3,759$ km²), Donan Watershed (± 188 km²), Ijo Watershed (± 317 km²), Tipar Watershed (± 245 km²), Telemoyo Watershed (± 516 km²), Luk Ulo Watershed (± 567 km²), Wawar Watershed (± 765 km²), Cokroyasan Watershed (± 402 km²), and Bogowonto Watershed (± 585 km²), which include 8 regency administrative areas, namely Cilacap, Banyumas, Purbalingga, Banjarnegara, Wonosobo, Kebumen, Purworejo and Central Java Province and Kulon Progo in the Special Region of Yogyakarta Province.

In general, land use is divided into 2 categories, namely agriculture (upstream and downstream) and settlement (downstream).

The topographical condition is hilly at the northern part and flat at the southern part, bordering on the Indian Ocean.

The population amounts to 7,017,348 people with a growth rate of 0.73%.

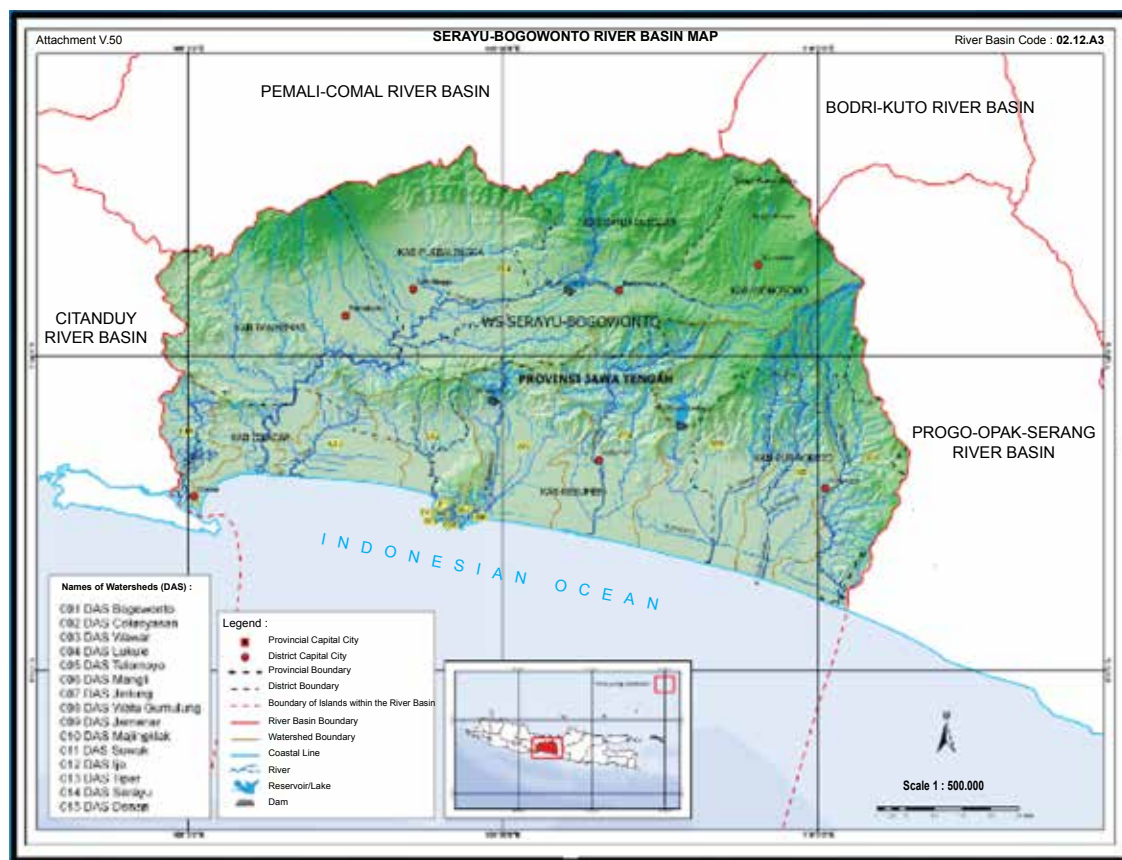


Figure 3: Serayu-Bogowonto River Basin

- **Progo-Opak-Serang River Basin**

The Progo-Opak-Serang River Basin is a cross-provincial river basin which crosses the Special Region of Yogyakarta Province and the Central Java Province.

In general, the topographical condition of the Progo-Opak-Serang River Basin consists of mountains and lowlands. The total area of Progo-Opak-Serang River Basin extends to approximately 4,993.85 km², covering:

- Special Region of Yogyakarta Province (3,136.55 km²), and
- Central Java Province (1,857.30 km²)

Land use generally consists of wetlands and non-wetlands (dry lands), industries, etc.

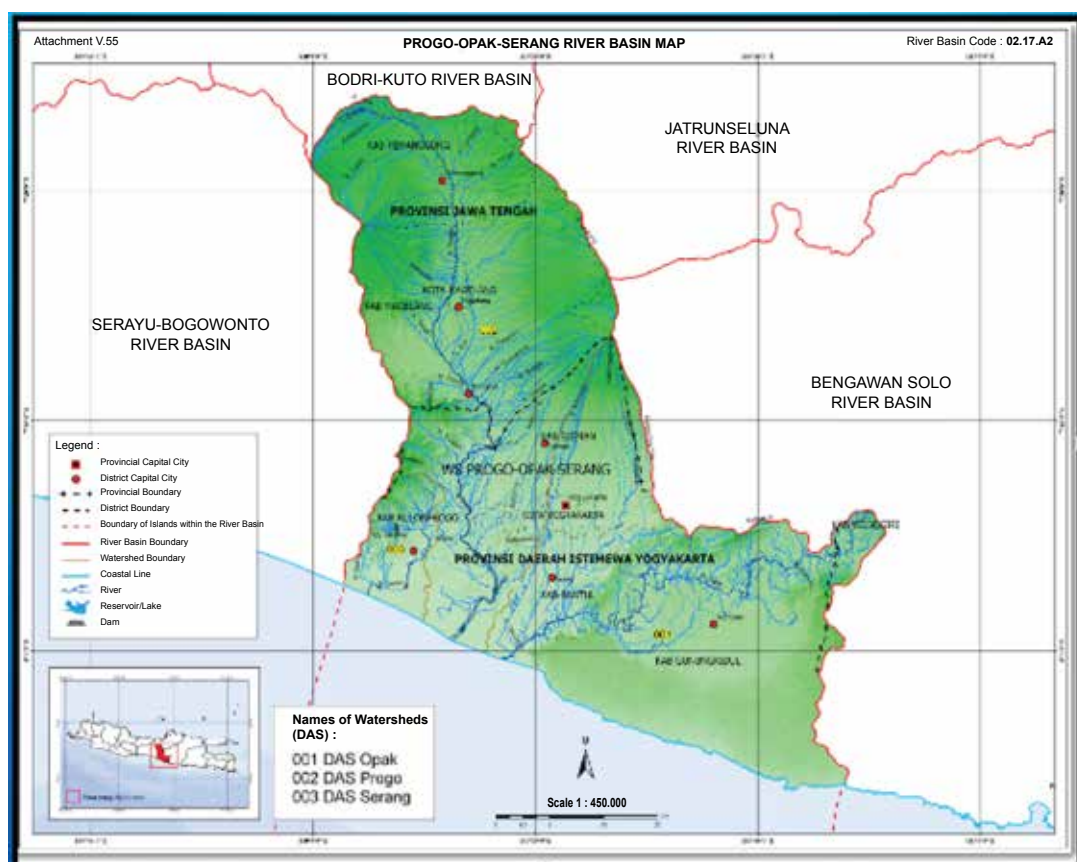


Figure 4: Progo-Opak-Serang River Basin

1.5. Hydrology

The hydrological and climate condition in general is as follows; annual rainfall varies between 1,700 mm to 4,000 mm per year, with monthly rainfall variation between 33 to 385 mm, and the number of rainy days is between 57 up to 102 days per year.

Temperatures range from 25°C to 27°C, while average humidity ranges from 80% to 85%. Wind speed ranges from 0.96m/second to 1.81m/second and average sunshine duration varies from 37% to 65%.

The website of BBWS Serayu-Opak informs that there are 19 locations of Water Observation Stations in Progo-Opak-Serang River Basin, and 21 locations in Serayu-Opak River Basin. But no information is given on the existence of Rain Observation Stations and Climatology Stations.

1.6. Watersheds and Rivers

BBWS Serayu-Opak, which consists of Serayu-Bogowonto River Basin and Progo-Opak-Serang River Basin, has an overall number of 18 watersheds and 57 first order rivers and 51 second order rivers as seen in the following Table 3.

Table 3: Number of Watersheds and Rivers

No	River Basin	Number of Watersheds	Number of Rivers	
			First Order	Second Order
1	Serayu-Bogowonto	15	20	51
2	Progo-Opak-Serang	3	37	0

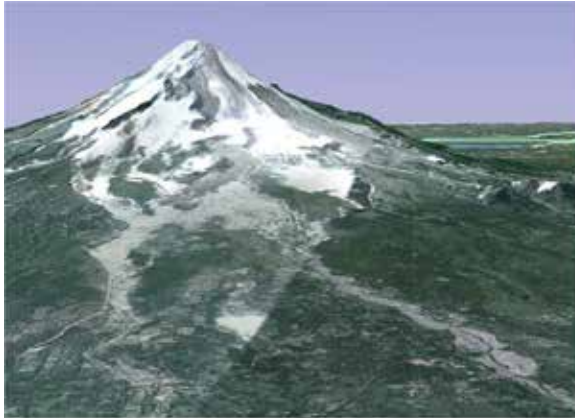


Figure 5: Mount Merapi

Some of the rivers and tributaries in Progo Watershed, namely Putih River, Krasak River and in Opak Watershed, namely Code River, Gajah Wong River, Kunng River, and Bening River, come from Mount Merapi. These rivers have special characteristics. The riverbeds consist of sand, gravel and rocks resulted from the eruption of Mount Merapi. In the upstream, the sand layer is very thick like in Putih River's channel in Jurang Jero village for example. In the dry season, there is no visible flow on the channel's surface, and sometimes there seems to be a braided

pattern. After heavy rains, there is a torrential flow that sweeps away some of the material resulted from the eruption and then a debris flow or lahar flow will occur. This debris flow is a torrential flow with a very high level of destructive force that often leads to disaster.

Aside from having the potential to cause a disaster, the material resulted from the volcanic eruption also brings benefits for the people. The volcanic ash is believed to fertile the soil and dry fields in the surrounding area, while the sand, gravel and the rocks can be sold as building materials.

In addition, it is known that there are several underground rivers, such as:

- 1) Bribin Underground River, with potential flow of 956 liters/second.
- 2) Ngobaran Underground River, with potential flow of 700 liters/second.
- 3) Seropan Underground River, with potential flow of 800 liters/second.

Among the three underground rivers above, the Bribin Underground River has been managed and utilized for supplying raw water for the surrounding community. The river is located in Dapadayu Village, Semanu Sub-regency, Gunungkidul Regency, which is approximately 11 km southeast of the town of Wonosari. This river is an underground river on karst rocks and empties into the Gulf of Baron in Indonesian Ocean, and is generally a part of the Opak River Territory.

In the river, a weir is built and a turbine is installed to pump water to the surface, in which the water is used as raw water.

The constructions of the underground river weir and water pump turbine were integrated into the constructed Facilities and Infrastructures of Raw Water Supply for Bribin Village, resulting in affordable water prices for water user community. The operational cost that was initially Rp 3,000,- per m³ is calculated to drop to Rp,- per m³.

Other than that, Bribin Cave was also developed to serve as Karst Laboratory and Underground River.

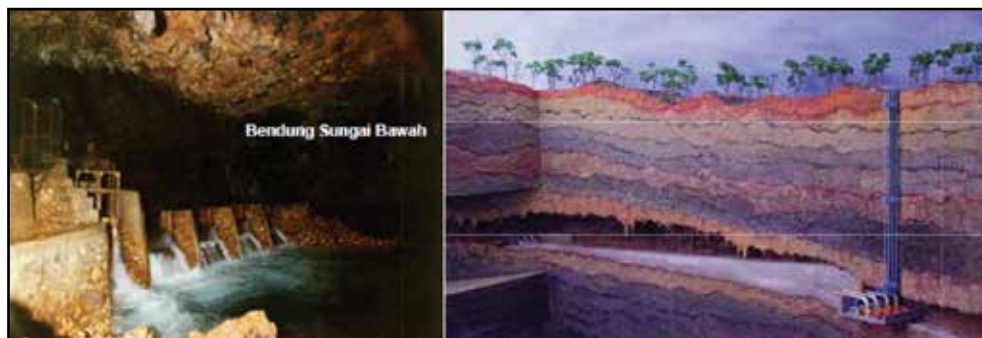


Figure 6: Weir and Pump Turbine in Bribin River



Figure 7: Bribin Cave

1.7. Budget Allocations

The cost budgets of BBWS Serayu-Opak for the periods of 2010, 2011 and 2012 can be seen in the following Table 4:

Table 4: Budget Allocation of BBWS Serayu-Opak

BUDGET YEAR	NAME OF WORK UNIT	BUDGET (Rp 1,000)	TOTAL (Rp,1,000)
2010	BBWS S-O	57,176,593	320,076,693
	SNVT	262,900,100	
2011	BBWS S-O	70,602,111	445,325,383
	SNVT for Water Resources Management	92,464,314	
	SNVT for Water Source Network Implementation	282,258,958	
2012	BBWS S-O	70,926,461	867,164,441
	SNVT for Water Resources Management	64,846,300	
	SNVT for Water Source Network Implementation	731,391,680	

1.8. Issues

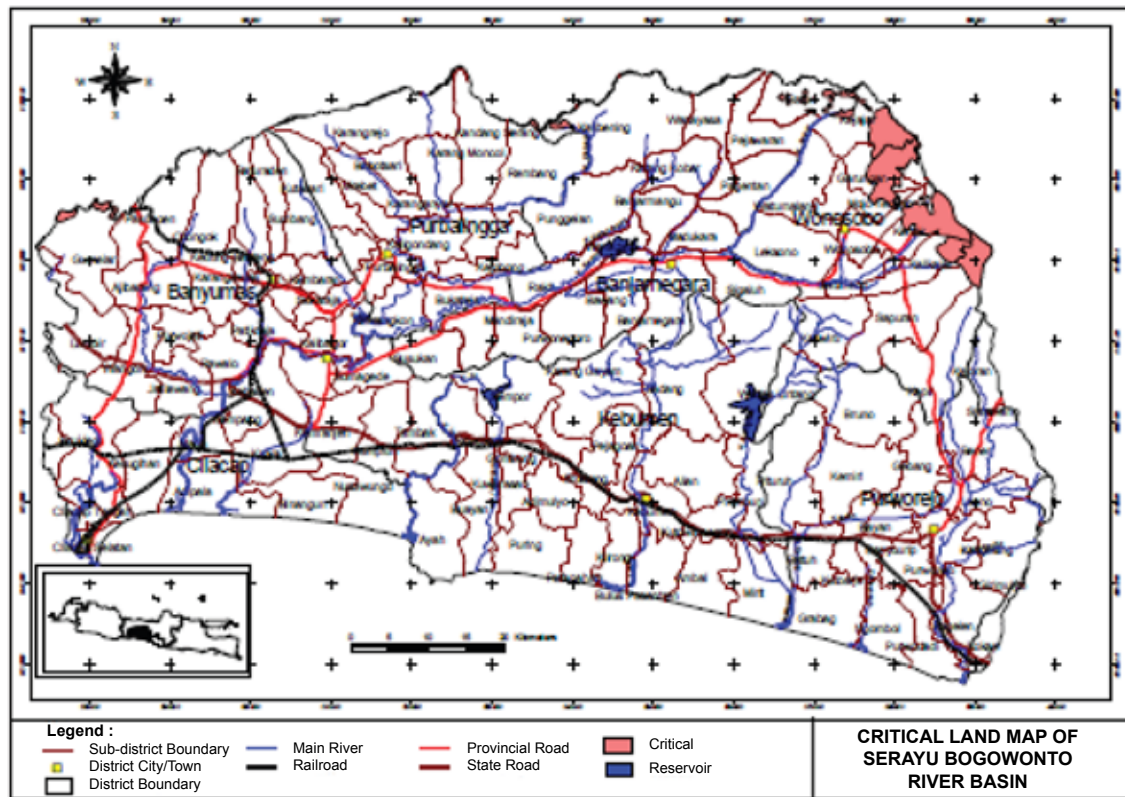
a) Critical Lands

The Decree of the Minister of Forestry Number 328 of 2009 decides that as many as 7 watersheds in the work area of BBWS Serayu-Opak are categorized as critical watersheds, namely the Serayu Watershed, Luk Ulo Watershed, Bogowonto Watershed, Progo Watershed, Bribin Watershed, Serang Watershed, and Wawar Medono Watershed.

In Serayu-Bogowonto River Basin, the levels of critical lands are categorized into 3, namely:

- First Priority or very critical:
 - Outside forest areas : 10,425.55 Ha.
 - Inside forest areas : 2,060.33 Ha.

- Second Priority or critical:
 - Outside forest areas : 33,055.73 Ha.
 - Inside forest areas : 13,542.65 Ha.
- Third Priority or rather critical:
 - Outside forest areas : 58,711.90 Ha.
 - Inside forest areas : 185,695.42 Ha.



Sources: Landsat ETM 7+ Image, 2006 and Team Interpretation, 2007

Figure 8: Critical Lands in Serayu-Bogowonto River Basin

The watersheds' critical conditions are also indicated by the erosion and sedimentation rates as well as the coefficient of river regime as seen in the following Table 5.

Table 5: Erosion Rates

WATERSHED/SUB-WATERSHED	AREA (Ha)	EROSION RATE (Ton/Ha/Year)
Opak Hilir	33,448	25,763
Opak Hulu	31,189	17,186
Oyo	78,666	34,839
Progo Hilir	68,176	41,585
Progo Hulu	178,912	39,796
Serang	30,259	43,283
Sungai Bawah Tanah	92,145	32,377
Total	512,797	234,829

Results of a study conducted by PPLH UNS-Regional Development Planning Agency of Central Java Province show that in 2002, sedimentation in Upper Progo Sub-watershed amounted to 0,890 mm/year, while the average erosion rate in Upper Progo Sub-Watershed was 47,51 tons/ha/year. Sedimentation in Opak Sub-watershed was 0,549 mm/year, while the erosion rate was

18,86 tons/ha/year. Serang Sub-watershed's sedimentation was 1,75 mm/year, while its erosion rate was 59,67 tons/ha/year.

Table 6: Coefficient of River Regime

RIVER	STATION	Qmax (m ³ /sec)	Qmin (m ³ /sec)	Qmax/Qmin
Progo River	Sta Duwet	213	1.06	201
	Kalibawang	331	12	28
	Badran	103	5.76	18
	Borobudur	205	6.56	31
Opak River	Karangsemut	83.2	1.89	44
Oyo River	Bunder	128	0.26	492
Serang River	Durungan	10.83	0.28	39

b) Floods, Debris Floods and Droughts

Floods and droughts are some of the impacts of land damages in the related watershed. In Serayu-Bogowonto River Basin, flood inundation occurs in 9 watersheds with total inundated area extending to 23,541 Ha as seen in the following Table 7 and Figure 9.

Table 7: Flood Inundation Area

No	Watershed	Flood Inundation Area (Ha)				
		0-0.3 m	0.3-0.6 m	0.6-0.9 m	> 0.9 m	Total
1	Serayu Watershed	1,307.44	795.5	306	634	3,042.94
2	Donan Watershed	138.38	5	0	0	143.38
3	Wawar Watershed	2,373.69	1,563.6	1,060.6	656.5	5,654.45
4	Telomoyo Watershed	1,518	756.06	353	416	3,043.06
5	Luk Ulo Watershed	793	664.69	524.38	650.5	2,632.57
6	Ijo Watershed	2,708	1,330	411	213	4,662
7	Cokroyasan Watershed	1,108.44	548.81	202.13	104	1,963.38
8	Bogowonto Watershed	439.38	294.63	223.13	238.75	1,195.89
9	Tipar Watershed	654	225.69	148	176	1,203.69
Total						23,541.36

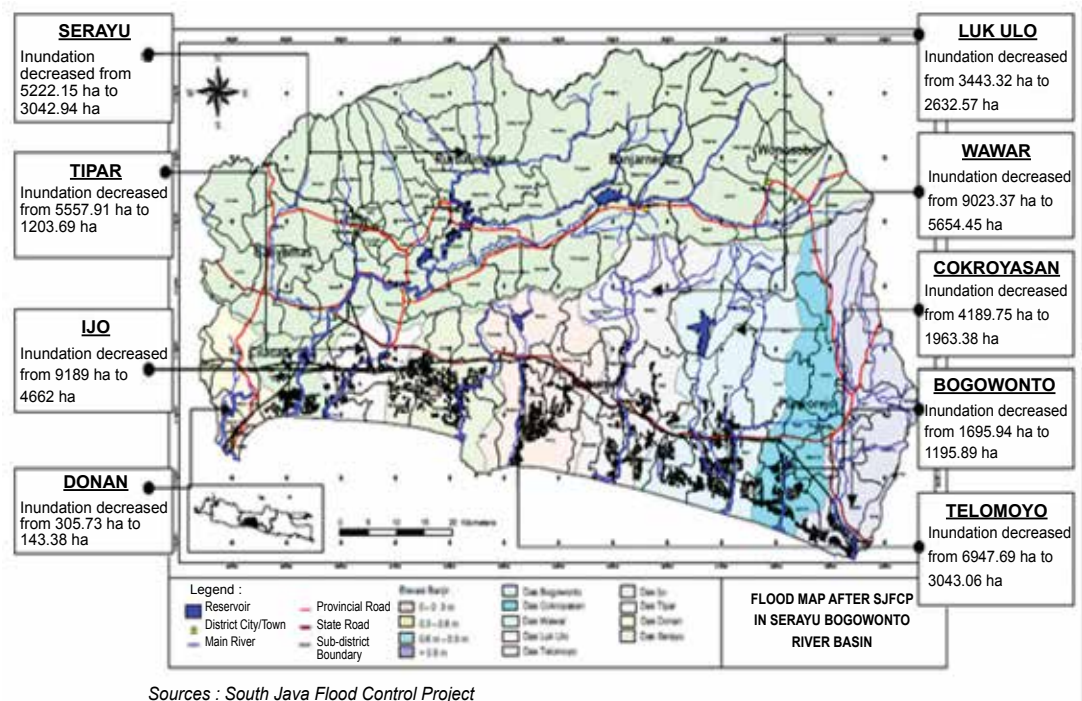


Figure 9: Flood Inundations after SJFCP



Figure 10: Eruption in 2010 and Material Deposit in Gendol River Resulted From the Eruption

Debris flow floods often occur in Progo-Opak-Serang River Basin, especially in rivers which have their upper reaches at Mount Merapi. These debris flow floods have a very high level of destructive force and have caused a lot of damages to sabo structures and other water resource infrastructures such as weirs and irrigation canals, drinking water pipes, embankments , etc..

Materials resulted from the 2010 eruption that are found on the slopes of Mount Merapi amount to 90 million m³, and this creates a potential for debris flow flood in the future.



Figure 11: Debris Flow and the Collapse of Tlatar Bridge

Droughts are common in Gunung Kidul area. In the dry season, the people often experience difficulties in obtaining clean water for household requirements.



Figure 12: Mount Kidul in the dry season and in the rainy season

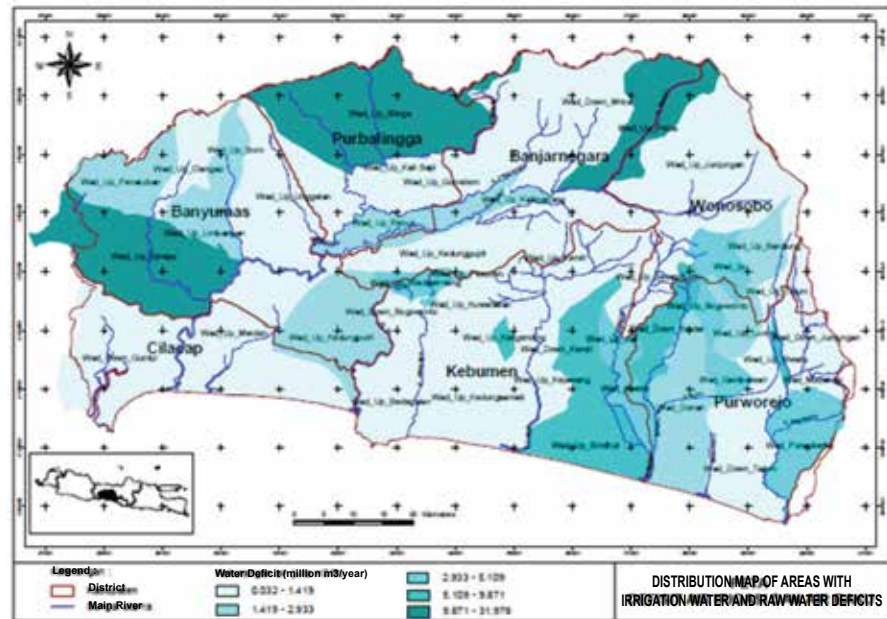


Figure 13: Spread of Water Deficit Areas

A drought that occurs in an area results from an imbalance between rainfall and potential evapotranspiration as well as the characteristic of the rocks. In Serayu-Bogowonto River Basin, most of the droughts occur in hill and mountain ecosystems and a small portion occurs on the plains. At the upstream and downstream of Serayu, the most extensive droughts occur in Banjarnegara, Banyumas and Purbalingga regencies.

c) Mass Movement Vulnerability

The degree of mass movement vulnerability in Serayu-Bogowonto River Basin can be seen in Table 8.

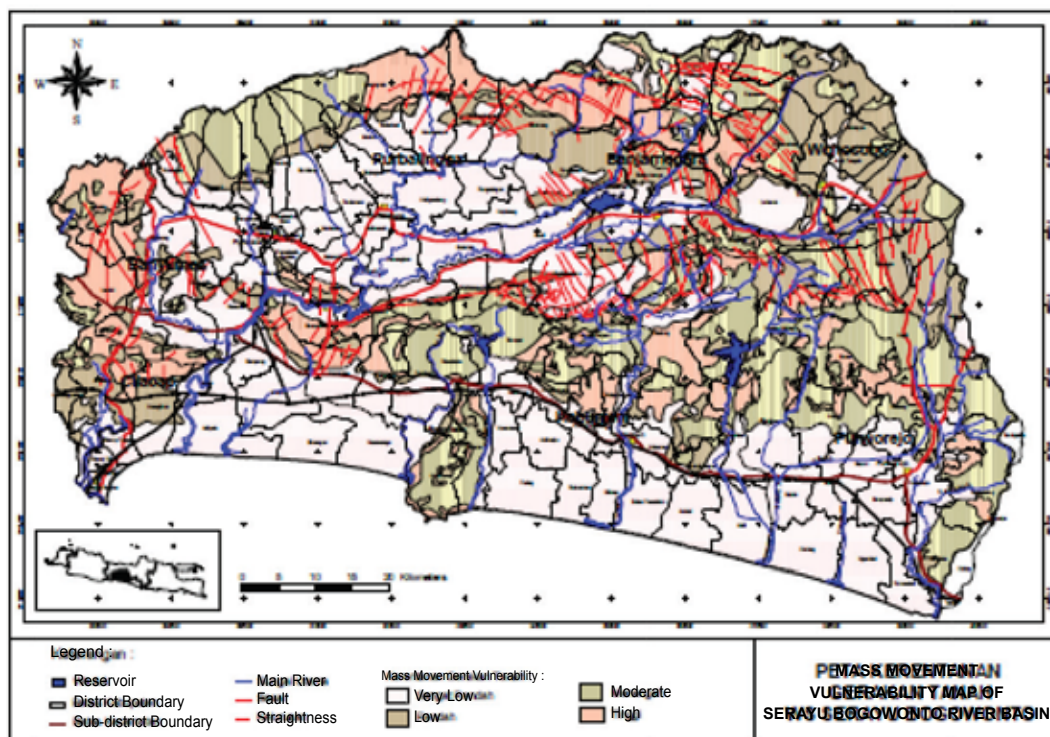


Figure 14: Areas Vulnerable to Mass Movement

Mass movement or landslide occurs frequently in Serayu-Bogowonto River Basin, especially at the upper part of watersheds, particularly in the rainy season. This happens because of the local geological and topographical conditions and triggered by excessive water content.

Table 8: Mass Movement Vulnerability Level

Regency	Vulnerability Level			
	High	Moderate	Very Low	Low
Wonosobo	4638.75	27385.25	11461.50	41314.25
Banjarnegara	19994.250	26421.500	41098.000	24924.500
Purbalingga	13909.25	8609.75	50879.25	8228.75
Banyumas	31886.250	20620.750	65155.000	17320.250
Cilacap	5297.250	1395.500	43133.000	10423.750
Kebumen	25776.000	38948.750	74081.250	7759.000
Purworejo	10969.50	38143.75	53974.75	4212.50

d) Category C Mining

Sand mining in rivers is done frequently by the local community by using traditional equipment and also by large companies by using heavy equipment. Legal mining can help the process of river restoration, but illegal mining can damage the environment and has the potential to cause disasters.



Figure 15: Illegal Mining in Krasak River and Serayu River

e) Other Issues

In addition to the issues mentioned above, there are other matters that need to be given attention to in water resources management in the work area of BBWS Serayu-Opak, namely :

- Improvement of water resources utilization, especially for raw water supply and hydropower exploitation. Raw water supply is currently only able to serve 38% of the urban population, with a population of 5,347,017 people. Meanwhile, the utilization of hydro power potential for Micro-Hydro Power Plant as not been performed optimally.
- Abrasion occurs on the South Coast, as in the case at the Glagah beach.
- Community empowerment is not yet optimal in planning, implementing, and especially in terms of maintenance of irrigation infrastructures, flood control infrastructures, *embungs*, reservoirs and raw water infrastructures. This is evident from the number of mining that occurred.



Figure 16: Abrasion of Glagah Beach

2. WATER RESOURCES MANAGEMENT

2.1. Water Resources Conservation

Some of the purposes of water resources conservation are to overcome the phenomena of critical lands, erosion and sedimentation, as well as to prevent or reduce their impacts on water resources and the infrastructures.

Attempts to overcome critical lands and erosion are carried out by involving the community through the Water Resources Management Coordination Team (TKPSDA) forum and also the National Movement for Water Safeguard Partnership (GN-KPA). The activities are in the form of planting trees (vegetative method) and constructing infiltration wells, terraces, and gully plugs (technical method). These efforts of conservation are spread in several places such as seen in the following Figure 17.

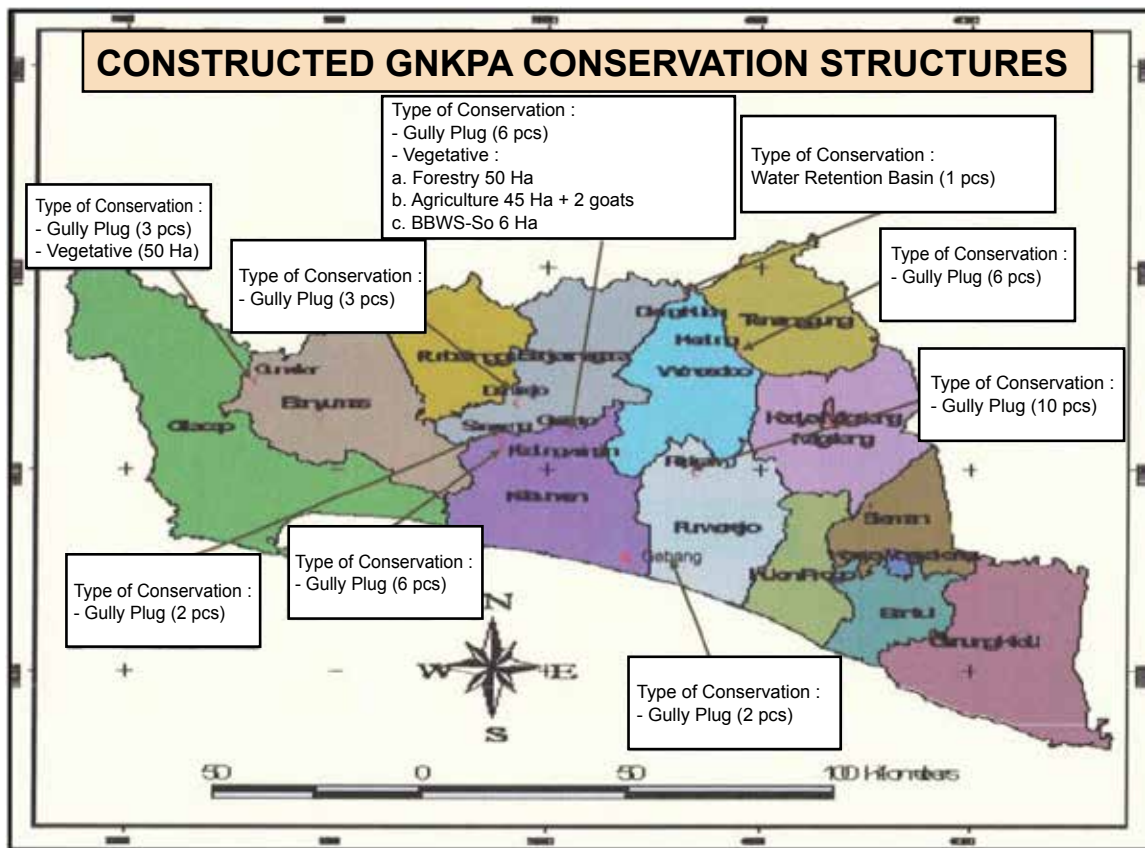


Figure 17: Locations of Conservation Activities



Figure 18: Trees Planting and Construction of Infiltration Wells

Efforts of sediment control carried out in upper part of reservoirs are in the form of the following activities:

- Normalization of Gatel River and Bagor River
- Rehabilitation of Consolidation Dams in 5 (five) locations, namely:
 - Consolidation Dam of Plumbon and Consolidation Dam of Rogobangsari in Gendol River;
 - Consolidation Dam of Salam (KR-C1), Consolidation Dam of Pondokrejo (KR-C2) and Consolidation Dam of Sumberejo (KR-C7) in Krasak River
- Riverbank reinforcement of Sindumartani (Opak River) and Selomartani (Kuning River)

In addition, other activities are also carried out, namely:

- Construction of Embung Serut in Gunungkidul Regency
- Construction of Embung Sukorejo in Sleman Regency
- Mechanical Construction (gully plugs, terraces, etc) of Upper Opak Watershed, Embung Tambakboyo (1 unit)
- Construction of Bumiroso Check Dam (Lower Serayu), Wonosobo Regency

- Construction of gully plugs, terraces, etc., in Wawar Watershed and Telemoyo Watershed
- Water Resources Rehabilitation (Bedono Check Dam in Butuh River, Check Dam in KemitRiver) (self-managed) (2 units)
- Rehabilitation of Embung Ledok, Embung Dengok, Embung Bete in Gunungkidul Regency

2.2. Water Resources Utilization

Water resources utilization is carried out by constructing large dams and weirs, including a weir in the underground river of Bribin. The water collected in reservoirs is utilized for power plants (hydroelectric power plants), irrigation and raw water.



Figure 19: Sermo Reservoir and Sempor Reservoir

The irrigation areas of Serayu-Opak River Basin which have been established based on the Regulation of Minister of Public Works Number 390/KPTS/M/2007 regarding the Establishment of Irrigation Areas under the Management, Authority and Responsibility of the Central Government, Provincial Government, and Regency/Municipal Government can be seen in the following Table 9.

Table 9: Irrigation Areas in BBWS Serayu-Opak

No	Authority	Irrigation Area	
		Total	Area (Ha)
1	Central Government	12	98,875
2	Provincial Government	62	34,684
3	Regency/Municipal Government	6,364	217,743
Total		6,438	351,302

Some of the physical infrastructures for irrigation water supply that have been built in the work area of BBWS Serayu-Opak can be seen in the following Figure 20.



Figure 20: Sempor Main Canal and Sapon Weir

The water resources are also utilized for providing raw water for the people. Water resource infrastructures that are utilized for raw water supply are as follows:

- a) Sempor Reservoir, in an amount of 100 liters/second
- b) Wadaslintang Reservoir, only 200 liters/second have been utilized from the reservoir's potential amounting to 800 liters/second
- c) Serayu Barrage, from the total capacity of 5 m³/sec, only 3 m³/sec have been utilized for Cilacap's raw water

Table 10: Raw Water Retrieval from Water Resource Structures for Drinking Water Companies (PDAM)

No	Drinking Water Company (PDAM)	Production Capacity	Serviced Inhabitants	Number of Inhabitants	Service Level
1	Wonosobo	889.00	231,020	744,913	31.01%
2	Banyumas	395.48	110,275	1,498,122	7.36%
3	Banjarnegara	218.00	51,309	871,541	5.89%
4	Purbalingga	396.50	89,557	843,814	10.61%
5	Cilacap	277.66	166,015	1,671,779	9.93%
6	Purworejo	186.50	88,860	767,381	11.58%
7	Kebumen	189.80	76,140	1,174,306	6.48%
Total/Average		2,552.94	813,176	7,571,856	10.74%

In order to meet the raw water requirements, Drinking Water Companies also conduct surface water retrieval as seen in Table 10 above.

Aside from this, several raw water supply facilities for rural areas have also been built in the area of BBWS Serayu-Opak, such as those in Banjarnegara, Kebumen and Purworejo, as seen in the following Figure 21.



Figure 21: Rural Raw Water Supply Infrastructures

2.3. Control of Water Destructive Power

Water's damaging ability can occur on land surface as well as in river channels, from the upstream to the estuary, especially during floods. Therefore, control of water's damaging ability is carried out from the upstream area to the estuary.

a) Debris Flow Control

Debris flow control is carried out in river channels located on the slopes of Mount Merapi based on the following control model:

- In the upstream area, a series of check dams are built, which function to control the direction and speed of debris flow.
- Sand pockets, in the form of embankments on both sides of the channel with spillway in the river channel, are built in the downstream area of check dams and in alluvial fan areas. In these sand pockets, partition can also be built in the form of embankment perpendicular to the river channel with spillway in the channel. The foundation of these sand pockets is to restrict the spreading of eruption materials in order to avoid

any disasters. Material deposits in these sand pockets can be used as construction materials.



Figure 22: Debris Flow Control Model

- At the downstream area of the sand pockets, a series of check dams are built, which function is to control the direction and speed of the flow so that hydrologically the sediment can be drained off gradually according to the amount of the water flow.

The construction of these check dams or sabo dams is linked to rural development, which is it complements structures with irrigation intakes, evacuation roads and bridges, as well as mining management. Until today, there have been built at least 244 check dams with material carrying capacities of more than 20 million M³, as seen in the following Table 11.

Table 11: Check Dams (Sabo Dams)

No	River	Location	Number of Check Dams	Storage Capacity (M ³)
1	Krasak	Special Region of Yogyakarta	23	2,340,000
2	Boyong	Special Region of Yogyakarta	56	1,302,000
3	Kuning	Special Region of Yogyakarta	16	2,364,000
4	Opak	Special Region of Yogyakarta	5	76,000
5	Gendol	Special Region of Yogyakarta	22	1,203,000
6	Apu	Central Java	5	659,000
7	Pabelan	Central Java	18	1,560,000
8	Trising	Central Java	6	754,000
9	Senowo	Central Java	8	1,238,000
10	Lamat	Central Java	14	851,000
11	Blongkeng	Central Java	15	1,478,000
12	Putih	Central Java	22	1,172,000
13	Batang	Central Java	10	1,618,000
14	Bebeng	Central Java	12	2,906,000
15	Woro	Central Java	12	747,000
Total			244	20,268,000

b) River Improvement and Arrangement

River channel improvement and arrangement is carried out in river segments that are located near the downstream area. Especially on the outer side of bends where flow eroding ability is higher, revetments are built as seen in the following Figure 23.



Figure 23: Revetment of Luk Ulo River

c) Coastal Protection

River mouths and beaches are also not free from the threat of water's damaging ability. Effect of waves at the mouth of the river could pose a barrier to the flow of the river, giving rise to flow blockage. Jetties are made to overcome this problem. A jetty is an embankment made unidirectional to the river channel that juts into the sea and functions to neutralize the effect of the waves, as shown in Figure 24 below.

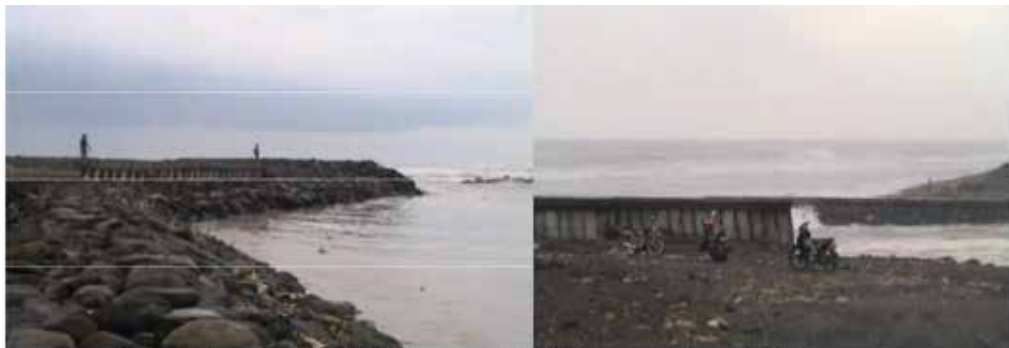


Figure 24: Jetties at the Mouths of Wawar River and Bogowonto River

Ocean waves can also cause damage in the form of coastal cliff erosion or abrasion. Wave breakers are built to overcome this problem, as shown in Figure 25 below.



Figure 25: Wave Breaker at Glagah Beach and Its Development Plan

2.4. Water Resources Information System

The water resources information system in BBWS Serayu-Opak is carried out in 3 main systems, namely:

- Radio Communication System, for early warning on debris flow flood;
- GSM Cellular System, for early warning on floods; and
- Internet Network System, for secondary data which can be accessed through <http://sda.pu.go.id/index.php/balai/114-bbws-serayu-opak> or bbws-so.net/sisda



Figure 26: Early Warning on Mount Merapi Debris Flow

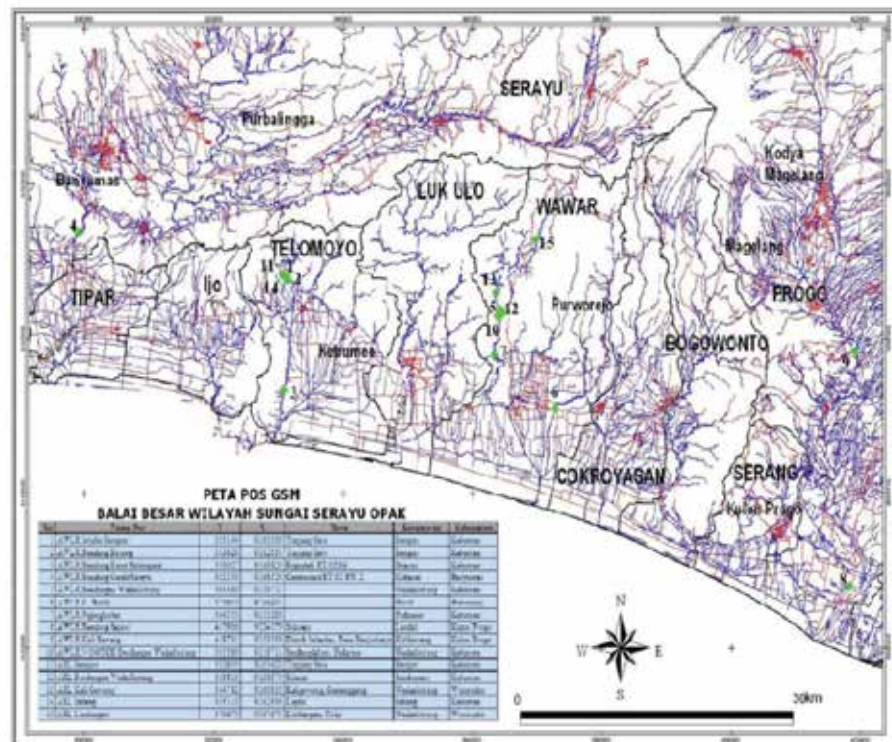


Figure 27: Early Warning of Hydro Telemetry Station(Automatic Water Level Recorder/AWLR and Automatic Rain Logger/ARL)

2.5. Community Empowerment, Monitoring and Participation

Community empowerment organizations have been established for monitoring illegal mining such as the *Forum Masyarakat Peduli Muara Bogowonto* (Community Care Forum for Bogowonto Estuary) and the *Forum Masyarakat Peduli Serayu Hilir* (Community Care Forum for Downstream Serayu), which work together with BBWS Serayu-Opak in handling flood prevention in Bogowonto

River and Serayu River.

Furthermore, community empowerment, monitoring and involvement in water resources management have also been implemented in various activities hosted by 2 (two) forums, namely the Water Resources Management Coordination Team (TKPSDA) and the National Movement for Water Safeguard Partnership (GNKPA).

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. General

In principle, the future water resources management in Serayu-Opak River Basin will be carried out by conducting conservation activities in watersheds in order to prevent sedimentation, especially sedimentation in reservoirs that are already in operation, save the use of water, overcome the damaging ability of floods, debris flow floods in rivers on the slopes of Mount Merapi, protect beaches or coasts from the threat of abrasion as well as utilize them for tourism, and utilize groundwater potential and springs for the welfare of the people through a comprehensive management.

3.2. Comprehensive Management

The comprehensive management of water resources in Serayu-Opak River Basin is carried out with the following approach:

- Arranging runoffs in watersheds by using various effective and efficient methods as part of water resources conservation efforts.
- Reducing the damaging ability of floods by controlling and managing floods, overcoming debris flow floods, and protecting beaches or coastal areas with adequate physical infrastructures in order to reduce damage potentials on the environment.
- Utilizing water resources in a sustainable manner as part of providing water for irrigation (agriculture), raw water, industries, hydroelectric power plants (PLTA), etc., through a comprehensive management, as part of the effort to realize community welfare.

The water resources management is implemented with reference to various existing legal provisions and laws, such as article 51, 53, and so forth of Law Number 7 of 2004 regarding Water Resources, Law Number 26 of 2007 regarding Spatial Planning, Government Regulation Number 26 of 2008 regarding National Spatial Plan, particularly article 99 and 106 concerning Zero Delta Q Policy, and article 34, 35, 36, and so forth of Government Regulation Number 38 of 2011 regarding Rivers.

3.3. Implementation Strategy

The implementation strategy for comprehensive management in the work area of BBWS Serayu-Opak uses the the following approach:

- Conducting a comprehensive and continuous inventorying of water resources data for various requirements as part of managing water resources in BBWS Serayu-Opak.
- Conducting monitoring and creating water resources and floods data and information system, conducting more comprehensive evaluation and studies for future water resources management by taking into account climate changes.
- Preparing a Comprehensive Management Plan of BBWS Serayu-Opak by conducting conservation, water resources utilization, control of water destructive power, debris flow flood control, coastal protection against abrasion, implementation of water resources information system, as well as empowering, monitoring and increasing the participation of the community.

In order for optimal implementation of management, it is necessary to empower the existing institutions/agencies, such as by seeking input through the TKPSDA of Serayu-Opak for further determination of policies.

The Management Plan, as the Detail of Management Model, can be made as a reference for the Large River Basin Organization on preparing the Strategic Plan, as well as a reference for the Regional Government in preparing the Regional Long-Term/Medium-Term Development Plan (RPJPD/RPJMD) as well as the Regional Government Work Plan (RKPD) in order to realize the implementation of water resources development in BBWS Serayu-Opak.

Attachment V.57

CITANUK-CISANGGARUNG RIVER BASIN MAP

River Basin Code : 02.09.A2

J A V A S E A

Scale 1 : 650,000

CITARUM RIVER BASIN

Legend :

- Provincial Capital City
- District Capital City
- Provincial Boundary
- District Boundary
- Boundary of Islands within the River Basin
- River Basin Boundary
- Watershed Boundary
- Coastal Line
- River
- Reservoir/Lake
- Dam

WS CITANUK-CISANGGARUNG

PROVINSI JAWA BARAT

CITANDUY RIVER BASIN

CIULAN-CILAKI RIVER BASIN

PEMALI-COMAL RIVER BASIN

Names of Watersheds (DAS) :

- 001 DAS Kalicilat
- 002 DAS Pasirangit
- 003 DAS Citawaya
- 004 DAS Cimamuk
- 005 DAS Kallawed
- 006 DAS Cisarungin
- 007 DAS Kallanyar
- 008 DAS Jatiroke
- 009 DAS Karanganyar
- 010 DAS Cipager
- 011 DAS Kedangpane
- 012 DAS Gersung
- 013 DAS Kallaga
- 014 DAS Kallad
- 015 DAS Cikandi
- 016 DAS Canggah
- 017 DAS Ciboga
- 018 DAS Kallangka
- 019 DAS Cikalapu
- 020 DAS Ciberes
- 021 DAS Cisanggarung
- 022 DAS Tanjung
- 023 DAS Kallayuh
- 024 DAS Bilekan
- 025 DAS Kallawit

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1. DESCRIPTION OF ORGANIZATION

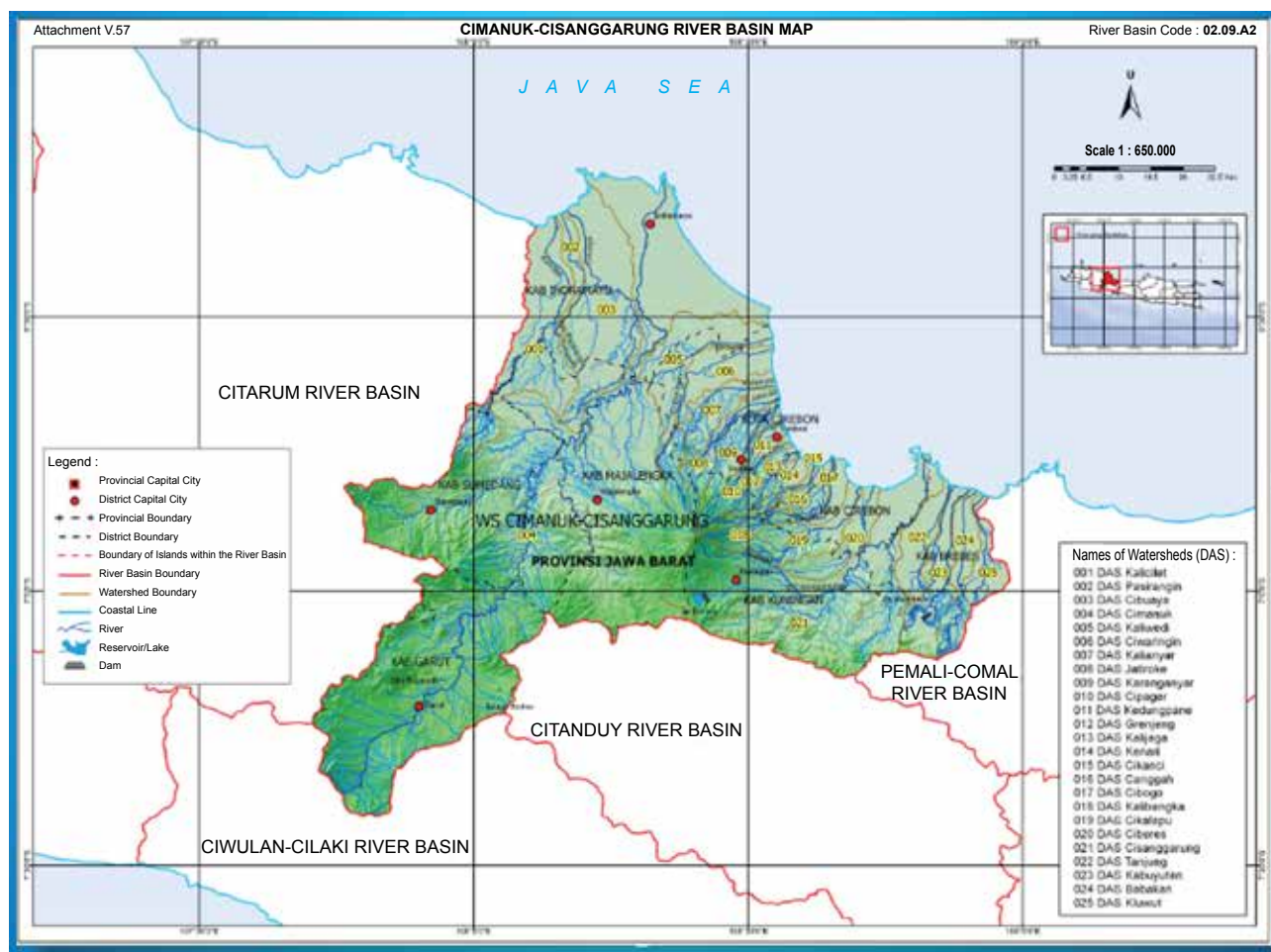


Figure 1: Cimanuk-Cisanggarung River Basin

1.1. General Information

Name	: Balai Besar Wilayah Sungai Cimanuk-Cisanggarung
Address	: Jl. Pemuda No. 40
Municipality	: Cirebon, 45132
Telephone	: (0231) 205876
Facsimile	: (0231) 205875
Website	:
E-mail	: bbwscimanuk@telkom.net
Legal Basis	: Regulation of Minister of Public Works Number 23/PRT/M/2008
Work Area	: Cimanuk-Cisanggarung River Basin
River Basin Classification	: Cross-Provincial River Basin (West Java Province–Central Java Province)

1.2. Brief History

1969/1970 to 1970/1971	Cimanuk Sub Proyek of Water Resources Development Planning Project (P3SA) Jln. Juanda No. 204, Bandung
1971/1972 to 1972/1973	Cirebon-Cimanuk Feasibility Study Project Jln. Jawa No. 6, Bandung

1975/1976 to 1976/1977	Jatigede Dam Project Komplek ATPUT, Bandung
1969/1970 to 1977/1978	River Protection Improvement Project for West Java Province
1978/1979	Cipanas-Ciwaringin Sub-Project, River Protection Improvement Project for West Java Province
1978/1979	Executive Agency for Cimanuk River Basin Development Project, Jakarta
1969/1970 to 1978/1979	Cisanggarung Arrangement and Protection Project, Jln. Pattimura No. 20, Jakarta
1979/1980	Executive Agency for Cimanuk River Basin Development Project (Refined) Jln. Pemuda No. 40, Cirebon
1985-1992	Executive Agency for Cimanuk River Basin Development Master Project, Jln. Pemuda No. 40, Cirebon
1992-1994	Executive Agency for Cimanuk-Cisanggarung River Basin Development Master Project, Jln. Pemuda No. 40, Cirebon
1994-2006	Master Implementer for Cimanuk-Cisanggarung River Basin Development, Jln. Pemuda No. 40, Cirebon
2007 until present	Balai Besar Wilayah Sungai Cimanuk-Cisanggarung (Large River Basin Organization of Cimanuk-Cisanggarung), Jln. Pemuda No. 40, Cirebon

1.3. Organization Structure

The Balai Besar Wilayah Sungai (BBWS) Cimanuk Cisanggarung is led by the Head of Organization, assisted by Head of Administration Department and 3 Heads of Divisions.

The Head of Administration Department is assisted by 3 Heads of Sub-Departments, while the Heads of Divisions are assisted by 2 Heads of Sections.

The operational activities are assisted by 2 (two) Heads of Work Units, namely the Head of Balai Besar Wilayah Sungai Cimanuk-Cisanggarung Work Unit and the Head of Non-Vertical Work Unit for Particular Purpose (SNVT) for the Implementation of Cimanuk-Cisanggarung River Basin Management.

The Heads of Work Units are assisted by several Contract Executive Officers.

1.4. General Condition of Work Area

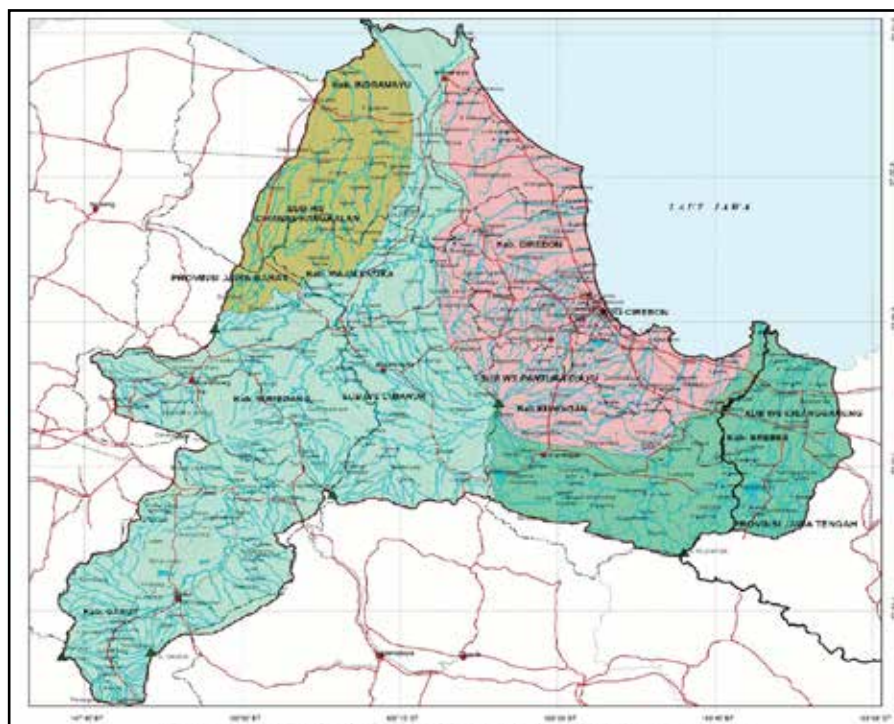


Figure 2: Cimanuk—Cisanggarung Sub-River Basin

Geographically, the Cimanuk—Cisanggarung River Basin is located at 107° 42' 51,02" East Longitude to 108° 54' 31,38" East Longitude and 6° 14' 43,96 South Latitude to 7° 23' 56,03" South Latitude. It covers a total area of 7,706.74 km² which consists of 4 (four) Sub-River Basins as follows:

- Cipanas-Pangkalan Sub-River Basin = 991.68 km²
- Pantura Cirebon-Indramayu Sub-River Basin = 1,167.91 km²
- Cimanuk Sub-River Basin = 3,216.14 km²
- Cisanggarung Sub-River Basin = 2,331.01 km²

The Cimanuk—Cisanggarung River Basin consists of several regencies and municipalities, which are the regencies of Cirebon, Indramayu, Sumedang, Kuningan, Majalengka, Garut, Brebes and the City of Cirebon. The total population for all regencies/municipalities in 2010 amounted to 9,053,851 people. Population projections for 2015, 2020, 2025 and 2030 are as shown in Table 1 below.

Table 1: Population Projections of Cimanuk-Cisanggarung River Basin

No	Regency/ Municipality	Population Projection				
		2010	2015	2020	2025	2030
1	Cirebon Regency	2,224,532	2,437,762	2,671,431	2,927,499	3,208,111
2	Cirebon City	318,624	373,522	437,879	513,324	601,767
3	Indramayu Regency	1,239,790	1,460,569	1,720,664	2,027,076	2,388,053
4	Sumedang Regency	685,571	781,607	891,095	1,015,921	1,158,233
5	Kuningan Regency	812,575	898,055	992,527	1,096,937	1,212,331
6	Kab. Majalengka Regency	1,282,281	1,406,134	1,541,949	1,690,883	1,854,202

7	Garut Regency	1,659,228	1,902,416	2,181,248	2,500,947	2,867,504
8	Brebes Regency	831,250	848,194	865,484	883,125	901,126
Total		9,053,851	10,108,259	11,302,277	12,655,712	14,191,327
Average Number of Person/Km²		778	868	971	1087	1219

Based on the table above, it can be seen that the projected populations in Cirebon City and Indramayu Regency in 2030 will be twice the population in 2010. This means that their population growths are higher than the other areas. It is believed that the population growths of those two areas are mostly due to urbanization rather than births.

Table 2 shows that the area of Cirebon City is relatively very small, and therefore, the population density is considered very high, which is 8,363 persons/km² in 2010, and is projected to be 15,794 persons/km² in 2030.

Table 2: Areas of Watersheds in Regencies/Municipalities

REGENCY/MUNICIPALITY	AREA OF REGENCY/ MUNICIPALITY	CIMANUK-CISANGGARUNG RIVER BASIN	
	(km ²)	AREA OF WATERSHED (km ²)	%
West Java Province			
Cirebon City	38.10	38.10	0.49%
Cirebon Regency	990.36	990.36	12.86%
Indramayu Regency	2,040.11	1,386.56	17.99%
Kuningan Regency	1,117.95	1,104.07	14.33%
Majalengka Regency	1,204.24	1,204.24	15.63%
Sumedang Regency	1,522.20	1,110.63	14.41%
Garut Regency	3,066.88	1,302.96	16.91%
Central Java Province			
Brebes Regency	1,657.57	569.82	7.39%
TOTAL	11,637.57	7,706.74	100%

There are 45 weirs in Cimanuk-Cisanggarung River Basin, including three rubber weirs which primarily serve as infrastructures for irrigating 842 irrigation areas spread in 5 regencies in the West Java Province and 1 regency in the Central Java Province, which overall area extents to 304,439 hectares. Some of the irrigation areas are under the authority of the Central Government and the others are under the authorities of Provincial Governments and Regency/Municipal Governments.

In addition, there are also several large dams, such as the Malahayu Dam, Sedong Dam, Darma Dam (built in 1962, height: 37,50 M) used for raw water supply and Situ Patok Dam (built in 1927, height: 27 M) used for irrigation.

1.5. Hydrology

The average rainfall in Cimanuk-Cisanggarung River Basin ranges from 890 to 3,470 mm/year, with details as follows:

- Cimanuk Watershed 2,800 mm/year
- Cisanggarung Watershed 2,700 mm/year
- PanturaCiayu Watershed 1,500 mm/year
- Cipanas-Pangkalan Watershed 1,700 mm/year

Since the 1980s, the hydrological condition of Cimanuk-Cisanggarung River Basin has been experiencing degradation, indicated by the value of flow coefficient that significantly increased from 0.58 in the 1980s to 0.74 in 2002.



Figure 3: Hydrological Map

Records of data on climate were obtained only from the Cirebon Climatology Station and Kuningan Climatology Station for the period of 2007. Data from the Cirebon Climatology Station represent the climatological condition of the lowlands, while the data from the Kuningan Climatology Station represent the climatological condition of the plains in Cimanuk-Cisanggarung River Basin. The information is needed for measuring evaporation/evapotranspiration. The types of climatological data that were recorded are stated in the following Table 3:

No	Climatological Condition	Unit	Cirebon Climatology Station			Kuningan Climatology Station		
			Max	Min	Rata-rata	Max	Min	Average
1	Temperature	°C	32	24.5	28.4	26.7	21.3	24.7
2	Relative humidity	%			60.5			85.8
3	Wind speed	km/day	94.2	2	45.5	3.7	0.5	1.7
4	Sunshine	%			52.6			15.6
5	Pan A evaporation	mm/day			7			-

In Cimanuk-Cisanggarung River Basin, there are 56 Water Observation Stations which are mostly built and managed by the Center for Water Resources Research and Development, and 137 Rainfall Monitoring Stations.

1.6. Watersheds and Rivers

The BBWS Cimanuk-Cisanggarung stated that it has 39 watersheds, which are divided into four sub-river basins. However, the Presidential Decree Number 12 of 2012 decided that the number of watersheds in the Cimanuk-Cisanggarung is 25 watersheds.

Cimanuk River and Cisanggarung River are the two largest main rivers among all rivers in the Cimanuk-Cisanggarung River Basin. The Cimanuk River has a length of 258 km, flood discharge of 1,125 m³/sec, and 774 tributaries ranging from first order to fifth order. The Cisanggarung River has a length of 104 km, flood discharge of 712 m³/sec, and 241 tributaries ranging from first order to fifth order.

Table 4: Number of Watersheds in Cimanuk-Cisanggarung River Basin

Watersheds According to BBWS Cimanuk-Cisanggarung			Watersheds According to Presidential Decree Number 12/2012	
Sub River Basin of Cipanas - Pangkalan			001	Kalolet Watershed
1	Cipanas Watershed	489,24	002	Pasirangin Watershed
2	Pangkalan Watershed	502,44	003	Cibuaya Watershed
Sub River Basin of Pantura - Cirebon			004	Cimanuk Watershed
1	Prawirokepolo Watershed	68,70	005	Kaliwedi Watershed
2	Prawirodarung Watershed	13,84	006	Ciwaringin Watershed
3	Gebangsawit Watershed	44,09	007	Kalianyar Watershed
4	Gabus Watershed	36,57	008	Jatiroke Watershed
5	Glayem Watershed	11,79	009	Karanganyar Watershed
6	Kamal/Dadap Watershed	40,20	010	Cipager Watershed
7	Cigedang Watershed	17,59	011	Kedungpane Watershed
8	Bobos Watershed	21,87	012	Grenjeng Watershed
9	Pamengkang Watershed	29,67	013	Kalijaga Watershed
10	Kumpulkuwista Watershed	155,13	014	Kenari Watershed
11	Ciwaringin Watershed	138,84	015	Cikanci Watershed
12	Terwu Watershed	13,29	016	Canggah Watershed
13	Sriganala Watershed	43,00	017	Cibogo Watershed
14	Winong Watershed	112,63	018	Kalibangka Watershed
15	Bondet Watershed	153,95	019	Cikalapu Watershed
16	Condong Watershed	33,80	020	Ciberes Watershed
17	Pekik Watershed	66,73	021	Cisanggarung Watershed
18	Tangkil/Kedungpane Watershed	37,01	022	Tanjung Watershed
19	DAS Sukaila Watershed	16,00	023	Kabuyutan Watershed
20	DAS Kesunean Watershed	48,50	024	Babakan Watershed
21	Jaga Watershed	40,97	025	Klumut Watershed
22	Mundu Watershed	23,74		
Sub River Basin of Cimanuk				
1	Cimanuk Watershed	3.216,14		
Sub River Basin of Cisanggarung				
1	Kanci Watershed	82,80		
2	Pengarengan Watershed	38,73		
3	Bangkaderes Watershed	203,85		
4	Ender Watershed	71,65		
5	Ciberes Watershed	98,59		
6	Tersana Watershed	28,87		
7	Beru Watershed	22,96		
8	Cisanggarung Watershed	1.215,73		
9	Bosok/GunungTumpeng Watershed	83,26		
10	Tengguli Watershed	90,00		
11	Tanjungkulon/Sinung	43,77		
12	Kabuyutan Watershed	67,96		
13	Babakan Watershed	85,19		
14	Kluwut Watershed	97,65		
Total		7.606,74		

1.7. Issues

a) Critical Lands

According to the Head of BBWS Cimanuk-Cisanggarung, the total area of critical lands in Cimanuk-Cisanggarung is 40,875 hectares and they are found in 11 locations. Three of them have the most severe conditions, namely:

- Upper Cimanuk Watershed, covering an area of 8,057 Ha or around 50% of the entire Cimanuk Watershed.
- Along the Cikamiri-Ciroyom Watershed in Garut Regency, covering an area of 3,572 Ha or around 35% of the Watershed's total area.
- Along the Cialing-Cicacaban Watershed in Sumedang Regency, covering an area of 6,618 Ha or around 46% of the Watershed's total area.

According to the Watershed Management Agency (BPDAS) of Cimanuk-Citanduy in 2003, as quoted by the Directorate of Watershed Management Agency in its website, the areas of critical lands in Cimanuk Watershed have reached 178,794 hectares, consisting of those located inside forest areas (46,129 hectares) and those located outside forest areas (132,665 hectares). The largest critical land area is found in Garut Regency, which reaches 90,045 hectares, as shown in Table 5.

Some of these critical lands are located in forest areas, on steep slopes that are protected areas; and the rest are located outside forest areas, on the people's arable lands. Forest damages occur because of the forest clearing and plundering done by the community in order to create cultivated areas. Cultivation of vegetables and fragrant roots are mainly done on steep slopes and the cropping pattern that does not follow the contour line is considered as the cause of erosion and cliff slides.

These critical lands worsen the hydrological condition of watersheds. This is seen from the very high discharge fluctuation in Rentang Weir, where the Q_{max} is 1,004 m³/sec, while the Q_{min} is 4 m³/sec, resulting in a ratio of 251.

The damages on these critical lands also give rise to problems in other parts, such as erosions, sedimentations, floods, flashfloods, droughts and even cliff slides.

Table 5: Spreading of Critical Lands

No	Regency	Forest Area (Ha)	Non Forest Area (Ha)	Total (Ha)
1	Kuningan	5,642	11,406	17,048
2	Cirebon	400	6,042	6,442
3	Garut	24,784	65,261	90,045
4	Sumedang	7,308	18,243	25,551
5	Majalengka	6,654	21,945	28,599
6	Indramayu	1,341	9,768	11,109
TOTAL		46,129	132,665	178,794

b) Erosions and Sedimentations

Erosions in relatively large amounts have been occurring for a long time in the Cimanuk Watershed as well as its tributaries. This has attracted the interest of experts to conduct researches, such as van Dijk and Vogelzang as quoted by the BPDAS of Cimanuk-Citanduy, Directorate General of Land Rehabilitation and Social Forestry, Department of Forestry in the Final Report on the Preparation of Forest and Land Rehabilitation Plan for Upper Cimanuk Watershed in 2007, as described below:

Table 6: Erosion Rates

Location	Year	Erosion	Disintegrated Layer
Cilutung Sub-watershed ¹⁾	1911/1912	13.2 t/ha/ year	0.9 mm/year
Cilutung Sub-watershed ¹⁾	1934/1935	28.5 t/ha/ year	1,9 mm/ year
Cilutung Sub-watershed ¹⁾	1948/1969	120 t/ha/ year	8.0 mm/ year
Cimanuk Sub-watershed ²⁾	1977	52 m ³ /ha/ year	5.2 mm/ year
Upper Cimanuk Sub-watershed	2007	57 m ³ /ha/ year	5.7 mm/ year

¹⁾ Arsyad ²⁾ Partosudono

Meanwhile, Forestronomic, in its posting, states that results of GIS analysis show that the upper part of Cimanuk has an erosion rate that reaches 13,119,529.30 tons/year. If the average specific gravity of soil is 1.44 tons/m³, the erosion rate will therefore be equal to 9,110,784.236 m³/year or an average of 5.17 mm/ha/year. Hardjowigeno (1992) provides a limitation by stating that the tolerance value for normal erosion is only 2.50 tons/ha/year.

**Figure 4: Riverbank Erosion**

In general, researches are carried out only on surface erosions. Other than that, the geological condition of Cimanuk Watershed itself causes river channel erosion in Cimanuk as well as its tributaries, such as Cipeles, Cipelang, Cikeruh, and so on. This channel erosion is evident in the form of riverbank erosion which also leads to riverbank slide. The surface erosion and channel erosion certainly cause problems at the downstream area, such as sedimentation which leads to siltation and narrowing of channel as well as estuary blockage.

Impacts of sedimentation on irrigation infrastructures in Rentang Irrigation Area occur at both the upper part and lowerpart of the Rentang weir.

The irrigation weir of Rentang is located in Cimanuk River, which receives suppletion from Cipeles River, Cilutung River, Cipelang River and Cidangdung River, through the Cipelang Main Canal and Sindopraja Main Canal. Sedimentation occurs in the suppletion canal and also in the main canals and their secondary canals.



Figure 5: Channel Narrowing in Sindupraja Main Canal, Majalengka Regency

As reported by the Conservation and Water System Division of the Center for Irrigation Research and Development of the Department of Public Works (2004), results of field observation on the annual average sediment in Upper Cimanuk Sub-watershed (Wado Sub-regency) showed that the annual average sediment amounted to tons/km²/year, with an average concentration of 770 mg/liter.

c) Floods and Droughts

Floods that occur in Cimanuk-Cisanggarung Watershed are the impact of the damaged hydrological condition of its watersheds. No less than 80.000 hectares in Cimanuk Watershed and 20.000 hectares in Cisanggarung Watershed are frequently flooded every rainy season.

In Cimanuk, there have been built embankments on the left and right sides of the river, stretching 2 x 70 kilometers in length, and a 21-kilometer floodway for draining off water straight into the sea in an amount of 900 m³/sec.



Figure 6: Flood Inundation Map

Overall, river embankments, stretching 382 km in length, have been built in the segments of Cipanas River, Pangkalan River, Cimanuk River, KumpulKwista River, Ciwaringin River, Winong River and Jamblang River.

In addition, embankments stretching 75 km in length have also been built in many other river

segments in order to overcome the flooding that occurs in every 10 years.



Figure 7: Flooding in the North Coast

Flooding occurs not only in the downstream, but also in the upstream, such as those that occurred in the villages of Haurpanggung and Sukakarya, Tarogong Kidul Sub-regency, Garut Regency. As many as 350 houses were flooded, the flood occurring in the settlements ranged from 1 to 1.5 meters in height, and three houses were washed away.



Figure 8: Cilutung in the Dry Season

Source: Kompas, 3 Sept 2001

Photographer: Hers Suganda

Meanwhile, in the dry season, the flow discharge of Cimanuk River declines sharply, and the river channel is often used as a soccer field for the children. This drought also brings an impact on Rentang Irrigation Area, where there are many rice fields that no longer receive water. This certainly makes household water requirements unable to be met, which then leads to more people trying to meet their requirements for clean water by using wells.

Several companies, such as hotels, hospitals, etc., try to meet their water requirements by making deep wells. If this continues, it is feared that such measure will lead to land subsidence. Excessive water intake can also trigger seawater intrusion into the land.

d) Landslides

The high level of rainfall in Cimanuk Watershed causes not only flooding, but also landslides, especially in the upstream area, such as in Garut and Majalengka. The Regional Disaster Management Agency (BPBD) of Garut Regency, for example, stated that no less than 16 regencies are always overshadowed by landslides during the rainy season.



Figure 9: Landslide in Garut

These landslides not only affect settlements areas, but they also damage transportation infrastructures, and due to this, it is not uncommon to see some settlements become isolated. Because of a landslide, the people of Mekarmulya, Selaawi, Mekarwangi and Mekarmukti villages and some of the people in Mekarmulya village in Talegong Sub-district (9,855 families), which total is around 60 percent or 31,000 people, were isolated at the time.

Other than by natural causes, landslides are also frequently caused by settlement or cultivation of steep slopes by the community, as well as by sand mining, which is often done in Mount Guntur.



Figure 10: Illegal Sand Mining at Mount Guntur

e) Coastal Abrasion



Figure 11: Fishpond in A Mangrove Forest

The Indramayu coastal region has a coast line of approximately 114 km. This region, located within the north coast area, is very strategic as the main line of transportation from Cirebon to Jakarta and vice versa. However, the mangrove forest, as the coastal buffer, often has its function changed into areas for aquaculture, settlement, industries and reclamation, which leads to changes in the coast line.

As one of the results, coastal abrasion has occurred in several places in Indramayu District. To prevent the coast line from being increasingly eroded, wave breaker construction in the form of piles of tetrapods has been built in several places such as in the Dadap, Limbangan, EretanWetan and Eretan Kulon villages.



Figure 12: Tetrapods at Indramayu Beach

2. WATER RESOURCES MANAGEMENT

2.1. Water Resource Conservation

To improve the hydrological condition of the Cimanuk Watershed, especially in the catchment area of Jatigede Reservoir, watershed conservation activities are carried out in an intensive and synergical manner between related agencies, namely the Department of Forestry, Department of Agriculture, Department of Public Works, Provincial Government of West Java, and District Government, in line with the National Movement for Water Safeguard Partnership (GNKPA). Aside from that, as part of the Critical Land Rehabilitation Movement (GRLK) and the National Movement for Forest and Land Rehabilitation (GNRHL) programs in West Java, activities of the GRLK and GNRHL are also carried out in the catchment area of Jatigede Reservoir.

The catchment area of the Jatigede Reservoir plan is located at the upper part of the Cimanuk Watershed. It covers an area of approximately 1462 km² and is within the area of Garut District and Sumedang District. Until Fiscal Year 2004, the catchment area of Jatigede Reservoir has a critical land with an area of 40,875 Ha or around 28% of the total extent of the catchment area, which is divided into 11 sub-watersheds.

Furthermore, in order for the positive impacts of GNKPA activities in Jatigede catchment area to be measured and monitored properly, it has been agreed that the Upper Cimanuk Sub-watershed and Cikamiri Sub-watershed are used as the pilot watersheds for the GNKPA, with emphasis as follows:

- 1) Upper Cimanuk Sub-watershed: as a pilot watershed conservation with emphasis on effort of vegetative technique;
- 2) Cikamiri Sub-watershed: as a pilot watershed conservation with emphasis on effort of mechanical technique, by utilizing the Arboretum of the Cimanuk Spring in LegokPulus (Sukakarya Village, Samarang Sub-district, Garut) as a center for researches on conservation plants and training for farmers, young generation and students.

2.2. Water Resources Utilization

In accordance with the Cimanuk-Cisanggarung River Basin Development Master Plan, as many as 13 reservoir potentials are identified in the Cimanuk Watershed and 12 reservoir potentials in the Cisanggarung Watershed. Out of the 25 reservoir potentials, only the Jatigede Reservoir that already has its design completed and it is currently under construction. Considering that the availability of raw water and irrigation water is in a very urgent condition, construction of water storages in the form of reservoirs, *embungs*/man-made lakes, or long storages in various scales is made as the main priority. Due to this, the Medium-Term Planning (PJM) of 2005-2009 of BBWS Cimanuk-Cisanggarung has included a program for the development and rehabilitation of water storages in the form of: (a) Reservoirs - 3 locations, (b) *Embungs*/man-made lakes – 10 locations, and (c) Long Storages – 7 locations.

Water potentials in the Cimanuk-Cisanggarung River Basin are approximately 13.38 billion m³/year and groundwater potentials area approximately 0.9 billion m³/year. Judging from the numbers, the amount of potentials is quite big, but judging from the distribution of the time and location of the spread, it is not profitable. Therefore, water resources management is needed to overcome the problem of water availability in the amount, time and location as required.

a) Rice Field Irrigation

The largest utilization of water resources is for irrigation water requirements. The main irrigation areas in the Cimanuk Watershed are shown in the table below:

Table 7: Main Irrigation Areas and Their Extent in Cimanuk Watershed in 2007

No	Name of Irrigation Area System	Current Extent		Future Extent *)	
		Extent (Ha)	Sub Total (Ha)	Extent (Ha)	Sub Total (Ha)
1	Cipanas 2 & Tenguli	3,333	3,333	3,333	3,333
2	Cilutung		13,796		9,796
	West	3,885		3,885	
	East	5,911		5,911	
	East Extension	4,000		-	
3	Rentangdan Floo Inlet		90,924		90,924
	Gegesik	22,632		22,632	
	Sindupraja	31,261		31,261	
	Cipelang & Parit Barat	18,049		18,049	
	Cipelang & Parit Utara	18,982		18,982	
4	Kerta Jaya		1,589		7,706
	Ujung Jaya	1,589		1,589	
	Palasah	-		6,117	
5	Cirebon Barat & Majalengka		21,085		8,085
	Cirebon	8,085		8,085	
	Majalengka	13,000		-	
6	Cipanas 1 & Cipondoh		6,192		7,449
	Bolang Amis, Loyang	2,405		2,405	
	Sumurwatu	-		1,257	
	Cibelerang	300		300	
	Cipondoh	618		618	
	Cipanas 1	2,869		2,869	
Totas Extent (Ha)			136,919		127,293

Irrigation water requirements are measured by taking into account the planting pattern, beginning of planting, and planting intensity, while the amount of irrigation water requirements at the intake gate is highly influenced by the efficiency of irrigation, which is usually estimated at 85%.

As described above, the water potentials in the Cimanuk-Cisanggarung River Basin are utilized for a variety of requirements, such as for meeting domestic, urban, industrial as well as irrigation water requirements. The beginning of planting for irrigation water requirement projections is established based on the beginning of the rainy season. In the future, projection for irrigation water requirements is likely to change because farmers will use the SR irrigation system that is believed to be more efficient in the use of irrigation water.

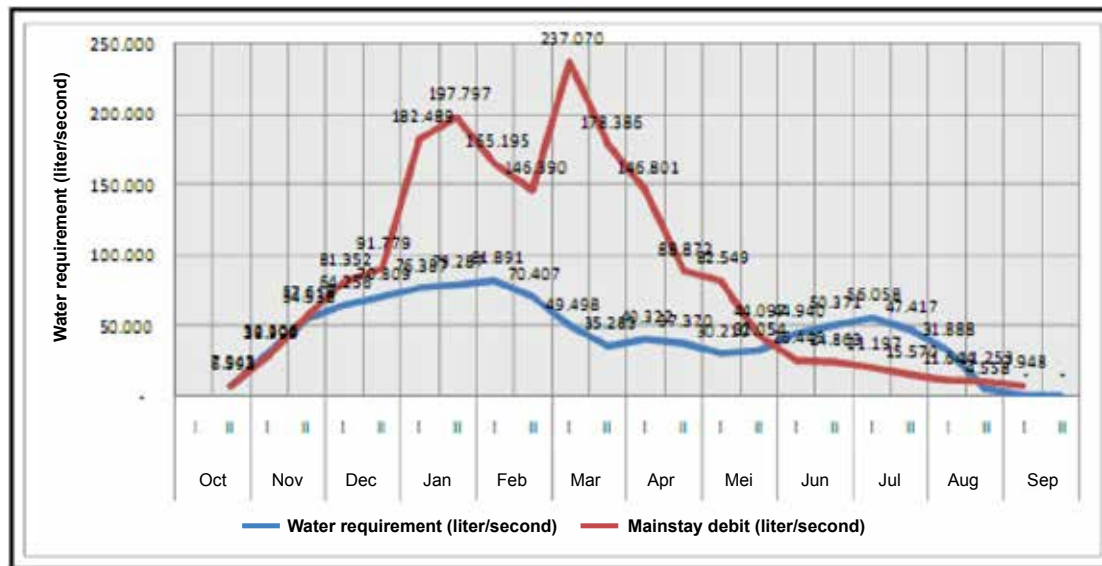


Figure 13: Irrigation Water Requirements of Rentang Irrigation Area

b) Fishpond Irrigation

Development of fishpond culture (shrimp and milkfish) is necessary to anticipate the following:

- Increased production for local requirements and for export
- Increased income of fishpondcultivators
- Increased employment
- Increased use of natural resources for fishpond culture and shrimp culture

Shrimp production will deliver greater results to the fish farmers. However, considering the character of water in this region, where the availability of water in the dry season ends to be less, the development of fishpond culture is directed in order not to focus only on shrimp mono culture, but also alternately with milkfish. Milkfish cultivation is suitable for the dry season, while shrimp cultivation is suitable for the rainy season, where the availability of water is greater because of the additional rainwater.

In the long run, the development of polyculture of shrimp with milkfish will make fishponds healthier due to the rotation between shrimp and milkfish. In this study, it is also emphasized that although the construction of Jatigede Reservoir is not yet completed, the provision of water in the dry season may not be sufficient for meeting fishpond water requirement (for shrimp culture).

Shrimp culture is ineffective if carried out in the rainy season because fishponds lack of salinity because of heavy rainfall, reduced evaporation due to overcast weather, and the quality of the freshwater that is used is probably decreased due to the effect of floods.

Infrastructures for fishpond irrigation network are canals, dividers, water gates, etc., need to be built and maintained.

The production of fishpond culture (for shrimp as well as milkfish) is reported to have declined due to several matters, including:

- Reduced supply of water for fishponds in the dry season
- Low water quality for fishpond culture
- Fishpondculture has not been carried out extensively

In 1998, fishpond culture production in PanturaCiayu (Indramayu and Cirebon regencies) was reported by Colenco as shown in Table 8.

The table shows that the areas of fishpondsin Indramayu District extended to 10,235 ha with production at 0.915 tons/ha/year or 9,360 tons/year.

The areas of fishponds in Cirebon District extended to 2,772 ha with production at 1,164 tons/ha/year or 3,227 tons/year.

Table 8: Fishpond Production in 1998

District	Nett Area (Ha)	Number of Cultivators (family)	Production (ton)	Production per Ha (ton/ha/thn)	Production per family (ton/ family)
Indramayu	10,235.00	4,337.00	9,360.60	0.915	2,158
Cirebon	2,772.00	1,501.00	3,227.00	1,164	2,150
Total	13,007.00	5,838.00	12,587.60	2,079	4,308

Source: Statistik Perikanan Jawa Barat (1998) in Colenco, Vol. C7 Fisheries, 1998.

Current Areas of Fishponds (2009)

Based on the information obtained from the Office of Maritime Affairs and Fisheries of Indramayu District and Cirebon District, the current areas of functional (utilized) fish pond sextend to 14,167 ha, consisting of:

- Indramayu District : 9,004 ha
- Cirebon District : 5,163 ha

2.3. Control of Water Destructive Power

- Control of water destructive power
Control of water destructive power involves the following issues:
 - Flood
 - Riverbank erosion
 - Seawater intrusion
 - Coastal abrasion, and
 - Estuary sedimentation

In the Medium-Term Planning of 2005-2009, flood management is focused on the normalization of Cipanas River in Indramayu District, rivers of TanjungKulon, Babakan and Kabuyutan in Brebes District.

The management of riverbank erosion and critical embankments in Cimanuk River and Cisanggarung River is prioritized on critical locations that pose threats on settlements, highways and agricultural lands based on the critical level and on community suggestions.

Coastal abrasion management is carried out by building jetties and groynes. Based on the urgency stated in the Medium-Term Planning of 2005-2009, the priorities are:

- Construction of Karangsong jetty and dredging of Prajugumiwang River's estuary
- Construction of River Glayem (Indramayu) jetty, and
- Protection of Tirtamaya Beach.

Until Fiscal Year 2006, flooding issues have been handled, which is evident from the controlled flood that occurred due to the overflow of the major rivers of Cimanuk Cisanggarung, which protect the Pantura Ciayu region, including the City of Indramayu, against the 25-year flood by, among others, constructing the Indramayu By-pass Canal and the Flood Gate in Bangkir, as well as embankments. In addition, the City of Cirebon is already safe against the threat of 10-year flooding caused by small rivers that flow through the City, namely Kedung Pane River, Sukalila River, Kesunean River and Kalijaga River. However, there are rivers that have not been handled completely and they still have the potential to threaten the Pantura road. These rivers are the Cipanas River in Indramayu District and Tanjung Kulon River, Babakan River, Kabuyutan River in Brebes District.

- Drought Control

Until Fiscal Year 2006, no reservoir has been built in Cimanuk River, and due to that, the Rentang Irrigation System and raw water requirement in the Pantura Ciayu region have not been handled well. As temporary solution, several rubber weirs have been built for long storages. These rubber weirs are located in Rambatan, Kumpul Kuista, Sigranala, Winong and Cisanggarung. In order to enlarge freshwater reception in the Pantura Ciayu region, the Kumpul Kuista-Winong collecting canal has been built, with a length of 8,65 km, average width of 15 m, and a depth of 1,6 m. In addition, rehabilitation is also conducted on reservoirs that were built before the Five-Year Development (PELITA), namely:

- Darma Reservoir (36 million m³) in Cisanggarung River
- Malahayu Reservoir (59 million m³) in Kabuyutan River
- As well as rehabilitation on 8 man-made lakes (situ).

- River Erosion Control

Measures of rehabilitation are taken to overcome the negative impacts of the lateral erosion and degradation of Cimanuk and Cisanggarung rivers. Among these measures taken are:

- Ground-sill construction,
- Revetment and retaining wall in location of critical riverbank, and
- River embankment relocation.

- Spring Conservation

Efforts to protect the Cimanuk River spring are done through reforestation and terracing in the area of Situ Cipanas spring in Simpang Village, Sub-district of Cikajang (Garut), and the construction of Cimanuk Legok Pulus Spring Arboretum in Sukakarya Village, Sub-district of Samarang (Garut).

2.4. Water Resource Information System

The Water Resources Information System of Citanduy River Basin is managed by the Water Resources Information System of BBWS Cimanuk-Cisanggarung, which office is located on Jalan Pemuda No. 40, Cirebon 45132.

The information is stored on the official site of BBWS Cimanuk-Cisanggarung and can be accessed through the following address:



There are several information that can be found and downloaded from this site.

2.5. Community Empowerment, Monitoring and Participation

Community empowerment, monitoring and involvement are carried out through a variety of activities, namely:

- 1) Water Resource Management Coordination Team (TKPSDA) of Cimanuk-Cisanggarung River Basin
- 2) National Movement for Water Safeguard Partnership (GN-KPA)
- 3) National Movement for Forest and Land Rehabilitation (GNRHL)
- 4) Critical Land Rehabilitation Movement (GRLK)

All of these activities are carried out in cooperation with various relevant agencies, including the Ministry of Forestry, Ministry of Agriculture, and the West Java Provincial Government along with the relevant District and Municipal Governments.

3. WATER RESOURCES MANAGEMENT IN THE FUTURE

3.1. Water Balance of Cimanuk-Cisanggarung River Basin in the Future (2027)

For 2027, the water in Cimanuk-Cisanggarung River Basin will be used for meeting the requirements of irrigation water (118,41 m³/second) or equivalent to ..?.., household, urban, and industrial water (11,765 m³/second or equivalent to 3,62%). Water requirements for fish ponds are estimated to reach 13,283 m³/second or 4,09%. The remaining water, amounting to 159,529 m³/second (49,12%) will still be drained off into the sea.

The table shows that in 2027, with the existence of Darma Reservoir and Malahayu Reservoir, and the construction of Jatigede Reservoir, Cipanas Reservoir, and Kadumalik Reservoir, there will still be a deficit in the Cipeles Irrigation Area, where the obstacle is only 79,3% Cijurey (0%), Ciberes (20,7%). There are only 10 irrigation areas which probabilities of success are above 80%, as implied by the Guidelines to Irrigation Design (Design Criteria 01), which are the irrigation areas of Palasah&Ujungjaya, Sindupraja, Gegesik, West Rentang, North Rentang, Indramayu Flood Inlet, Cipanas II, Cilutung and Jengkelok Atas.

Similarly for the fulfillment of household, urban and industrial water requirements, where in general there will be water shortage, especially for the City of Cirebon which will only succeed as much as 13,8%, Kuningan District (0%) and Cirebon District (86,2%).

An attempt to overcome the deficits is by constructing the Jatigede Reservoir which is currently in progress and there is also a possibility of constructing the Cipanas Reservoir. The deficit in the household, urban and industrial water requirements in 2027 will not change with the construction of the two reservoirs because the Kuningan District and Cirebon District are not directly affected by the construction of the two reservoirs.

Based on the table, it can be concluded that with the construction of Jatigede Reservoir and Cipanas Reservoir, the irrigation areas that will experience deficit will only be those irrigation areas within the Cisanggarung Sub-River Basin, namely Cijurey, Ciberes, Manenteng, Upper District, Lower District and Lower Jengkelok. The fulfillment of household, urban and industrial water requirements in Kuningan District, Cirebon City, and Cirebon District will still experience deficit. The conclusions are:

- 1) It is necessary to build dams (reservoirs) in the Cisanggarung Sub-River Basin, such as in Cileuweung or in Cimulya, in order to overcome water deficit for irrigation areas and household, urban and industrial water requirements in the Cisanggarung Sub-River Basin.
- 2) It is necessary to build water catchment/reservoirs/man-made lakes in order to meet the household, urban and industrial water requirements of Kuningan District and Cirebon District.

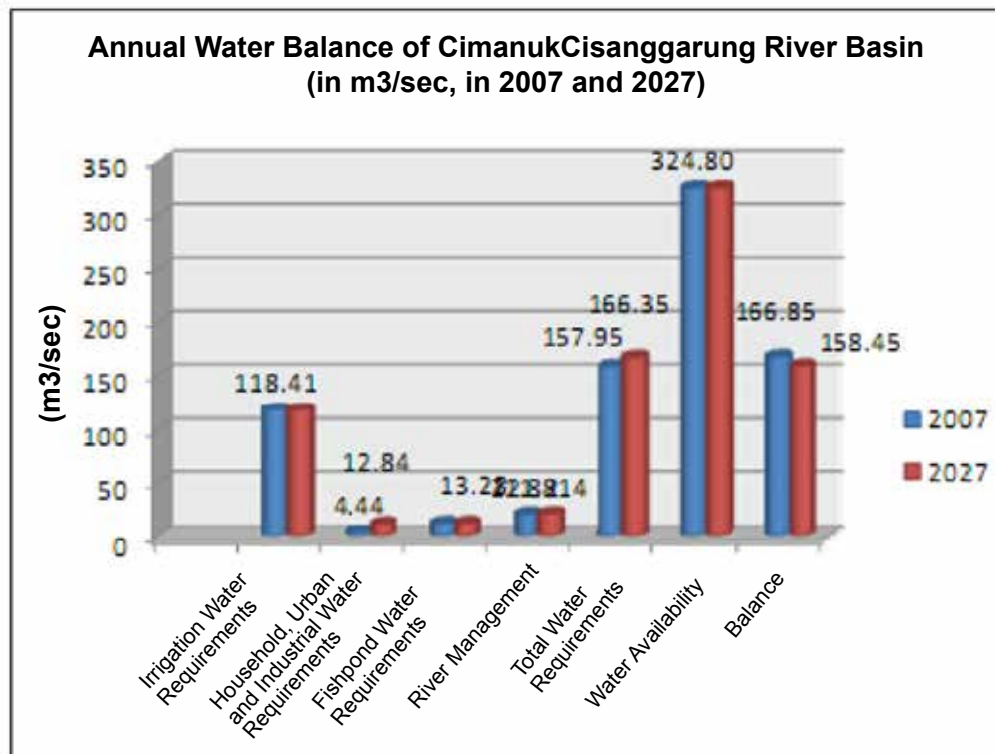


Figure 14: Water Balance in 2007 and 2027

3.2. Reservoir Development

1) Reservoir Development Potential

Reservoir construction is one of the efforts in water resources conservation in a river basin. In Cimanuk-Cisanggarung River Basin, which consists of 4 sub-river basins, potentials for reservoir construction are found in 3 sub-watersheds, namely Cipanas-Pangkalan Sub-river basin, Cimanuk Sub-river basin and Cisanggarung Sub-river basin.

- a) In Cimanuk Sub-river basin and Cipanas-Pangkalan Sub-river basin, there are 12 potential reservoir infrastructures for catching water and 1 diversion canal for diverting the flow from Cipeles-Ciujah River. Water catchment potentials reach 2,752.7 million m³ and they can irrigate 184,120 hectares of rice fields, generate electricity in an amount of 1,883.5 Gwh/year and supply raw water for household, urban and industrial requirements in an amount of 9.4 m³/second.
- b) In Cisanggarung Sub-river basin, there are 14 potential reservoir infrastructures for catching water, including 2 existing reservoirs (Darma Reservoir and Malahayu Reservoir). Water catchment potentials reach 596.9 million m³ and they can irrigate 98,551 hectares of rice fields, generate electricity in an amount of 76.6 Gwh/year and supply raw water for household, urban and industrial requirements in an amount of 4.45 m³/second.

2) Development Plan

Based on the previous Master Plan, the Jatigede Reservoir, with an elevation of approximately 271 m, serves as the most economic option with an IRR value of 16% and it has the highest NPV at an interest rate of 12%. The construction cost is US\$ 91.4 million. Without the construction of hydroelectric power generation, the reservoir will only irrigate 80,000 hectares of new rice fields, with a cost of US\$ 325 million. But in the current development, the Jatigede Reservoir scheme is planned to have an elevation of approximately 260 m.

In addition, there are several options in the construction of reservoirs in Cimanuk Watershed, including:

- Jatigede Reservoir is built first, then followed by the construction of a Hydroelectric Power Plant (400 MW) and weir in Cipeles and Cilutung for increasing the water catchment of Jatigede Reservoir and increasing irrigation water supply in the dry season. After that, the Cipasang Reservoir is built at an elevation of approximately 504 m (generating 312 MW). The Cipasang Reservoir is also intended for reducing sediment flow to the Jatigede Reservoir and for facilitating the arrangement of Cimanuk River. Although this does not improve the condition in Rentang Irrigation Area (90.000 Ha), it remains to be an economic project based on the electrical power that is generated.
- Kadumalik Reservoir (Cilutung Reservoir) is built first (in order to reduce the extent of irrigation water), followed by the construction of Jatigede Reservoir (400 MW). The third phase is the construction of Cipeles Reservoir and the installation of Hydroelectric Power Plant in Kadumalik with a capacity of 95 MW.
- Cibatut Reservoir with 10 MW power potential is the only proposed reservoir which is only for generating electricity (Hydroelectric Power Plant) that is economically feasible.

Table 9: Reservoir Potentials

Name of Reservoir	Volume (million m ³)	Benefit		
		Irrigation (Ha)	Electricity (GWH/year)	Raw Water (Ha)
1. Situbener	15	720	2.6	-
2. Cikajang	0.3	-	4.7	-
3. Garut	0.1	-	30	-
4. Cibatut	0.5	-	75	-
5. Balekambang	144	8,700	-	10,000
6. Cipasang	710	19,000	740	22,000
7. Jatigede	979.5	90,000	690	80,000
8. Kudumalik	435	12,900	194	15,000
9. PasirKuda	20	1,200	86	5,800
10. Jelegong	20	-	22.7	7,500
11. Ujungjaya	71	4,900	-	14,000
12. Cipanas	63	4,600	-	
13. Cipelas-Cipanas	175	11,900	-	

3.3. Raw Water Development

In order to meet the requirements for raw water, especially in the coastal region of the North Coast, a Long Storage System is planned to be built in three locations, namely:

- 1) Long Storage System in Indramayu, with the construction of a rubber dam in Rambatan River.
- 2) Long Storage System in KumpulKuista-Jamblang, with the construction of rubber dams in KumpulKuista River, Sigranala River, and Kincong River.
- 3) Long Storage System in Babakan-Kabuyutan, with the construction of a rubber dam in Cisanggarung River.

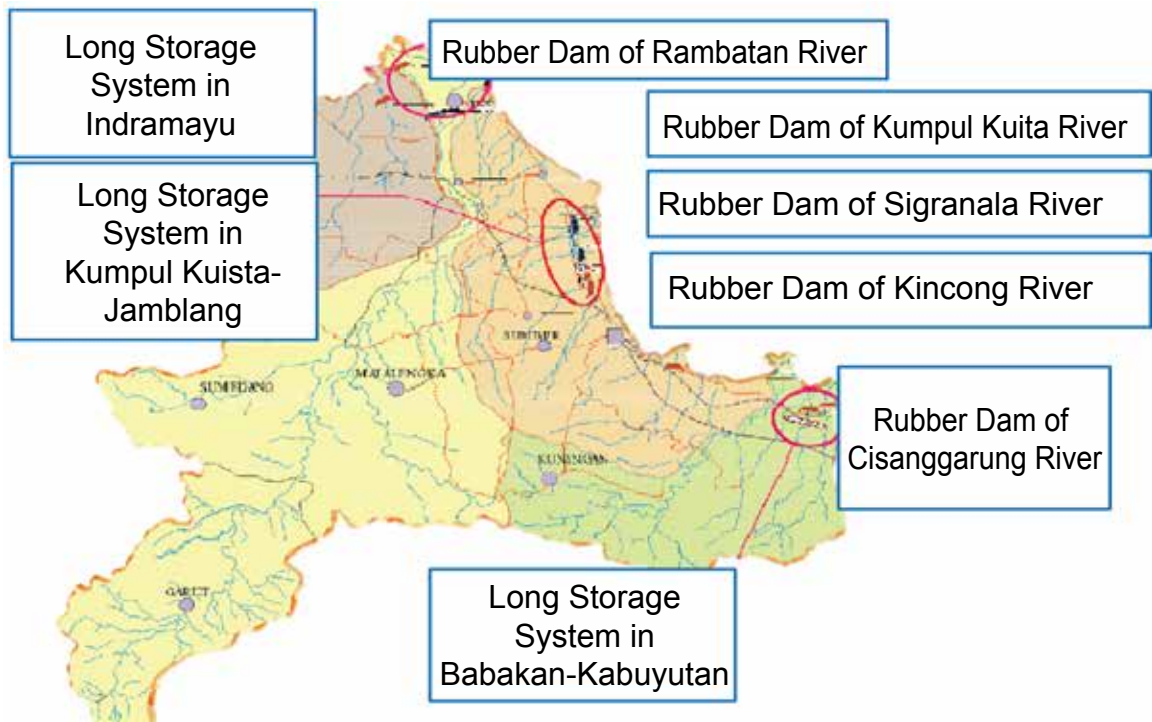


Figure 15: Raw Water Development Potentials